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The Four-Capital Method of Sustainable Development Evaluation

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ABSTRACT

This paper is part of the special issue of *European Environment* devoted to the outputs of the EU SRDTOOLS project,¹ which developed and applied a new model of regional sustainable development evaluation. The paper introduces the concept and framework of the four-capital model, which was used in the project. First it discusses some issues around sustainable development evaluation, before introducing the theory of the four-capital model. It then describes how indicators can be used to evaluate programmes such as those financed by the EU Structural Funds against criteria for sustainable regional development in terms of the four capitals. An 'ideal' indicator set is listed in the appendix. Copyright © 2007 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

Defining Sustainable Development

SUSTAINABLE DEVELOPMENT (SD) HAS BEEN DEFINED AS DEVELOPMENT THAT MEETS THE NEEDS of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987). This highlights the critical importance of taking a longer time perspective, and recognizing potential trade-offs between meeting current needs and ensuring that resources are available to meet future needs. This implies a form of socio-economic development, which increases human well-being or quality of life for today's generations but does not lead to or contribute to a decline in future well-being. Meeting human needs and increasing quality of life may be regarded as the 'development' part of sustainable development. Being able to maintain this into the future may be regarded as the 'sustainability' part.

Sustainable development is therefore explicitly concerned with defining *social welfare* goals and the *means* by which they are pursued. Defining the nature of these goals is central to political and social deliberation and decision-making. Whether the nature of development that follows from these decisions

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is sustainable is also, in large part, a matter of judgement, although, in respect at least of the environmental dimension of SD, scientific assessment of what is or is not sustainable can make a significant input into such judgements.

Implications for Evaluation

Sustainable development policy raises new challenges for evaluation. These challenges include the practical concern not to introduce a paralysis in policy-making by waiting to understand all possible direct and indirect effects, and the principal methodological challenge of comparing and weighting (explicitly or implicitly) disparate effects which may be expressed in different units.

There is also the challenge of evaluating impacts, and their relation to policies, at different levels (global, international (e.g. EU), national, regional and local) and at different spatial scales. It is difficult to generalize how these issues of levels and scales and levels should be dealt with, because this will differ depending on the context and case under investigation. However, these dimensions need always to be borne in mind in any particular evaluation.

Sustainable Development Evaluation Methods

Evaluation requires that all impacts of relevance both to the objectives of the project and its results, that are either projected *ex ante*, or that can be identified *ex post*, are assessed. Frequently used methods and techniques for evaluating contributions to SD include concept or issue mapping, cost–benefit analysis (CBA), use of secondary source data, multi-criterion analysis (MCA) and strategic environmental assessment (SEA). Where impacts are commensurable and can be quantified in terms of the same numeraire, then the evaluation task is, conceptually at least, relatively unproblematic. This is the basis for cost–benefit analysis (CBA) or fully quantified and weighted versions of multi-criterion analysis (MCA). The problems with such approaches arise when the impacts are not quantifiable and/or commensurable, and therefore cannot be measured in terms of a common numeraire, which is of course the case in many SD evaluations. There are also a number of other considerations that may limit the appropriateness of the full CBA/MCA approach. Many of these considerations derive from policy principles, including the following.

- *The sustainability principle.* This is related to the idea of sustainable development but is primarily concerned with environmental sustainability, that is, the need to maintain important environmental functions for future generations. These functions can include climate stability, the protective functions of the ozone layer, and various biodiversity functions, as well as standards of environmental quality important for human health or for avoiding pollution.
- *The precautionary principle.* One of the justifications for the sustainability principle is that the loss of certain environmental functions may be irreversible and/or entail very large costs. However, uncertainty about the likelihood of loss and actual costs make quantitative assessment procedures inapplicable. In these circumstances, the precautionary principle states that actions that may incur very large costs should not be undertaken, irrespective of their probabilities (which may be very low) and their benefits (which may be very high).
- *What might be termed the 'appropriateness principle' in assessment.* For example, there are situations where assessing choice in terms of financial trade-offs may be morally inappropriate: The willingness to pay (WTP) needs to be consistent with ability to pay. This means that the WTP (for environmental functions/survival/security) of poorer people is unlikely to be an accurate reflection of what they think something is actually worth. Where such valuations are used to drive resource allocations, in practice they suggest that the priorities of the worse off are less important than those of the better off.

- *The principle of justice.* The point above is an example of the possibility that marginal valuations may be irrelevant to or in conflict with considerations of justice. For example, the assessment of social costs and benefits in the IPCC's Second Assessment Report (Pearce *et al.*, 1996) was met with outrage not only because of the 15:1 factor of difference with which lives in rich and poor countries were valued, but also because no distinction was made between those responsible for anthropogenic climate change and those likely to suffer its consequences. These types of distributional concern could be addressed through allocating differential weights. However, even if weights could be agreed they do not reflect the opinion of some that such a trade-off model in relation to issues of justice is inappropriate.

The Four-Capital Model

The Concept of Capital

The concept of capital derives from economics, whereby capital *stocks* (assets) provide a *flow* of goods and services, which contribute to human well-being. In its narrowest interpretation capital is used to mean manufactured goods that themselves produce, or facilitate the production of, other goods and services. This kind of capital is referred to below as 'manufactured capital'.

However, it is clear that flows of benefits derive from many other sources than manufactured capital. In conventional capital markets increasing attention is being paid to 'intangible' forms of capital, which may affect the valuation of firms. These intangibles include brands, reputation and the intellectual quality of the workforce. In some knowledge and service companies intangibles can account for the greater part of company worth.

In economics too the concept of capital has been extended in a number of directions, to take into account the quality (as opposed to the quantity) of labour (human capital), the networks through which labour is organized and which create the social context for economic activity (social/organizational capital) and the natural resources and environment, which both provide inputs into the economic process and maintain the existence of life on earth (natural capital). Ekins (1992) put forward a 'four-capital model', relating manufactured, human, social and natural capital to the process of production and the generation of human welfare. This model was elaborated further by Ekins (2000). The same model seems to have commended itself to Serageldin and Steer (1994) of the World Bank, who write of the 'need to recognise at least four categories of capital', as defined as in Box 1.

Other types of capital have also been suggested, principal among them financial capital. However, financial capital, and the financial system through which it acts, may better be seen as a type of social capital, a conventional way of allocating and representing the power to mobilize the other four kinds of capital, which have the real inherent power to deliver benefits. This is an important point, because the EU Structural Funds (SFs) are themselves financial capital, and in fact this clarifies the essential nature of this type of capital as social capital. The SFs are the product of a political process, which has determined their allocation to certain regions of the European Union in order to achieve certain social and economic objectives. They represent the power to mobilize and create other kinds of capital rather than embodying real productive power themselves. An evaluation of the SFs would seek to determine the extent to which they have been successful in the exercise of this power, and to recommend guidelines and procedures for their deployment in the future. These guidelines and procedures will themselves be further examples of social capital, if their effect is to enable the SFs more effectively to achieve their objectives.

Manufactured capital

Manufactured (or human-made) capital is what is traditionally considered as capital: produced assets that are used to produce other goods and services. Some examples are machines, tools, buildings and infrastructure.

Natural capital

In addition to traditional natural resources, such as timber, water, and energy and mineral reserves, natural capital includes natural assets that are not easily valued monetarily, such as biodiversity, endangered species and the ecosystems that perform ecological services (e.g. air and water filtration). Natural capital can be considered as the components of nature that can be linked directly or indirectly with human welfare.

Human capital

Human capital generally refers to the health, well-being and productive potential of individual people. Types of human capital include mental and physical health, education, motivation and work skills. These elements not only contribute to a happy, healthy society, but also improve the opportunities for economic development through a productive workforce.

Social capital

Social capital, like human capital, is related to human well-being, but on a societal rather than individual level. It consists of the social networks that support an efficient, cohesive society, and facilitate social and intellectual interactions among its members. Social capital refers to those stocks of social trust, norms and networks that people can draw upon to solve common problems and create social cohesion. Examples of social capital include neighbourhood associations, civic organizations and co-operatives. The political and legal structures that promote political stability, democracy, government efficiency and social justice (all of which are good for productivity as well as being desirable in themselves) are also part of social capital.

Box 1. Four types of capital

All the different kinds of capital can only be identified as such from the flows of benefits to which they give rise. Where these benefits can be given a money value, then the value of the capital stock from which they derive is simply the net present value of the benefit flow over time. The benefits are no less real if they cannot be so valued, but obviously in this case the capital stock that gives rise to them will need to be described, and perhaps quantified, in a different way. There are many examples of benefits, and therefore of capital stocks (especially social and natural), to which it is difficult or impossible to give a money value. Different types of capital can of course also be combined to create new flows of benefits.

The Four-Capital Model of Sustainable Development

Sustainable development as defined above is simply related to the four-capital model discussed in the previous section. Meeting human needs and increasing quality of life (through consumption, satisfying work, good health, rewarding personal relationships and well functioning social institutions, and the full range of environmental goods and services) may be regarded as resulting from the flows delivered by the capital stocks. Doing so sustainably requires that these capital stocks are maintained or increased over time.

This immediately raises the question as to whether it is the total stock of capital that must be maintained, with substitution allowed between various parts of it, or whether certain components of capital are non-substitutable, i.e. they contribute to welfare in a unique way that cannot be replicated by another capital component. With regard to natural capital, Turner (1993) has distinguished between weak environmental sustainability, which derives from a perception that welfare is not normally dependent on a specific form of capital and can be maintained, for example, by substituting manufactured for natural capital, though with exceptions, and strong sustainability, which derives from a different perception that

substitutability of manufactured for natural capital is seriously limited by such environmental characteristics as irreversibility, uncertainty and the existence of 'critical' components of natural capital, which make a unique contribution to welfare.

The point at issue is that there may be limitations to the substitution of one form of capital for another, if it is the case that one form of capital plays some unique role in welfare creation. The potential for unsustainable development lies in the loss of one or more capital stocks, or in the trade-offs made between different forms of capital, and the degree to which

- any decline represents a breach of some critical threshold (see ten Brink *et al.*, this issue, for further discussion), and if not whether
- any decline in one form is compensated by increases in other forms.

The existence and nature of trade-offs needs to be understood empirically. Some critical thresholds may be amenable to largely scientific determination and description. Others may be more normative, in terms of both the existence of critical thresholds and whether there are acceptable trade-offs, which would allow them to be breached.

Sustainability Criteria

If there are concerns that current modes of development (meeting human needs and increasing quality of life) are unsustainable, it is interesting to consider whether these concerns largely have an economic, social or environmental basis (or some mixture of the three); and further, what are the criteria of sustainability, or the critical thresholds, that could be applied across these dimensions to facilitate judgements as to whether development is sustainable or not.

With regard to the economic dimension, economists have long had guidelines as to whether economic growth and development should be regarded as sustainable. The rate of inflation, public sector net credit requirement and balance of payments, among others, are all considered to be important indicators of economic sustainability. The sustainable development idea has brought little new to this particular sustainability dimension.

Social sustainability is affected by such conditions as poverty, inequality, unemployment, social exclusion and the corruption or breakdown of social institutions, but the relationship between sustainability and these conditions is clearly very complex and quite different between different societies. It seems unlikely that a social sustainability threshold for unemployment or inequality, comparable for example to the target rate of inflation for economic sustainability, will be identified. What seems more important in this case is to ensure that the direction of change is towards what is considered necessary for sustainability, rather than the attainment of some particular number (e.g. full employment).

The environmental dimension of sustainability is different from both the economic and social dimensions, in that it is possible to articulate principles of sustainability based on scientific evidence, and thence to derive thresholds and standards for environmental sustainability, according to which it is possible to distinguish between sustainable and unsustainable use of the environment and the functions that it performs for people. An important part of any evaluation of the contribution of the SFs to SD would be to seek to determine whether and to what extent they have contributed to trends in relation to environmental sustainability thresholds and standards.

Historically, economic development has sought to maximize manufactured capital and income flows, while attaching much less weight to assets, such as human health, social networks, clean air and water and biological diversity. As a result, economic development has often occurred to the detriment of human, social and natural resources, which are clearly valuable to human society, but are usually not included in economic accounting systems. As discussed above, considerations of SD require that the

traditional definition of capital must be expanded to include environmental and social, as well as economic, resources.

Much recent work on measuring progress towards SD has addressed specific issues, such as measuring emissions related to climate change or the environmental and social impacts of particular sectors (e.g. agriculture, energy and transport). Measuring SD at an aggregate level, however, requires a broad integration of indicators of economic, environmental and social changes. One way to achieve this integration is to extend the traditional framework used for measuring economic activity – the national accounts. These extensions could record changes in environmental assets, and highlight environment-related transactions (e.g. pollution abatement and control expenditure). Such extensions in the social area could allow the linking of accounts measuring employment, human capital and the distribution of household income and consumption among socio-economic groups.

Measuring natural and human capital requires both monetary and physical data. While work in these fields has progressed, the application of a fully extended national accounts framework remains a medium- to long-term objective. In the short term, complementary approaches to achieve such integration are required. Many of these approaches have used or developed ‘indicators of sustainable development’, which are the subject of the next section.

Sustainable Development Indicators

Since the UN Conference on Environment and Development in 1992, which established the idea of sustainable development as an overarching policy objective, there has been an explosion of activity to develop sustainable development indicators (SDIs), in order to determine whether sustainable development was actually being achieved. Because the meaning of sustainable development was not particularly clear (and is still often the source of some confusion), this activity was characterized by much experimentation. Many indicator sets were put forward by different bodies at different levels (international, national, regional, local), and substantial efforts have since been invested in seeking to rationalize these into ‘core’ sets that can be used for comparison and benchmarking, while the development of particular sets of indicators for specific purposes has continued to flourish.

There are two main approaches to constructing indicators of sustainable development: the framework approach, which sets out a range of indicators intended to cover the main issues and concerns related to sustainable development, and the aggregation approach, which seeks to express changes in a common unit (normally money), so that they can be aggregated. A limitation of the first approach is that unless all the indicators in the framework are moving in the same direction (i.e. all making development more, or less, sustainable), it is not possible to say whether, in total, sustainable development is being approached or not. A limitation of the second approach is that it is often impossible, very difficult or very controversial to convert all changes of interest to money values, or any other common numeraire. While with this approach the change in respect of sustainable development may be expressed as a single number, the number may lack credibility. A third approach, confined to assessing environmental sustainability, involves establishing standards of environmental sustainability and calculating the ‘gap’ between current environmental situations and the standards.

In 1996 the UN Committee on Sustainable Development (UNCSD) published its first set of SDIs, comprising 134 economic, social and environmental indicators (UN, 1996). The indicators were structured in a matrix that related driving force, state and response indicators to the chapters in Agenda 21. Because it was felt that not all the indicators were relevant for the European Union, EUROSTAT carried out a study using a subset of 36 of these indicators, publishing the results of the study in 1997 (EUROSTAT, 1997). UNCSD subsequently produced a ‘core’ set of 59 SDIs based on its original set,

and EUROSTAT (2001) did another study involving 63 indicators, which related closely to the UNCSA core set.

There are many other frameworks of SDIs. Internationally, one of the best known is that produced by the Organisation for Economic Co-Operation and Development (OECD). The OECD was given a mandate to work on sustainable development in 1998. Pursuant to this its work has resulted in theoretical, methodological, and policy and indicator oriented publications (OECD, 1998, 2000a, 2000b, 2001a, 2001b, 2001c). The first publication in this field (OECD, 1998) was largely environmentally focused, but this was followed by a conference on sustainable development indicators in 1999, the proceedings of which were published in 2000 (OECD, 2000a). This contained a set of 'possible core sustainable development indicators', a number of country case studies on different aspects of sustainable development indicators and sectoral/environment indicators for the major environmentally significant sectors. It also contained a new set of social indicators, with context indicators and structured according to the themes of promoting autonomy (or self-sufficiency), equity, healthy living (or just health) and social cohesion. Within the themes the indicators were grouped according to social status and societal response (similar to the pressure–state–response framework it had used for environmental indicators).

In December 2001 the EU Council of Ministers agreed a set of seven headline indicators to measure progress in relation to the Sixth Environmental Action Plan (6EAP) and the last four of the priorities of the EU Sustainable Development Strategy, and an 'open list' of a further 33 indicators (CEU, 2001).

In order to illuminate the theoretical framework described in the previous section, an indicator framework related to the four-capital model of sustainable development is required. Because indicators, both monetary and non-monetary, of manufactured capital are routinely used, they are not further considered here. Those relating to the other three kinds of capital are now briefly discussed in turn.

Environmental/Natural Capital

Natural capital has featured regularly in various definitions of sustainability and sustainable development. In all the work on indicators of sustainable development that has taken place since 1992, most efforts have been invested in developing and making operational environmental indicators. EUROSTAT has produced a set of environmental indicators, based on a major expert consultation, while the European Environment Agency has produced its Environmental Signals indicators. The EU Council of Ministers has also agreed an environmental indicator set in relation to the EU's Sustainable Development Strategy.

The OECD's main source of environmentally relevant data is published as a compendium of indicators and it is structured according to a pressure–state–response (PSR) framework, where pressures include both direct environmental pressures and the indirect pressure of the human activities producing the direct pressures, the states refer to various environmental conditions and the responses relate to societal intentions and actions in respect of the environmental conditions, and include general data. The compendium has been published every two years since 1993 and is used as the indicator framework for the OECD country environmental performance reviews. Ten headline indicators have been selected from this compendium and the indicators have been also selected or combined to form the environmental indicators of the OECD sustainable development indicator set.

The frameworks of environmental indicators produced by EUROSTAT and the OECD are as in Table 1. It can be seen that there is substantial overlap, but also a few differences.

There is a need to be clear as to whether the measure of the capital stock, or the flows to which it gives rise, are to be measured in physical or money terms. The converter is the *price* of the stock or flow, which may vary over time. For example, suppose that a forest consists of a certain tonnage of useful wood (W), which at time t_0 has a value of Wp_w , where p_w is the price of the wood per tonne. In t_1 the

EUROSTAT	OECD
<i>Themes (pollution)</i>	<i>Pollution issues</i>
Climate change	Climate change
Ozone depletion	Ozone layer depletion
Air pollution	Air quality
Waste	Waste
Water pollution	Water quality
Dispersion of toxic substances	
	<i>Resource issues</i>
<i>Themes and indicators (resource depletion)</i>	Water resources
Water consumption	Forest resources
Timber balance	Land resources
Urbanization of land	Energy resources
Energy use	Fish resources
Fishing pressure	Biodiversity (and wildlife)
Loss of biodiversity	Mineral resources
	<i>Key sectors</i>
<i>Mixed resource and pollution themes</i>	Energy, transport, industry, agriculture
Marine environment and coastal zones	
Urban environmental problems	<i>Other issues</i>
	Risks
	Environmental expenditure and taxes
	Multilateral environmental agreements

Table 1. Structure of the environmental indicator sets of EUROSTAT and OECD

forest will have added some wood through growth, but the price of wood may have gone down. The natural capital in tonnes of wood will have increased, but its value may have decreased, depending on the relative rate of growth in wood and fall in price. In physical terms there would therefore have been an increase in natural capital, but in monetary terms there may have been a decrease.

Human Capital

In 2001 the OECD produced a publication specifically on human and social capital (OECD, 2001d), in which it discusses measurement issues and the evidence that stocks of these types of capital are related to economic performance and personal well-being. Because of their relative unfamiliarity, these are discussed in some detail. Human capital was defined as ‘the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being’ (OECD, 2001d, p. 18). The key function in the creation of human capital is learning. This may be learning within the family and early childcare settings, formal education and training, workplace training and informal learning at work or in daily life. There is much evidence that learning is much influenced by ‘cultural capital’ – ‘the collection of family-based resources such as parental education levels, social class, and family habits, norms and practices which influence academic success’ (OECD, 2001d, p. 23). Major specific influences include work habits of the family, academic aspirations and expectations and the support and guidance to help achieve them, and a stimulating environment for thinking, imagination and discussion of ideas and events. Learning is negatively affected by social disadvantage, but can be positively affected by aspects of social capital to be discussed further in the next section. Putnam (2000) found that learning outcomes were strongly and significantly correlated with a composite measure of social capital comprised of the following indicators:

- intensity of involvement in community and organizational life
- public engagement (e.g. voting)
- community volunteering
- informal sociability (e.g. visiting friends)
- reported levels of trust.

There is substantial evidence that human capital levels are positively related to wages, employment and economic growth. Indeed, one would expect these to be the principal economic benefits to flow from human capital. There is also substantial evidence that human capital is positively related to non-economic social and personal well-being, which may in turn feed back into economic growth. There is a case for regarding health itself as an element of human capital, because it is clearly positively related to productivity. These other social benefits of education may be regarded as elements of social capital, to be discussed in the next section, so that human and social capital are obviously closely inter-related.

Human capital, the benefits flowing from it or proxies for these may be measured in a number of different ways, all of them more or less problematic.

- *Education spending, or other expenditures such as on research and development.* These are input measures. There is no guarantee that they result in human capital and corresponding output benefits.
- *Educational credentials (e.g. years of schooling or other education at various levels, or enrolment rates) and qualifications.* These are output measures but there is no guarantee that these outputs are actually being put to productive use (i.e., they may be a stock of human capital in theory, but they may not be leading to a flow of benefits).
- *Various measures of training and the higher skill levels to which they lead.* It is likely that employment-based training, although an input measure, leads to its intended outputs and benefits, because those qualified in this way often move into more advanced employment in a related field.
- *Surveys of student achievements or adult skills,* of which easily the most commonly investigated is various forms of literacy (e.g. prose, document, quantitative literacy).
- *Health status.*
- *Indicators of motivation and productivity,* such as absenteeism (for health or other reasons) from work.
- *Employment and unemployment, and average wages.* All jobs presuppose a certain level of human capital, and the level of this should be related to wages.
- *Indicators of disadvantage,* leading to educational and learning disadvantages, or of the outcomes of measures and policies to reduce it.
- *Levels of invention or entrepreneurship,* as shown for example in numbers of patents or new business start-ups.

Social Capital

In essence, social capital derives from relationships. Distinctions in the literature include those between 'bonding', 'bridging' and 'linking' relationships, where the first relate to the close ties mainly between kin and ethnic groups and the second to the relationships that allow individuals to transcend those groups, while linking relationships connect individuals and groups to other groups and institutions. It should be noted that, unlike other forms of capital, the attitudes and activities generated by social capital may not necessarily be in the broad social interest: closely bonded groups may be exclusive; the activities of some closely bonded groups may be anti-social (e.g. criminal gangs) and other groups may pursue their own narrow interests at the expense of society at large (e.g. business associations or trade unions).

OECD (2001d)	World Bank (1997)
Context indicators	Horizontal associations
Self-sufficiency	Civil and political society
Equity	Social integration
Health	Legal and governance aspects
Social cohesion	

Table 2. Headings for indicators of social capital

The definition of social capital by OECD (2001d, p. 41) is ‘networks together with shared norms, values and understandings that facilitate co-operation within or among groups’. However, this seems an unnecessarily narrow definition, and it would be desirable for a broad evaluation of sustainable development to include in social capital various other social arrangements that are recognized by the OECD as being closely related to their preferred concept:

- organizational capital, which ‘reflects the shared knowledge, teamwork and norms of behaviour and interaction within organisations’ (OECD, 2001d, p. 19)
- cultural capital, ‘the habits or cultural practices based on knowledge and demeanours learned through exposure to role models in the family and other environments’ (OECD, 2001d, p. 23)
- political, institutional and legal arrangements.

Social capital is discussed in some detail by the World Bank (1997). This publication notes that there are broadly three views on what social capital consists of: informal and local horizontal associations; hierarchical organizations (such as firms and professional associations) and formalized national structures, such as government and its agencies and legal arrangements. These three descriptions of social capital share several common features.

- ‘All link the economic, social, and political spheres. They share the belief that social relationships affect economic outcomes and are affected by them.
- All focus on relationships among economic agents and how the formal or informal organization of those can improve the efficiency of economic activities.
- All imply that “desirable” social relationships and institutions have positive externalities. Because these cannot be appropriated by any one individual, each agent has a tendency to under-invest in social capital; hence, there is a role for public support of social capital building.
- All recognize the potential created by social relationships for improving development outcomes but also recognize the danger for negative effects. Which outcome prevails depends on the nature of the relationship (horizontal versus hierarchical) and the wider legal and political context’ (World Bank, 1997, p. 79).

Based on these definitions of social capital, the World Bank (1997, p. 88) suggests a number of indicators of social capital. Table 2 compares the headings for social capital given by OECD (2001d) and the World Bank (1997).

The Structural Funds and Sustainable Development

Articles 158 and 160 of the treaty establishing the European Union state that economic and social cohesion, achieved by reducing regional disparities of economic development, is a fundamental objective of

the Union. The resulting EU regional policy, financed by the European Funds (the Structural Funds – SFs – and the Cohesion Fund), transfers over 35% of the Union budget to the least favoured regions.

Thus the SFs are an instrument of the EU to implement Community policies for economic and social cohesion. In particular, they are applied, using a programming approach, to support the convergence of regional economic performance, supporting those regions with particular structural difficulties that hinder development and the attainment of average EU living standards. In supporting regional convergence the SFs also support the balanced and sustainable development of regions.

Following the publication of the 'Agenda 2000' document (EC, 1999a), the 1999 Structural Fund (SF) Regulations further strengthened the requirements for the inclusion of the two horizontal themes of environmental sustainability and equal opportunities in the 2000–06 programmes, making them more systematic and extensive.

Many SF programmes (which go by a number of names, including Operational Programmes, Regional Development Programmes and Single Programming Documents, as will be seen in the case studies elsewhere in this special issue) include projects that relate explicitly to environmental sustainability, such as projects promoting water treatment plants or other eco-technologies or eco-industries. These so-called 'positive action' projects have an important role to play in addressing attitudes and changing perceptions of those involved in managing and implementing the programmes. However, they are only one component of the overall aim of the Commission, which is to 'mainstream' these horizontal themes, integrating them across all stages of programming including monitoring and evaluation, and into all policies pursued. Thus the two concepts are both necessary and complementary, with 'positive action' projects paving the way for more comprehensive mainstreaming.

Any evaluation of the SFs would need to look in detail at the programmes they have financed and otherwise supported in different regions of the EU. However, for these evaluations to be compared across the EU, they would need to have common core methodology and indicators. It is this common evaluative core, and the indicators that may be used to represent it, that is derived and presented in the sections that follow.

Evaluating the Structural Fund Programmes

When considering indicators related to the evaluation of the SFs, it is clearly important that they are closely related to the objectives that the SFs are seeking to achieve. In 1999 the European Commission published a working paper outlining an indicative methodology for the monitoring and evaluation of the SFs (EC, 1999b), from which it is possible to construct an indicator set related to the SFs' intended outcomes.

The basic criteria applied by the EC (1999b) for the evaluation of the SF programmes were the following.

- *Relevance.* The indicators need to be clearly related to the priorities and objectives of the SFs. EC (1999b) sets out the fields of intervention of the SFs, which provide the clearest link between the SF objectives and the activities that seek to achieve them.
- *Quantification.* This criterion ensures that the indicators can be used to set targets and, where appropriate, establish baselines.
- *Reliability.* This criterion is important for clarity of definition and ease of aggregation of the indicators.
- *Availability.* Data need to be available for entry into the monitoring and evaluation system for the indicators. Ideally they should be in time-series form dating from before the application of the SFs, to give a chance of identifying the SFs' effects.

The EC (1999b) also distinguished between three different kinds of objective for the SFs:

- *operational objectives*, expressed in terms of outputs (e.g. the provision of training courses to the long-term unemployed);
- *specific objectives*, expressed in terms of results (e.g. the improvement, through training, of the employability of the long-term unemployed);
- *global objectives*, expressed in terms of impacts (e.g. a reduction in unemployment among the previously long-term unemployed).

With regard to indicators, the EC (1999b) identified the following kinds of indicator as relevant to an evaluation of the SFs.

- *Input indicators*. The budget allocated to each level of assistance. Financial indicators are used to monitor progress in terms of the (annual) commitment and payment of the funds available for any operation, measure or programme in relation to its eligible cost. These indicators are readily available but give little information about the effectiveness of the SFs.
- *Output indicators*. These relate to the activity engaged in through the application of the SFs and may be of a physical (e.g. length of road constructed) or other (e.g. number of firms supported) output.
- *Result indicators*. The direct and immediate effects of a programme. The indicators provide information on changes to, for example, the behaviour, capacity or performance of direct beneficiaries. Such indicators can be of a physical (reduction in journey times, number of successful trainees, number of road accidents etc.) or financial (leverage of private sector resources, decrease in transportation cost) nature.
- *Impact indicators*. These refer to the programme's consequences beyond its immediate effects. Specific impacts are those effects occurring after some time but which can be directly linked to the action taken. Global impacts are longer-term effects affecting a wider population. The impacts that are of interest are those that either support, or are in conflict with, the achievement of other policy objectives.

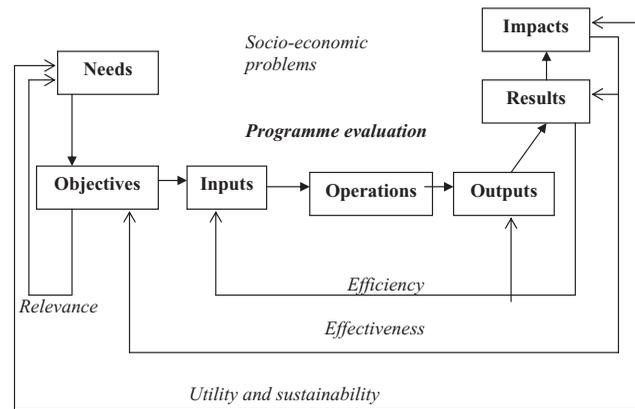
If the lines of cause and effect can be adequately established, it would clearly be desirable for the indicators to follow the sequence

inputs \Rightarrow outputs \Rightarrow results \Rightarrow impacts

Such a sequence should be easiest to establish for inputs, outputs and results. Measuring impacts is complex and clear causal relationships are often difficult to establish. It might be necessary to include some impacts that can plausibly be linked to the application of the SFs, but not in a direct way. In order to establish the impacts of a programme it is also necessary to define in advance a range of context and baseline indicators that are relevant to the overall objectives of the programme, and to its predicted impacts. It is against these baseline indicators that the actual impacts of the programmes will need to be estimated.

The EC (1999b) also lists a number of issues that any evaluation would need to address.

- *Relevance*. To what extent are the programme's objectives relevant in relation to the evolving needs and priorities at national and EU level?
- *Efficiency*. How were the resources (inputs) turned into outputs or results? Efficiency analysis looks at the ratio between the outputs, results, and/or impacts and the inputs (particularly financial resources) used to achieve them.
- *Effectiveness*. How far has the programme contributed to achieving its specific and global objectives? Effectiveness analysis compares what has been done with what was originally planned; i.e., it compares actual with expected or estimated outputs, results and/or impacts.



Source: EC (1999b, p. 9).

Figure 1. Key evaluation issues and their relation to objectives and indicators

	Indicators	Effectiveness	Efficiency	Sustainability	Utility
Programme activities	Financial input				
Operational objective	Financial/physical output	Actual/planned output	Output compared with cost	Extent to which output and results will be continued after end of programme	
Specific objective	Result	Actual/planned results	Results compared with cost		Improvement in context, baseline and other indicators related to needs
Global objective	Impact	Actual/planned impacts	Impacts compared with cost		
Needs	Context/baseline				

Table 3. An evaluation framework for an SF programme

Source: adapted from EC (1999b, Table 2, p. 10).

- *Utility*. Did the programme have an impact on the target groups or populations in relation to their needs?
- *Sustainability*. To what extent can the changes (or benefits) be expected to last after the programme has been completed?

These issues are related to the objectives and indicators of a programme as in Figure 1.

The evaluation issues, objectives and indicators may then be related in a matrix as in Table 3. Context and baseline indicators are defined in relation to the needs which that is intended that the SF programme will address. Output, result and impact indicators are defined in relation to the objectives of the programme. A comparison between the actual and planned (as expressed in the programme’s objectives) outputs, results and impacts indicates the *effectiveness* of the programme. A comparison between outputs, results and impacts and the costs (financial inputs) indicates the *efficiency* of the programme. The extent to which the outputs and results are sustained following the end of the programme indicates the *sustainability* of the programme. The relationship between the objectives of the programme and the context and baseline indicators relating to the perceived needs gives an indication of the *relevance* of the programme, while the change in these context and baseline indicators due to the programme’s impacts indicates the *utility* of the programme.

Evaluating the Structural Funds in Relation to Sustainable Development

An environmental evaluation of the SFs by ECOTEC in 1999 noted that 'their main objective is to help create employment and generate economic development' (ECOTEC, 1999, p. iii). The dilemma for sustainable development is that, as long as the SFs generate a typical path of economic development, 'the greater the success in stimulating economic growth and employment, the greater the increase in production and consumption and the greater the use of environmental resources and the amounts of waste, by-products and emissions produced' (ECOTEC, 1999, p. 2). In other words, in the context of Table 3, the impacts of the SF programmes would be likely to meet economic and development needs that were their primary focus, but might include negative environmental effects that were not consistent with the European Union's new horizontal objective of sustainable development.

Resolving this dilemma and moving towards sustainable development will require 'a significant shift and change to new patterns of development, production, consumption and behaviour' (ECOTEC, 1999, p. 2), in which increased incomes and employment are accompanied by reductions in environmental impacts and resource use, rather than their increase. This implies a very different path of development to that which has hitherto characterized industrial economies, and one that is far more eco-efficient, where this term denotes the ability of an economy to generate ever-increasing amounts of value from a constant or reducing level of resources and with ever-declining environmental impacts.

The SFs are a relatively small part of any country or region's overall economic activity, and cannot be expected to strike out on a sustainable development path all by themselves, but the SFs are of a sufficient size to be able in some contexts either to reinforce the old unsustainable development path, or to contribute to a shift towards sustainability. An important priority of a sustainable development evaluation framework for the SFs would therefore seem to be the ability to give insights into whether or not the SFs were in fact improving the eco-efficiency of the regions in which they were being implemented, as well as their economic, social and environmental impacts overall.

This gives a new interpretative twist to the effectiveness and efficiency columns in Table 3. With regard to effectiveness, it is not just actual/planned impacts that are of interest, but also planned/unplanned impacts, where the planned impact might be some aspect of economic development, and the unplanned impact some negative environmental effect. In this case the 'eco-effectiveness' of the SF intervention will depend on the extent to which this ratio is above or below a benchmark figure from elsewhere in the economy. Similarly, with regard to efficiency, it will not just be impacts/input cost that are of interest, but also impacts/environmental damage. SFs may only be said to be moving the region or country towards sustainable development if this measure of 'eco-efficiency' was substantially higher than the average for their economy as a whole.

It can therefore be seen that the evaluation framework of Table 3 is well suited to give insights into the important sustainable development concepts of eco-effectiveness and eco-efficiency. It remains, however, to make it more suitable for the evaluation of sustainable development as a whole.

In the four-capital model of sustainable development discussed above the quantity of capital may be measured either according to the *stock* of the asset that it comprises, or in relation to the *flow* of benefits to which the capital stock gives rise. The contribution of the SFs to sustainable development can therefore be measured using indicators that show the changes as a result of an SF programme in the stocks and flows of the different types of capital. These changes have already been identified as the outputs, results and impacts from an SF programme.

Therefore, in order to relate the earlier discussion on SF evaluation to sustainable development, it is only necessary to divide the indicators into eight kinds, corresponding to the stocks and flows of the different types of capital. This leads to a matrix for the evaluation of the SFs of the form shown in Table 4, which may be visualized in terms of adding an extra dimension to the indicator column in Table 3. The

Type of capital	Stock/flow (S/F)	Type of indicator				Policy synergy/conflict
		Inputs (In)	Outputs (O)	Results (R)	Impacts (Im)	
Environmental/natural (E)	Stock	E/S/In	E/S/O	E/S/R	E/S/Im	+ (synergy), – (conflict)
	Flow	E/F/In	E/F/O	E/F/R	E/F/Im	+, –
Human (H)	Stock	H/S/In	H/S/O	H/S/R	H/S/Im	+, –
	Flow	H/F/In	H/F/O	H/F/R	H/F/Im	+, –
Social/organizational (SO)	Stock	SO/S/In	SO/S/O	SO/S/R	SO/S/Im	+, –
	Flow	SO/F/In	SO/F/O	SO/F/R	SO/F/Im	+, –
Manufactured (M)	Stock	M/S/In	M/S/O	M/S/R	M/S/Im	+, –
	Flow	M/F/In	M/F/O	M/F/R	M/F/Im	+, –

Table 4. An evaluation matrix relating indicators to the four-capital model

policy synergy/conflict column is included in recognition of the fact that an SF programme is likely to have multiple economic, social and environmental impacts. While, hopefully, its major intended impacts will generate utility in relation to meeting human needs, as illustrated in the final column of Table 3, it may have other impacts, which may be positive or negative and may be synergistic or in conflict with other policy objectives. This is likely to arise especially in relation to economic and environmental policy objectives. The main purpose of the SFs is to generate economic development in selected European regions. The indicator framework here developed would not only enable an evaluation to measure the extent, efficiency and effectiveness with which it has achieved this (as shown in Table 3), but also show up any other impacts (perhaps negative environmental effects associated with the economic development) that may conflict with other policy objectives (as shown in Table 4). By using the matrix to map the full impacts of the SF inputs, via their outputs and results, on each of the four types of capital, this framework could give insights into the contribution of the SFs to sustainable development as a whole.

However, this structure would very soon become unwieldy unless it were possible to limit the number of indicators in, especially, the result and impact columns. In practice, these are limited by data availability. Moreover, for some capitals flow indicators are difficult to establish and, additionally, in some cases it is hard to determine whether a certain indicator refers to a stock or a flow of a certain capital. In the case studies that follow, therefore, no attempt is made to differentiate between stock and flow indicators.

The appendix gives an 'ideal' indicator framework for the evaluation of the EU SFs, on the basis of the arguments in this and the previous section. In practice, however, data availability did not permit the case studies to use more than a small proportion of the indicators shown.

Conclusion

The four-capital model seems to provide a robust theoretical framework for the evaluation of sustainable development outcomes. Of course the application of the framework will need to take account of the specificities of different situations, in particular the interactions between different levels and considerations related to different scales. Many of these issues become apparent and are further explored in the case studies that use the model and that make up most of the rest of this special issue.

Appendix. Four-Capital Indicators Related to the Structural Funds

An 'ideal' indicator set for manufactured, environmental, human, and social capital to evaluate the contribution of the EU structural funds to sustainable development. Note that in the tables, no distinction has been made between indicators of stocks of capital and the flows to which they give rise.

Type of intervention	Indicator
Transport infrastructure (rail, road, airport, port, urban transport, multimodal transport)	Financial investment in the different categories
Telecommunications infrastructure (ICT, services and applications for the citizen and SMEs)	Financial investment in the different categories
Energy infrastructure (new plants assisted)	Financial investment in the different categories

Table A.1. Manufactured capital

Environmental theme	Impacts	
Climate change	Increase in CO ₂ emissions and other GG emissions	
Air pollution	Concentrations of low-level ozone Increase in emissions of main local air pollutants (SO _x , NO _x , NMVOCs)	
Waste	Solid waste generation (municipal solid waste (MSW) arisings, hazardous waste arisings) % MSW to landfill Improvements in solid waste management	
Water pollution	Concentrations of various pollutants in surface waters % coastal sites complying with Bathing Water Directive Emissions of heavy metals	
Water consumption	Water abstraction as % of availability Water consumption	
Forest resources	Forest cover Forest depletion and growth	
Fishing pressure	% stocks fished above MBAL (minimum biologically acceptable level) Reduction in catches of depleted stocks fished (tons by species)	
Urbanization of land	Greenfield development as % of total new development Area converted from greenfield to developed land	
Loss of biodiversity	% land area protected Loss, damage, fragmentation of protected areas Wetland loss through drainage Incidence of forest fires	
Change of landscape	% land area with landscape designation Development along coast Loss of cultural features Loss of areas within which active management of landscape features	
Energy	% renewables as share of power generation Energy consumption	
Transport	% share of passenger traffic by car % population exposed to unacceptable noise levels Change in road passenger km	
Agriculture	% agriculture share of land use Change in number of farms Pesticides per km ² agricultural land	% organic farming in agricultural land use Nitrates per km ² agricultural land Agricultural water use

Table A.2. Environmental capital

Type of measure	Impacts
Status and spending with respect to education	Educational attainment (ISCED levels) broken down by gender and age
Status and spending with respect to training	Success rate of training (% finding employment on completion)
Status and spending with respect to research & development	Number of patents taken out from innovations being developed Net employment created or safeguarded Brain import/export
Health status and spending	Life expectancy Nutritional status of population Immunization against childhood diseases Exposure to air pollution Health and environment related health expenditure Extent of drug/alcohol abuse
	Infant mortality
	Suicide rates
Labour market conditions (wages, employment and unemployment)	Unemployment (male, female, youth etc) Activity rate (male, female full-time equivalents)
Labour productivity and motivation	Absenteeism Worker productivity
Inventiveness and entrepreneurship	Number of start-up businesses Ratio of entrepreneurs/population
Learning disadvantage	Long-term unemployment

Table A.3. Human capital

Type of measure	Impacts
<i>Values</i>	
Trust	Extent of trust (in local associations, hierarchical organizations, government, scientists) Fear of crime
Equity	Population living below poverty line Measures of income inequality (gender, age)
	Children in poor households Workless households
<i>Social health</i>	
Social integration and cohesion	Voter turnout (male, female, young, retired) Citizen satisfaction with the local community Newspaper readership Access to childcare provision Access to public transport system Access to retirement homes
	Time spent commuting Access to green spaces Access to healthcare Access to internet Divorce rate
Social exclusion	Crime rates Benefit dependency (ratio)
	Retirement age Prisoners per 100 000 people Extent of homelessness
<i>Social organization</i>	
Networks, horizontal associations	Networks of civic engagement: e.g. number and types of neighbourhood associations, community groups, cooperatives, sport clubs etc Voluntary groups or number of volunteers
Hierarchical organizations	Number and type of organizations (i.e. good sectoral representation and diversity) Business clusters
	Survival rates of start-ups
<i>Governance</i>	
Political arrangements	Decentralization of decision making Partnerships Transparency of procedures
	Participation in planning process LA 21 processes Length of political procedures
Legal, financial arrangements	Length of civil cases
	Differential interest rates

Table A.4. Social capital

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