



Bellagio STAMP: Principles for sustainability assessment and measurement

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ABSTRACT

Revisiting the way society defines and measures progress has been identified as one of the key levers in tackling the root causes of unsustainable development. The recent economic and food crises exposed a critical weakness in the ability of currently mainstream indicators of progress to provide early warning and take adequate preventive action.

Since the early 1990s a growing number of organizations have been involved in the development of indicator systems around the key socio-economic and environmental concerns of sustainable development within their own context. In order to provide guidance and promote best practice, in 1997 a global group of leading measurement and assessment experts developed the Bellagio Principles. The Bellagio Principles have become a widely quoted reference point for measuring sustainable development, but new developments in policy, science, civil society and technology have made their update necessary.

The Bellagio Sustainability Assessment and Measurement Principles (BellagioSTAMP) have been developed through a similar expert group process, using the original Principles as a starting point. Intended to be used as a complete set, the new BellagioSTAMP includes eight principles: (1) Guiding vision; (2) Essential considerations; (3) Adequate scope; (4) Framework and indicators; (5) Transparency; (6) Effective communications; (7) Broad participation; and (8) Continuity and capacity. The paper provides the rationale for the revision of the principles, their detailed description and guidance for their application.

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1. Introduction

Changing the way society measures progress represents a key leverage point in tackling the root causes of unsustainable development (Hjorth and Bagheri, 2006; Meadows, 1998). The recognition is not new, but the gap between the mainstream practice of measuring progress and what the public (and, increasingly, policy-makers) believes should be measured has grown.

The severity and interlinkages of the global crises in financial markets, food and climate that broke into the open in 2008 after many years in the making presented societies with unprecedented challenges. Societies and major institutions were caught off guard partly because the key indicators they were (and still are) using were blind to problems that triggered the crisis. Managing the complex web of sustainability problems as a result of the crisis requires

new tools. We must be much better at assessing financial risk and performance, both at the macro and microeconomic level. But we must also use better metrics for tracking poverty, food security, carbon, water availability and a host of other issues that are not well captured by traditional economic accounts (see, e.g., Costanza et al., 2009; Dasgupta, 2010).

This was confirmed recently by the Commission on the Measurement of Economic Performance and Social Progress and iterated in the Istanbul Declaration, both representing high-level calls for action (OECD, 2007; Stiglitz et al., 2008). A link is increasingly being made between the purpose and measurement of economic growth in a finite world and the need for structural changes in macroeconomic policy—including, as a central element, a redefinition of the goal of development from growth to well-being and sustainability.

For at least three decades, there has been recognition that this requires a systematic revision of our monitoring, statistical data collection and reporting systems. Hundreds, if not thousands, of such initiatives have been started and more are born every day (International Institute for Sustainable Development (IISD), 2009; OECD, 2009a). Many of the initiatives involve science-policy dialogues and engage civil society in a discourse on the key constituents and targets of sustainability, well-being and quality of life and the actions needed to get us closer to these targets. We continue

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moving toward an ‘indicator zoo’, characterized by a multitude of approaches but still limited impact on policy and outcomes that are priorities for sustainable development (Pintér et al., 2005).

In recognition of the risks and opportunities associated with the growing measurement movement, in 1996 an international group of leading measurement practitioners developed the Bellagio Principles (“the Principles”) to provide high-level guidance for measuring and assessing progress toward sustainable development (Hardi and Zdan, 1997; IISD, 1997). They recognized that measurement reform is about more than selecting new indicators and technical revisions to our statistical data collection and reporting mechanisms. The idea behind the Bellagio Principles was that harmonization is not simply a matter of selecting common frameworks and indicators, but of following a common approach of developing and using measurement systems as an integral part of how institutions and society function. The Principles were not expected to lead directly to common indicator sets, but to help guide overall indicator system design and analysis that—over time—will result in convergence and better accountability.

The original Principles became widely known. To keep them up to date and reflect the changing context for measurement, a review and update was organized, following a similar approach used for developing the original Principles. The review meeting, involving internationally recognized measurement practitioners, was held in April 2009 at the Rockefeller Foundation’s Bellagio Center in Bellagio, Italy, where the original group had gathered. The meeting was co-organized by the IISD and the OECD’s Measuring the Progress of Societies initiative, a global policy coordination forum on the use of measurement in driving policy change compatible with sustainable development (OECD, 2009b).

Renamed the Sustainability Assessment and Measurement Principles, or STAMP, the Principles are more succinctly phrased and eliminate some of the ambiguities and duplications that were present in the original set and also some new points of emphasis. The number of Principles has been reduced from ten to eight. While still aiming for brevity, this paper provides the rationale for the revision of the Principles and additional guidance to aid in their interpretation and use.

2. Foundations

Sustainable development is an integrative concept. Consequently, any assessment of progress toward sustainability must also be an integrative process with a corresponding framework for decision-making (Ginson, 2006). For 60 years, Gross Domestic Product (GDP) has been the dominant way in which the world has measured and understood progress. This approach has failed to explain several important factors that impact on people’s lives (European Commission, 2007, 2009; Stiglitz, 2009; Thornhill, 2009). A plethora of approaches available to measure welfare and sustainable development now exist, without a consensus on which one is correct at a general level (Kulig et al., 2010). The attention to long-term trends in coupled socio-ecological systems, as well as to the importance of evidence and accountability in dealing with related risks, has started to affect political decision-making. Evidence-based policy-making represents an effort to reform or restructure policy processes in order to improve prioritization and their effectiveness (e.g., Young et al., 2002). At the same time, the level of analytical capacity to implement evidence-based policy-making is low; thus risk of failure of evidence-based policy-making is high (Howlett, 2009).

There is more emphasis on developing a sound evidence base for policies, including long-term impact evaluations of programs. These evaluations need to be theory-based and use “multi-method” approaches (Sanderson, 2002). While the call for “evidence-based

policy” accompanied by “green” policy instruments is strengthening, as is shown e.g., in an analysis of the practice in the United Kingdom (Boaz et al., 2008), experience from the European Union and OECD countries also shows that decisions that are based on the principles of sustainable development and balance environmental, social and economic targets are scarce and often ineffective. According to a recent synthesis from the fields of political science, geography, sociology and science and technology studies, many policies directly contradict available “evidence” (Juntti et al., 2009).

Democracy can be seen as an ally of long-term policy design, to the extent that it can generate public legitimacy and accountability, and potentially foster more equitable and just outcomes. Recent debates on how to “manage” policy transitions to sustainability have been curiously silent on governance, despite their potential implications for democracy (Hendriks, 2009). Evidence-informed practice and policy at the macro level can also deal with ethical issues and provide answers to such central questions as how to reflect ethically on problems of scarce resources, social and economic justice, and empowerment of clients (Gabbrill, 2008).

From the perspective of science, two recent aspects need to be highlighted: the emergence of post-normal science and the increasing demand for policy-relevant science. With regard to the first, *post-normal science* underlines the importance of uncertainty and the need to recognize multiple perspectives in trying to understand the nature of an increasingly complex and interlinked world (Funtowicz and Ravetz, 1993). This is particularly relevant for areas of research that study the interaction of “linked socio-ecological” systems, often studied in the context of a place or a particular problem (Gallopín, 1996).

Science that is defined, among others, more by the nature of the problem rather than by the tools and framework of a particular discipline has also contributed to the emergence of sustainability science (Kates et al., 2001). While sustainability sciences has other attributes, from the point of view of *policy relevance* it emphasizes the growing role and responsibility of science in tackling real-world, practical problems that require integrative, adaptive approaches that connect not only across disciplinary fields, but also in terms of temporal and spatial scales.

Another element with a strong connection to policy is related to the development of monitoring, data collection and data sharing mechanisms. While data quantity and quality continue to be serious problems, progress is being made. In terms of data collection *Group on Earth Observation* (2009) represents a major international initiative aimed at significantly and systematically improving the availability and quality of geospatial data. The availability of cheaper monitoring tools combined with pervasive wireless technology and growing access to the Internet enables a type of *civic science* where data collected through traditional methods and institutions of science can be organically combined (“mashed up”) with both quantitative and qualitative information gathered by citizens for use in public policy and even individual decision-making (Backstrand, 2003). The development of Web 2 (social networking, wikis and so on) has opened new opportunities for both producing and using information.

Another characteristic of civil society initiatives—although not only theirs—is the active and increasing interest in networking with others involved in measurement work. Some of the networks that sprung up over the last few years, such as the mostly U.S.-based International Sustainability Indicator Network (ISIN, 2009), initially withered but later became successfully reincarnated and also developed an educational form—in the case of ISIN, the Community Indicators Consortium (CIC, 2009). Others, such as the Canadian Sustainability Indicators Network (CSIN), have grown rapidly and even integrated a wide range of government and business members (CSIN, 2011). A multistakeholder global umbrella network has been formed around the Measuring the Progress of Societies initiative

(OECD, 2009a). Beyond the networks, extensive online participatory policy-making foresight exercises are conducted to ensure governments' acknowledgements of the value of collective intelligence from civil society, academic and private-sector participants in participative policy-making (Hilbert et al., 2009).

These developments have strongly influenced business attitudes and practices with regards to sustainable development and, more specifically, to assessment of and reporting on sustainable development performance. The Bellagio Principles have not been applied in the business world to assess the progress of individual companies toward (or away from) sustainability, and, in our opinion, they have had very limited influence on the assessment of the performance of whole business sectors with regard to sustainable development. One of the reasons for this failure is that businesses focus on the management of issues that are dominated by the market system. Managing non-market issues, such as social and environmental performance, is important only as long as business can demonstrate how voluntary social and environmental management contributes to competitiveness and economic success.

The standard business interpretation of sustainable development, helped by the TBL (Triple Bottom Line) concept, has led to the application of the Global Reporting Initiative (GRI) framework (GRI, 2006), now in its third iteration. The widespread use of the GRI indicators in business limits the scope for application of the Bellagio Principles for business, but it has led to the expansion of sustainability reporting (The Global Reporters, 2004). While the GRI offers a menu of environmental and social performance indicators, choosing from these menus is not alone enough to implement reflect the basic values and adopt a systemic, let alone holistic, approach to sustainable development (Parris and Kates, 2003).

These developments represent a great challenge, but also a key opportunity, for developing an effective framework to assess progress toward sustainable development.

3. Overview of the Principles

3.1. Principle 1: Guiding vision

Assessment of progress toward sustainable development will be guided by the goal of delivering well-being within the capacity of the biosphere to sustain it for future generations.

Before one can assess progress, one needs to know what “sustainable development” looks like. Sustainable development is—by definition—about looking to the future (WCED, 1997). It requires a vision of what “development” means for a society, as well as an understanding of whether that development can be sustained by future generations.

The Stiglitz-Sen-Fitoussi commission note that “at a minimum, in order to measure sustainability, what we need are indicators that inform us about the change in the quantities of the different factors that matter for future well-being” (Stiglitz et al., 2009).

And so it follows that one needs first to define what “well-being” is, as well as to understand the factors that matter for it in the future.

Discussions about “well-being” and “development” are essentially political: there is no one way to characterize what well-being means for a society. As a result, a variety of approaches have been taken (see, for example, Canadian Index of Wellbeing, 2009, and Australian Treasury, 2004). Discussions about what pattern of activity is, or is not, sustainable are more scientific. Both are necessary to prepare the guiding vision. Citizens may have different views about what “well-being” means, and experts may disagree over whether different development paths are sustainable (Hall, 2005), but first

reaching agreement on an overall guiding vision is an important step toward these more detailed conversations: a vision helps us to assess progress by defining, in general terms, the direction for desirable change without making more detailed pronouncements about the progress or sustainability that could be contentious. The vision can also provide a foundation for more detailed alternative scenarios.

The process of developing the vision may be just as—or even more—important than the vision itself (Meadows, 1998). Participation and social engagement during the development of the vision are an important attribute of the process and can better ensure that the final assessment is owned by, and resonates with, the peoples whose progress one seeks to assess (Hall et al., 2005).

3.2. Principle 2: Essential considerations

Assessment of progress toward sustainable development will consider:

- the underlying social, economic and environmental system as a whole and the interactions among its components, including issues related to governance;
- dynamics and interactions between current trends and drivers of change;
- risks, uncertainties, and activities that can have an impact across boundaries;
- implications for decision making, including trade-offs and synergies.

Achieving sustainable development depends on a myriad of interconnected factors and the entire socio-ecological system needs to be considered as a whole. Many of the most significant problems that jeopardize sustainable development are “wicked”: they are difficult or even impossible to solve. Because they contain complicated interdependencies, trying to solve one part of a wicked problem can lead to other problems. Tackling these problems requires understanding and analysis of the dynamics and interactions within the system and of the risks and uncertainties (Meadows, 2008).

Many different approaches have been used to label the component parts of the system, but, however the parts are labelled, it is important to look at a broad range of social, economic and environmental concerns. The OECD recommends considering human well-being (comprising Individual and Social Wellbeing, Culture, Economy and Governance) and ecosystem condition (OECD, 2009b).

It is also important to understand the links between current trends and drivers of change. This need not attempt to be exact, but it needs to be included; “[n]o limited set of figures can pretend to forecast the sustainable or unsustainable character of a highly complex system with certainty. The purpose is, rather, to have a set of indicators that give an “alert” to situations that pose a high risk of non-sustainability” (Stiglitz et al., 2009). Sustainable development is, as we have already noted, about looking to the future, an exercise by definition plagued by risk and uncertainties. These need to be recognized, confronted and included in an assessment, as do the effects of activities that cross boundaries.

Finally, it is important not to lose sight of the purpose of the assessment. It needs to be a useful tool to aid decision-making, either through direct influence on policy-making or through a more diffuse influence on citizens. Assessments of progress toward sustainable development can be helpful in the political economy of reform, for example, by explaining the trade-offs and synergies

likely to flow into other areas from a policy decision in one area, and “indicators can help average individuals better understand complex issues and may encourage greater citizen engagement in the public policy process.” (Walker, 2007, p. 25)

3.3. Principle 3: Adequate scope

Assessment of progress toward sustainable development will adopt:

- an appropriate time horizon to capture both short- and long-term effects of current policy decisions and human activities;
- an appropriate geographical scope.

One of the most significant challenges of any policy framework for sustainable development is the temporal scale, i.e., the long-term vision incorporated into the very concept of sustainable development. Sustainability makes sense only over time—which frequently extends over the mandate of policy-makers—and in reference to the future, while it also demands immediate actions. Hence, an appropriate time horizon means that, in the assessment, we need to capture both short- and long-term effects of current policy decisions and human activities, including those on future generations. At the same time, it is important to adopt a time horizon long enough to capture the time scales of ecosystem change that may far transcend the span of a generation’s time horizon. A long enough time scale is a precondition to build on historic and current conditions to anticipate future trends and determine where we want to go or where we could go.

Despite the importance of intergenerational equity and thus long time horizons, most indicator initiatives limit their attention to short-term perspectives or do not explicitly specify their time horizons (Kates et al., 2005). While this may be acceptable in cases when the issue being tracked is stable or represents no danger, the importance of time scale becomes immediately clear once one deals with problems that are close to or beyond critical thresholds, as is the case with regard to a series of global ecological problems (Rockström et al., 2009). Thus what matters, particularly in the case of critical problems, is not just where critical thresholds are and how far we are from breaching them, but also the time it might take before thresholds are crossed, with and without various policy measures (Sicherl, 2002).

A similar problem emerges in the assessment of sustainable development concerning the spatial scale. In an integrative approach, sustainability must extend to the global scale, even if actions are also needed locally. Hence, the appropriate geographical scope of an assessment must range from local to global scales, depending on the issue in question, in order to capture the impacts of actions; the space of the assessment must be large enough to include not only local, but long distance, impacts on people.

3.4. Principle 4: Framework and indicators

Assessment of progress toward sustainable development will be based on:

- a conceptual framework that identifies the domains within which core indicators to assess progress are to be identified;
- standardized measurement methods wherever possible, in the interest of comparability;
- comparison of indicator values with targets, as possible.

Establishing the frame of analysis is an important but difficult part of dealing with public policy controversies such as sustainable development (Rein and Schön, 1986). An important starting point of the assessment process is to develop a conceptual framework that defines the issues to be measured, the priorities for the reference community whose actions are to be assessed, and the specific domains that core indicators have to cover.

The assessment is an ongoing process that starts with the measurement of a baseline and includes follow-up measures to determine progress. This is possible only if the measures are comparable and are standardized, which helps comparability. Another desired feature of the assessment is the ability to make projections and models based on the most recent data and infer trends and build scenarios on their basis.

With good indicator systems, policy-makers are not flying blind. They have factual information to guide them to where they can most effectively deploy their efforts. Furthermore, such systems help all those involved in the decision-making to work off the same information base. Moreover, it seems the very process of constructing an indicator set—when it involves a cross-section of society and is developed from the bottom up—can build a shared sense of vision, broker consensus and mobilize communities to action.

The assessment is also a policy tool to indicate progress toward set goals of sustainability; hence the definition of targets corresponding to the goals and a comparison of indicator values with targets and benchmarks (when possible) is desirable.

3.5. Principle 5: Transparency

Assessment of progress toward sustainable development will:

- ensure the data, indicators and results of the assessment are accessible to the public;
- explain the choices, assumptions and uncertainties determining the results of the assessment;
- disclose data sources and methods;
- disclose all sources of funding and potential conflicts of interest.

The transparency principle addresses two crucial issues:

- The importance of the public understanding of the employed methods, data and assumptions on which the assessment process is built;
- Public assurance that results of the assessments are reliable and subject to scientific/technical scrutiny.

The selected methods can seriously influence the results of the assessments and may limit the range and scope of data collected for an assessment. The methods also may have an impact on the relative weight of the applicable issues and can attach increased weight to specific data. If these choices are not transparent, the interpretation(s) of the assessment results may be misleading or, in extreme cases, simply false.

Similarly, if the limitations in data selection, the lack of relevant data sources and the use of substitute or proxy data are not revealed, the uncertainties in the final assessments can be easily overlooked, leading to inadequate or wrong policy decisions.

Both the purpose and the outcome of measurement may be influenced by the clients who order and finance the measurement/assessment activities. If the identity of the funding agents remained hidden, the eventual biases might distort the outcome of the assessment and the professional independence of the

evaluators could be questioned. Both cases would lead to public mistrust and damage the process.

3.6. Principle 6: Effective communications

In the interest of effective communication, to attract the broadest possible audience and minimize the risk of misuse, assessment of progress toward sustainable development will:

- use clear and plain language;
- present information in a fair and objective way that helps to build trust;
- use innovative visual tools and graphics to aid interpretation and tell a story;
- make data available in as much detail as is reliable and practicable.

Knowledge utilization literature is quite clear: decision-makers do not necessarily seek out the best information they need to make a decision. To increase the probability that information relevant for a particular decision-making context is considered, it needs to be actively brought to the attention of the relevant audiences (Webber, 1991–1992).

The value of proactive communication has been pointed out by many authors with regard to sustainability and the environment, where issues are often characterized not only by high degrees of complexity and uncertainty, but also by relevance for policy and the everyday life of the public (see, e.g., Denisov and Christoffersen, 2001; Denisov et al., 2005; Pintér, 2002). Effective communication requires sophistication, a strategic approach that goes beyond packaging and transmission of information and recognizes the value of dynamic engagement between the producers and consumers in a process of joint information and knowledge construction (Chandler, 1994; Thorngate, 1996). While engagement is covered by Principle 7, Principle 6 addresses the “packaging” and presentation of information.

To make proper use of indicators and their assessments, people need to trust them. There are several factors that contribute to building trust, but one of the most critical is presenting information objectively, without any apparent bias. This can be challenging, because many sustainability issues involve conflict either in the present or between the present and future generations, and perceptions of what is “objective” may vary by the audience. On balance, assessments that recognize and learn to manage multiple audiences and expectations are perceived as more objective and effective (Cash et al., 2002).

Although people may understand indicator trends by reading analyses, the impact of the information can be greatly increased by good visual presentation of the data has become much easier over the past decade. When presenting indicators, it is increasingly important to think about presenting not only statistical data, but broader contextual information in different formats. This includes text, but also map-based data or stories in multimedia format accompanying the indicators. Increasingly, tools are being developed that attempt to combine the dynamic presentation of different types of information—quantitative and qualitative—into integrated platforms (e.g., International Institute for Information Design (IIID), 2008; Pintér, 2008).

In order to make data more relevant, often it needs to be presented at different scales. Drilling down from the global level to the neighbourhood is technically feasible and presenting aggregates on multiple scales can be helpful. It not only helps reveal more granular detail that may be hidden in higher level averages, but also engages audiences in a process of inquiry.

3.7. Principle 7: Broad participation

To strengthen its legitimacy and relevance, assessment of progress toward sustainable development should:

- find appropriate ways to reflect the views of the public, while providing active leadership;
- engage early on with users of the assessment so that it best fits their needs.

Measurement and assessment initiatives need strong leadership, coordination and governance mechanisms, balanced with meaningful public involvement. Finding the right balance is a delicate matter and navigating the process requires cultural, social and political sensitivity. No—or only token—participation may simplify the measurement process, but also may result in reduced legitimacy and use of the results. Weak leadership, however, may bog the process down in the multitude of perspectives regarding what needs to be measured, how to agree on priorities and how to move from the general importance of measurement to concrete action.

Active leadership is needed to maintain momentum and direction in a multi-stage process and to ensure continuity over multiple reporting cycles. Leadership is also needed to formally represent the initiative to general society and the media and decision-makers, to organize and manage working groups and to commission background research.

Strong leadership must be complemented by broad participation for several reasons. As Stiglitz et al. (2008) observed, one of the main concerns with regard to mainstream measurement systems is that the indicators used provide an inadequate representation of the real values and priorities of society. In order to bridge the gap, measurement and assessment systems should reflect not only the best scientific understanding of sustainability, but also key values that are missing from measurement tools such as the GDP (Meadows, 1998). Representatives of the public need to be involved in the indicator development process.

Public participation is also important for making measurement systems more relevant and increasing the legitimacy of results in the eyes of those involved. Legitimacy and relevance have been identified as key factors of effectiveness and influence (Mitchell et al., 2006). Involvement in indicator selection, particularly when the process feeds into decision-making, has been shown to empower communities in cases when conventional development approaches failed (Fraser et al., 2005). There are many options for involving the public through focus groups, Internet fora, interviews and others. Participation should also be timed to ensure its results can inform the design of the measurement system rather than be considered an opportunity to legitimize decisions already made.

3.8. Principle 8: Continuity and capacity

Assessment of progress toward sustainable development will require:

- repeated measurement;
- responsiveness to change;
- investment to develop and maintain adequate capacity;
- continuous learning and improvement.

Sustainable development requires an ongoing process of planning, management, evaluation, adaptation and accountability, based on a regular flow of information (Dalal-Clayton and Bass, 2002). One-off or short-term measurements may be useful, but in order to recognize long-term trends, consistent time series data are needed.

Although monitoring, data collection and indicator systems need stability and consistency, they also need periodic review and adjustment to make sure they cover important emerging issues and do not allocate resources to collecting irrelevant data. This is particularly important related to sustainability issues such as climate change, where new science and quickly evolving policy agendas frequently produce new data requirements.

The costs of systematic data collection, monitoring and reporting are often grossly underestimated, and budgets for statistical data collection are easy targets for cost-cutting in times of budget crises. This has been well documented for environmental statistics, but even socioeconomic data collection capacities in developed countries can be inadequate (Reamer, 2009; United Nations Environment Programme (UNEP), 2004). Agencies responsible for data collection, monitoring and reporting can be subject to budget cuts and political pressures, particularly when the story told by data is politically or economically inconvenient. Recognizing the risks in these, calls have been made to grant statistics agencies autonomy similar to that provided to central banks (Totaro, 2009).

Ultimately, measurement and indicator systems are not only elements of the mechanisms of social organizations, but they need to be subject to continuous review and revision (see, e.g., Déri et al., 2007), by external experts or involving public participation, where stakeholders assess the relevance of the indicator systems.

4. Options and guidance for the application of the STAMP

Over the last two decades, sustainable development has evolved from a vague vision to an integral aspect of decision-making in the public and private sectors. At the same time, several elements of good governance and evidence-based decision-making—such as long-term objectives, policy coherence, openness and participation, effectiveness and accountability—became more frequently considered. In order to base decisions on reliable information, different types of feedback mechanisms were established, focusing on different elements of the policy or management cycle:

Sustainability science is characterized by an interdisciplinary and problem-centred approach, strong links between the production of knowledge and its influence on society, a higher degree of responsibility of researchers (for more than merely scientific outputs) and, as a result, a high level of reflexivity (Nowotny et al., 2001). The benefits of promoting and applying the STAMP in this area are numerous:

- The STAMP supports the dissemination of the principles of sustainability science in the broader field of “conventional” research.
- The STAMP offers an orientation and encourages researchers to make normative implications explicit.
- The STAMP strengthens interdisciplinary research and multidimensional frameworks, as well as transformation-oriented and systemic knowledge.
- The STAMP highlights the importance of participation of societal and field experts and advocates the consideration of context-factors in the research process.

While the Quality Criteria of Transdisciplinary Research (Bergmann et al., 2005) focuses on the genuine characteristics of transdisciplinary research (focusing on problems from

everyday life, involving actors from civil society, co-production of knowledge), the STAMP distinguishes between researchers and decision-makers.

Impact Assessments or Appraisals (ex-ante) serve to assess the effects of decisions in advance and support choice between various options. Typical examples on the E.U. level are the Impact Assessment procedure (European Union, 2002) and the Strategic Environmental Assessment (European Union, 2001), and, on the national level, various forms of Regulatory Impact Assessment, Sustainability Assessment and other types of appraisal and integrated assessments (e.g., in the United Kingdom, Switzerland and forthcoming in Germany). A common characteristic is that these instruments are concerned with decisions with high potential for societal conflict and therefore the assessment serves not only to assess the potential effects of a decision in a scientific and neutral way, but also to support a (more or less democratically legitimized) valuation and decision. The origins of this kind of feedback mechanism lie in Environmental Impact Assessment (EIA), established in 1969 by the U.S. National Environmental Policy Act (NEPA). Since then, we can observe three tendencies: (i) broadening of the impact area to an integrated assessment of environmental, economic and societal effects; (ii) broadening of the object of assessment from projects only to programs and policies; and (iii) conducting the assessment at an earlier stage of project, policy or program preparation to include more fundamental upstream decisions (e.g., in land use planning). Considering the assessment stages identified in the new Impact Assessment Guidelines (European Union, 2009) and the results of an evaluation of the E.U. Impact Assessment System (Watson et al., 2007), the following benefits of promoting and applying the STAMP in this field can be expected.

The STAMP highlights key elements of sustainable development (e.g., holistic approach, geographical scope, dynamics, risks and uncertainties) when applying the principle of ‘proportionate level of analysis’ to determine the likely impacts of a proposed action. By finding appropriate ways to reflect the views of the public, the STAMP encourages a participative approach going beyond ‘consultation of interested parties.’

The STAMP helps improve the standardization of Impact Assessments: although the current Impact Assessment System provides great flexibility, it lacks basic uniform standards. The STAMP could easily be integrated into more specific checklists and guidelines for Impact Assessments and Appraisals. Therefore, it will be necessary to expand the aspects of “trade-offs and synergies” mentioned in Chapter 2 of the STAMP. Especially with respect to Impact Assessments, it is desirable to assess and integrate effects across multiple dimensions, and on this basis to formulate recommendations and make decisions. The methods of participatory multi-criteria analysis especially possess significant potential; see, for example, Multi-Scale Integrated Assessment (Giampetro, 2004) and Social Multi-Criteria Evaluation (Munda, 2003), which explicitly address the structure of the evaluated problem and focus on whose perspectives are represented and how. In addition, the STAMP could be taken into account when organizing future monitoring and evaluation systems and defining core indicators of key policy objectives, important steps when conducting an Impact Assessment.

We are aware that the STAMP would need to be specified in each Impact Assessment e.g., when decisions are taken about ‘broad participation’ (see Principle 7) specific criteria need to be derived for many of the expected impacts (especially social and economic impacts) in participatory processes. However, we think that due to their benefits, applying the STAMP in impact assessments and project appraisals as discussed above is worthwhile.

Monitoring systems are key components of permanent feedback mechanisms accompanying the whole policy or management cycle. They serve to systematically and periodically collect and analyze data, many of them based on or leading to indicator

systems. In order to increase the relevance of monitoring systems for decision-makers, an approach called “from studies to streams of information” is necessary (Rist and Stame, 2005). This is reflected in the STAMP from a number of angles. It emphasizes the importance of regular assessment and the requisite institutional capacity, but it also brings attention to systematic and effective communication that should no longer follow a linear model but instead engage citizens in a process of jointly creating assessment content, in effect practicing ‘citizen science’ (Harvey, 2006).

While many assessments in this category still produce their main flagship report, they rely on continuously updated databases and indicator systems and a wide range of thematic or sub-global reports that are issued between major reports. One example where several elements of STAMP have particular relevance is the United Nations Environment Programme’s (UNEP) Global Environment Outlook (GEO). GEO is a multi-scale, science-based but policy-oriented assessment that is produced in a global participatory process (UNEP, 2007). The assessment makes use of the most recent monitoring data to provide definitive information on the state and directions of the global environment with sub-global detail, to evaluate the effectiveness and impacts of policies affecting the environment (and, through that, human well-being) and to explore policy options for the future. Based on GEO, UNEP and IISD developed an extensive capacity-building program targeting sub-global audiences interested in preparing Integrated Environmental Assessments (IEAs; Pintér et al., 2007). Assessment and reporting systems such as GEO, its sub-global IEAs and the related capacity-building program represent opportunities for applying the STAMP in a practical context.

Evaluations (ex post) serve to identify, analyze and evaluate short-, medium- and long-term effects triggered by the intervention and are usually employed at the end of a policy or management cycle. In contrast to baseline and monitoring studies, the intervention is placed in the centre of interest in order to fully capture substantial, territorial and temporal dimensions of effects and their causality. Evaluation mirrors the tension between legitimization and learning, with a variety of evaluation approaches and models. Inspired by the U.S. Joint Committee on Standards for Educational Evaluation and on the basis of their Program Evaluation Standards, new Standards for Evaluation have been developed. These serve the purposes of training, orientation and meta-evaluation, but offer no certification of evaluators or evaluation reports. They are intentionally left thematically unspecific and focus not on program evaluation only, in order to remain applicable for all kinds of evaluations in various policy areas. Combining Evaluation Standards and the STAMP could lead to an integrated guideline for sustainability evaluations.

All of these types of feedback mechanisms are closely related and mutually supportive. Applying the STAMP in all cases highlights a broad variety of questions that should be answered and therefore it has a strong influence on the scope of assessment. At the same time, the STAMP pays attention to the assessment process by applying participatory approaches on the one hand, and by focusing on decision-makers in the public and private sectors on the other.

5. Conclusions

As the convergence of financial, environmental and food crises of 2008 demonstrated, *Anthropocene* (a term coined by Crutzen and Stoermer (2000), the new planetary phase of development characterized by a distinct human influence on Earth System scale processes) is a phase with potential for increased risk and vulnerability. In order to tackle, and in the long run prevent, such risks society must develop better governance mechanisms across all

stages of the policy cycle. Having better measurement approaches, capacity and practices in place is part of this governance challenge, and the STAMP attempts a principled transition from current practices to practices more tailored to the challenges at hand.

Focused on sustainable development, the STAMP builds on a rich and growing science, policy and management tradition that grew after the Brundtland Commission’s report in 1987. The need for strengthening the evidence base is a common element of this tradition, but although the recognition of this need is widespread, there is no consensus on how this can be achieved and how different interested actors, both in the public and private sectors, should harmonize their approaches. Although these actors and their interests are diverse, the STAMP tries to go to a level of generality where it is applicable to most.

The authors of the STAMP had three distinct audiences in mind that could benefit most from applying the Principles in their monitoring and assessment practice: the communities involved in developing alternative metrics systems, the communities focused on integrated assessment and reporting, and those practicing project or policy-focused evaluation. First case studies in using the STAMP are already on the way. Bakkes (in press) explored the applicability of the STAMP to global integrated assessments, such as the OECD Environment Outlook, UNEP’s GEO and sub-global assessments carried out by the Netherlands Environmental Assessment Agency. He concluded that the Principles match the needs of practitioners and would be also of use in the review of assessment design options.

With regard to Bakkes’ latter point, a few early assessment-focused applications of the STAMP have already taken place. For instance, the Principles were presented and informed the design of the overall conceptual approach and methodology of UNEP’s GEO-5 report and a similar application happened related to the China Environment and Development Outlook Feasibility Study (CEDO-F) of the China Council for International Cooperation on Environment and Development (CCICED). While these are admittedly early uses they underline that the STAMP’s applicability goes beyond monitoring and indicator systems.

As Section 4 of this paper pointed out, the interests and the communities of monitoring, measurement, assessment and evaluation practitioners may overlap, but they also have their specific methods, interests and applicability for the STAMP. The STAMP may provide soft guidance or be more formally adopted or incorporated into formally established codes of conduct, standard or best practice. In order to facilitate the use and adoption of the original Bellagio Principles, IISD developed a series of case studies to illustrate how the Principles may work in practice. The case studies demonstrated not only the broad applicability of the Principles to various sectors and stages of the governance cycle, but also their practical use (Hardi and Zdan, 1997). Given the early stage of the sustainability measurement movement, however, the history and selection of such cases was limited and the case studies were selected to fit the Principles retroactively, without actual project application. Building the Principles proactively into actual case studies, along with a richer selection of case studies, may see a similar effort for the STAMP result in practical and more useful guidance.

Returning, in a sense, to its roots, one area where the STAMP may have particular relevance is in the context of the twentieth anniversary conference of the first Earth Summit, to take place in 2012. While most attention may be focused on forward-looking issues such as the green economy or global environmental governance, the conference also would be an opportunity for organizations, from the global level to the local level, to carry out an assessment of their successes and failures and reasons over the last twenty years. How this can be done will be an important question that may even determine the objectivity and usefulness of the assessments. The

Bellagio STAMP may well be an important guide that raises the standard of these assessments to the necessary level.

References

- Australian Treasury, 2004. Economic Roundup Winter 2004. Policy Advice and Treasury's Wellbeing Framework, http://www.treasury.gov.au/documents/876/HTML/docshell.asp?URL=Policy_advice.Treasury_wellbeing_framework.htm.
- Bakkes, J., 2011. Bellagio Sustainability Assessment and Measurement Principles (BellagioSTAMP)—significance and examples from international environment outlooks. In: Rubik, F., von Raggamby, A. (Eds.), *Sustainable Development, Evaluation and Policy-Making: Theory, Practice and Quality Assurance*. Edward Elgar, Cheltenham, UK, in press.
- Backstrand, K., 2003. Civic Science for Sustainability: reframing the role of experts policy-makers and citizens in environmental governance. *Global Environ. Politics* 3 (4), 24–41.
- Bergmann, M., Brohmann, B., Hoffmann, E., Loibl, M.C., Rehaag, R., Schramm, E., Voß, J.-P., 2005. Quality Criteria of Transdisciplinary Research—A Guide for the Formative Evaluation of Research. ISOE Studentexte No. 13. Institute for Socio-Ecological Research (ISOE), Frankfurt am Main.
- Boaz, A., Grayson, L., Levitt, R., Solesbury, W., 2008. Does evidence-based policy work? Learning from the UK experience. *Evidence Policy* 4 (2), 233–253.
- Canadian Index of Wellbeing, 2009. <http://www.ciw.ca/en/TheCanadianIndexOfWellbeing/DomainsOfWellbeing.aspx>.
- Cash, D., Clark, W.C., Alcock, F., Dickson, N., Eckley, N., Jäger, J., 2002. Salience, Credibility, Legitimacy and Boundaries: Linking Research, Assessment and Decision Making. Faculty Research Working Papers Series RWP02-046. Kennedy School of Government, Harvard University, Cambridge, MA. http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID372280_code030203530.pdf?abstractid=372280&mirid=2.
- Chandler, D., 1994. The Transmission Model of Communication. The University of Wales, Aberystwyth UK, <http://www.aber.ac.uk/media/Documents/short/trans.html>.
- CIC, 2009. Community Indicators Consortium, <http://www.communityindicators.net/>.
- Costanza, R., Hart, M., Posner, S., Talberth, J., 2009. Beyond GDP: The need for new measures of progress. In: *The Pardee Papers No. 4. The Frederick S. Pardee Center for the Study of the Longer Range Future*, Boston University, Boston, MA, http://vip2.uvm.edu/~gundiee/publications/Pardee_Paper_4.Beyond.GDP.pdf.
- Crutzen, P.J., Stoermer, E.F., August 30, 2000. The Anthropocene. In: *IGBP Newsletter* 41, <http://www.mpch-mainz.mpg.de/~air/anthropocene/>.
- CSIN, 2011. Canadian Sustainability Indicators Network, <http://www.csin-rcid.ca/>.
- Dalal-Clayton, B., Bass, S., 2002. *Sustainable Development Strategies: A Resource Book*. Earthscan, London.
- Dasgupta, P., 2010. Nature's role in sustaining economic development. *Philos. Trans. R. Soc. B* 365 (1537), 5–11, <http://rsta.royalsocietypublishing.org/content/365/1537/5.full.html#ref-list>.
- Deniso, N., Christoffersen, L., 2001. Impact of environmental information on decision-making processes and the environment. In: *UNEP/GRID-Arendal Occasional Paper 01-2001*. UNEP/GRID-Arendal, Arendal, Norway, <http://www.grida.no/impact/papers/fullimpact.pdf>.
- Deniso, N., Folgen, K., Rucevska, I., Simonett, O., 2005. Impact II—telling good stories. We have the message but how to communicate it using the right messengers. A collection of practices and lessons. In: *Arendal: UNEP/GRID-Arendal Occasional Paper 01 2005*, Arendal, Norway, <http://www.grida.no/res/site/file/publications/impact2-occasional-paper1-2005.pdf>.
- Déri, A., Swanson, D., Bhandari, P., 2007. Training module 8. Monitoring, evaluation and learning—for improvement and increased impact of the IEA process. In: L. Pintér, Swanson, D., Chenje, J. (Eds.), *IEA Training Manual*. UNEP, Nairobi, <http://hqweb.unep.org/ieacp/res/site/File/iea-training-manual/module-8.pdf>.
- European Commission, 2007. *Beyond GDP: Measuring progress, true wealth, and the well-being of nations*. Conference Proceedings. European Communities, Brussels, <http://www.beyond-gdp.eu/news.html>.
- European Commission, 2009. *GDP and beyond*. Measuring progress in a changing world. In: *Communication from the Commission to the Council and the European Parliament #52009DC0433*. Commission of the European Community, Brussels, <http://www.beyond-gdp.eu>.
- European Union, 2001. Directive on Strategic Environmental Assessment, 2001/42/EC. Official Journal of the European Communities, 21.7.2001, <http://eur-lex.europa.eu>.
- European Union, 2002. Directive on Impact Assessment, COM (2002)276 final. Communication from the Commission on Impact Assessment, European Commission, Brussels, <http://eur-lex.europa.eu>.
- European Union, 2009. Impact Assessment Guidelines, SEC (2009) 92, 15 January 2009, http://ec.europa.eu/governance/impact/commission_guidelines/commission_guidelines_en.htm.
- Fraser, E.D.G., Dougill, A.J., Mabee, W.E., Reed, M., MacAlpine, P., 2005. Bottom up and top down: analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *J. Environ. Manag.* 78 (2), 114–127.
- Funtowicz, S., Ravetz, J., 1993. Science for the post-normal age. *Futures* 25 (7), 735–755.
- Gallopín, G.C., 1996. Environmental and sustainability indicators and the concept of situational indicators. A systems approach. *Environ. Model. Assess.* 1 (3), 101–117.
- Gambrill, E., 2008. Evidence-based (Informed) macro practice: Process and philosophy. *J. Evid. Based Soc. Work* 5 (3–4), 423–452.
- Giampetro, M., 2004. *Multi-Scale Analysis of Agroecosystems*. CRC Press, Boca Raton.
- Ginson, R.B., 2006. Beyond the pillars: sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making. *J. Environ. Assess. Pol. Manag.* 8 (3), 259–280.
- GRI, 2006. *Global Reporting Initiative: G3 Core Indicators*. Version 3.0, <http://www.globalreporting.org/ReportingFramework/G3Online/>.
- Group on Earth Observation, 2009, <http://www.earthobservations.org/>.
- Hall, J., 2005. Measuring progress—an Australian travelogue. *J. Off. Stat.* 21 (4), 727–746.
- Hall, J., Carswell, C., Jones, R., Yencken, D., 2005. Collaborating with civil society: reflections from Australia. In: *OECD, Statistics, Knowledge and Policy: Key Indicators to Inform Decision Making*. OECD, Paris.
- Hardi, P., Zdan, T., 1997. *Assessing Sustainable Development: Principles in Practice*. IISD, Winnipeg, <http://www.iisd.org/pdf/bellagio.pdf>.
- Harvey, K., 2006. Monitoring change: Citizen science and international environmental treaty-making. In: *Papers on International Environmental Negotiation: Ensuring a Sustainable Future*, vol. 15, pp. 77–90.
- Hendriks, C.M., 2009. Policy design without democracy? Making democratic sense of transition management. *Policy Sci.* 42 (4), 341–368.
- Hilbert, M., Miles, I., Othmer, J., 2009. Foresight tools for participative policy-making in inter-governmental processes in developing countries: lessons learned from the eLAC Policy Priorities Delphi. *Technol. Forecasting Social Change* 76 (7), 880–896.
- Hjorth, P., Bagheri, A., 2006. Navigating towards sustainable development: a system dynamics approach. *Futures* 38 (1), 74–92.
- Howlett, M., 2009. Policy analytical capacity and evidence-based policy-making: lessons from Canada. *Can. Public Adm.* 52 (2), 153–175.
- IIID, 2008. Data designed for decisions. Enhancing Social, Economic and Environmental Progress. A Joint IIID and OECD Conference, Paris 18–20, June 2009, <http://www.dd4d.net>.
- IISD, 1997. *Complete Bellagio Principles*. IISD, Winnipeg, <http://www.iisd.org/measure/principles/progress/bellagio.full.asp>.
- IISD, 2009. *Compendium of Sustainable Development Indicator Initiatives*, <http://www.iisd.org/measure/compendium/searchinitiatives.aspx>.
- ISIN, 2009. International Sustainability Indicators Network, <http://www.sustainabilityindicators.org/>.
- Juntti, M., Russel, D., Turnpenny, J., 2009. Evidence, politics and power in public policy for the environment. *Environ. Sci. Policy* 12, 207–215.
- Kates, R., Clark, W., Corell, R., Hall, J., Jaeger, C., Lowe, I., Mooney, H., 2001. Sustainability science. *Science* 292 (5517), 641–642.
- Kates, R., Parris, T., Leiserowitz, A., 2005. What is sustainable development? Goals, indicators values, and practice. *Environment: Sci. Policy Sustainable Dev.* 47 (3), 8–21.
- Kulig, A., Kolfoort, H., Hoekstra, R., 2010. The case for the hybrid capital approach for the measurement of the welfare and sustainability. *Ecol. Indic.* 10 (2), 118–128.
- Meadows, D.H., 1998. Indicators and information systems for sustainable development. In: *A Report to the Balaton Group*. The Sustainability Institute, Hartland Four Corners, VT.
- Meadows, D.H., 2008. *Thinking in Systems: A Primer*. Chelsea Green Publishing Company, White River Junction, VT.
- Mitchell, R.B., Clark, W.C., Cash, D.W., Dickson, N.M., 2006. *Global Environmental Assessments: Information and Influence*. MIT Press, Cambridge.
- Munda, G., 2003. Social multi-criteria evaluation: methodological foundations and operational consequences. *Eur. J. Oper. Res.* 3 (158), 662–677.
- Nowotny, H., Scott, P., Gibbons, M., 2001. *Rethinking Science. Knowledge and the Public in an Age of Uncertainty*. Polity Press, Cambridge.
- OECD, 2007. *The Istanbul Declaration*, http://www.oecd.org/document/23/0,3343,en_21571361_31938349_39161687_1_1_1_1_00.html.
- OECD, 2009a. *Measuring the Progress of Societies Knowledge Base—Inventory of Initiatives*, <http://www.measuringprogress.org/knowledgeBase/>.
- OECD, 2009b. *A Framework to Measure the Progress of Societies*, <http://www.oecd.org/progress/taxonomy>.
- Parris, T.M., Kates, R.W., 2003. Characterizing and measuring sustainable development. *Annu. Rev. Env. Resour.* 28, 559–586.
- Pintér, L., 2002. *Making Global Integrated Environmental Assessment and Reporting Matter*. PhD Thesis. University of Minnesota, Minneapolis, St. Paul, http://www.iisd.org/pdf/pinter_thesis.pdf.
- Pintér, L., 2008. *BalatonTrend: an experiment in building next generation stakeholder information systems for indicator and multimedia commentary visualization*. In: *Presented at the OECD and Statistics Sweden Seminar on Turning Statistics into Knowledge*, Stockholm, May 26, 2008, <http://www.oecd.org/dataoecd/47/22/40010783.pdf?contentId=40010787>.
- Pintér, L., Hardi, P., Bartelmus, P., 2005. *Sustainable Development Indicators: Proposals for a Way Forward*. UN Division for Sustainable Development, New York, NY.
- Pintér, L., Swanson, D., Chenje, J. (Eds.), 2007. *Integrated Environmental Assessment Training Manual*. UNEP, Nairobi <http://www.unep.org/ieacp/iea/>.
- Reamer, A., 2009. *Dire Straits: The Urgent Need to Improve Economic Statistics*. Brookings Institution, Washington D.C., http://www.brookings.edu/opinions/2009/0304_census_reamer.aspx.
- Rein, M., Schön, D., 1986. *Frame-critical policy analysis and frame-reflective policy practice*. *Knowledge Technol. Policy* 9 (1), 85–104.
- Rist, R., Stame, N., 2005. *From Studies to Streams: Managing Evaluative Systems*. Transaction Publ, New Brunswick.

- Rockström, J., Steffen, W., Noone, K., Persson, Å., Stuart Chapin, F., Lambin III, E.F., Foley, J.A., 2009. A safe operating space for humanity. *Nature* 461, 472–475, <http://www.nature.com/nature/journal/v461/n7263/full/461472a.html>.
- Sanderson, I., 2002. Evaluation, policy learning and evidence-based policy making. *Public Admin.* 80 (1), 1–22.
- Sicherl, P., 2002. Time distance: a missing link in comparative analysis. In: Presented at the RC33 Research Committee on Logic and Methodology in Sociology, Session 13XVth World Congress of Sociology, Brisbane, Australia, 7–13 July, 2002, <http://www.sicenter.si/pub/Brisbane14.pdf>.
- Stiglitz, J., 2009. Towards a better measure of well-being. In: *Financial Times*, September 13.
- Stiglitz, J.E., Sen, A., Fitoussi, J-P., 2008. Issues paper. Commission on the Measurement of Economic Performance and Social Progress, Paris, http://www.stiglitz-sen-fitoussi.fr/documents/Issues_paper.pdf.
- Stiglitz, J.E., Sen, A., Fitoussi, J-P., 2009. Report by the Commission on the Measurement of Economic Performance and Social Progress, Paris, <http://www.stiglitz-sen-fitoussi.fr>.
- The Global Reporters, 2004. Risk and Opportunity: Best Practice in Non-Financial Reporting. The Global Reporters, 2004 Survey of Corporate Sustainability Reporting, UNEP, London.
- Thorngate, W., 1996. Measuring the Effects of Information on Development., <http://www.idrc.ca/books/focus/783/thorn2.html>.
- Thornhill, J., 2009. A measure remodeled. In: *Financial Times*, January 27, 2009.
- Totaro, L., 2009. Statistics agencies need ECB-like independence, ISTAT head says. In: *Business Week Internet Edition*, December 31, 2009., <http://www.businessweek.com/news/2009-12-31/statistics-agencies-need-ecb-like-independence-istat-head-says.html>.
- UNEP, 2004. Strengthening the Scientific Base of the United Nations Environment Programme: environmental statistics: status and challenges: an assessment of Joint United Nations Statistics Division/United Nations Environment Programme Data Collection. Prepared for the Twenty-Third Session of the Governing Council/Global Ministerial Environment Forum Nairobi, 21–25 February 2005. UNEP/GC.23/INF/15. Nairobi: UNEP, <http://www.unep.org/GC/GC23/documents/GC23-INF15.doc>.
- UNEP, 2007. Global Environment Outlook 4. UNEP: Nairobi, http://www.unep.org/geo/geo4/report/GEO-4_Report_Full.en.pdf.
- Walker, D., 2007. Key national indicators can improve policy making and strengthen democracy in statistics, knowledge and policy. In: *OECD, Measuring and Fostering the Progress of Societies*. OECD Publishing, Paris.
- Watson, J., Wolff, J., Kuehnemund, M., Ward, B., Burke, S., Mitchener, M., 2007. Evaluation of the Commission's Impact Assessment System, The Evaluation Partnership, Contract Number SG-02/2006, April 2007, http://ec.europa.eu/governance/impact/key_docs/docs/tep_eias_final_report_executive_summary.en.pdf.
- WCED, 1997. Report of the World Commission on Environment and Development: Our Common Future, <http://www.un-documents.net/wced-ocf.htm>.
- Webber, D.J., 1991–1992. The distribution and use of policy knowledge in the policy process. *Knowl. Tech. Pol.* 4(4), http://en.wikipedia.org/wiki/Triple_bottom_line.
- Young, K., Ashby, D., Boaz, A., Grayson, L., 2002. Social science and the evidence-based policy movement. *Social Policy Soc.* 1, 215–224.