Analysing Articulations of Sustainable Development

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INTRODUCTION

A "sustainable development" is one that contributes in an equitable way to human welfare and does so in a way that minimizes the drain on natural resources. Many academic, civil, commercial and legislative projects claim to do this – promoting biopolymers, carbon taxes, design for recycling are examples. Following Mulder et al [1] we shall refer to them as "articulations" of sustainable development. But how are they to be assessed? There is no simple, "right" answer to questions of sustainable development – instead, there is a thoughtful, well-researched response that recognizes the concerns of stakeholders, the conflicting priorities and the economic, legal and social constraints of a technology as well as its environmental legacy.

How can students be introduced to this complexity and equipped to assess the viability of projects that claim to be sustainable? The aim of the method described here is not to define a single metric of index of sustainability; rather it is to improve the quality of discussion by providing a reasoning-path and guided access to relevant data.

Fig. 1. The three Capitals and Sustainable Development

1 THE THREE CAPITALS

"Wealth" is a generic term for all that we value. Global or national "wealth" can be seen as the sum of three components: the *net manufactured capital*, the *net human capital* and the *net natural capital* [2] and Fig. 1. They are defined like this.

- *Manufactured capital ("Prosperity")* – Industrial capacity, institutions, roads, built environment and financial wealth.
- *Human capital ("People")* – Health, education, skills, technical expertise, accumulated knowledge, happiness.
- *Natural capital ("Planet")* – Clean atmosphere, fresh water, fertile land, productive oceans, accessible minerals and fossil energy.

A narrow view of a Sustainable development is as a development that conserves Natural capital. A broader view is a development that takes into account the evolution of the three capitals and aims at the increase, or minimal decrease, in them all. It is this second view that informs the method described below

2 ANALYSING SUSTAINABLE TECHNOLOGIES

Examination of many articulations of sustainable development drawn from journals, conferences, national and international government publications suggests the following picture. Each articulation has a motivating target that we will refer to as its "Prime Objective". Each involves a set of Stakeholders. In assessing the sustainability of project the first step is to identify these: if the Prime Objective is not achievable or major Stakeholders are left dissatisfied, the project is unlikely to be sustainable. Further examination suggests that the central issues might be grouped under the six broad headings:

- *Materials and Manufacture:* supply-chain risk, life-cycle demands and recycle potential.
- *Design:* product function, performance and safety.
- *Environment*: energy efficiency, resource conservation, preserving clean air, water and land.
- *Regulation:* awareness of, and compliance with, National and International Agreements, Legislation, Directives, Restrictions and Agreements.
- *Society*: individual health, education, shelter, employment, equity and happiness.
- *Economics*: the cost of the project, and the benefits that it might provide.

This suggests the following way of analyzing articulations of sustainable development. It has 5 steps (Fig 2). The first is a statement of Prime Objectives (Step 1). Stakeholders are identified and their concerns listed (Step 2). This is followed by a Fact-Finding search (Step 3) assembling data relevant to each of the headings listed above. This provides the background for a debate or discussion of the impact of these facts on Human, Natural and Manufactured capital (Step 4).

The analysis ends with reflection on possible priority changes (Step 5). The first three steps are objective and deterministic; the last two are subjective, and therefore open to debate and creativity.

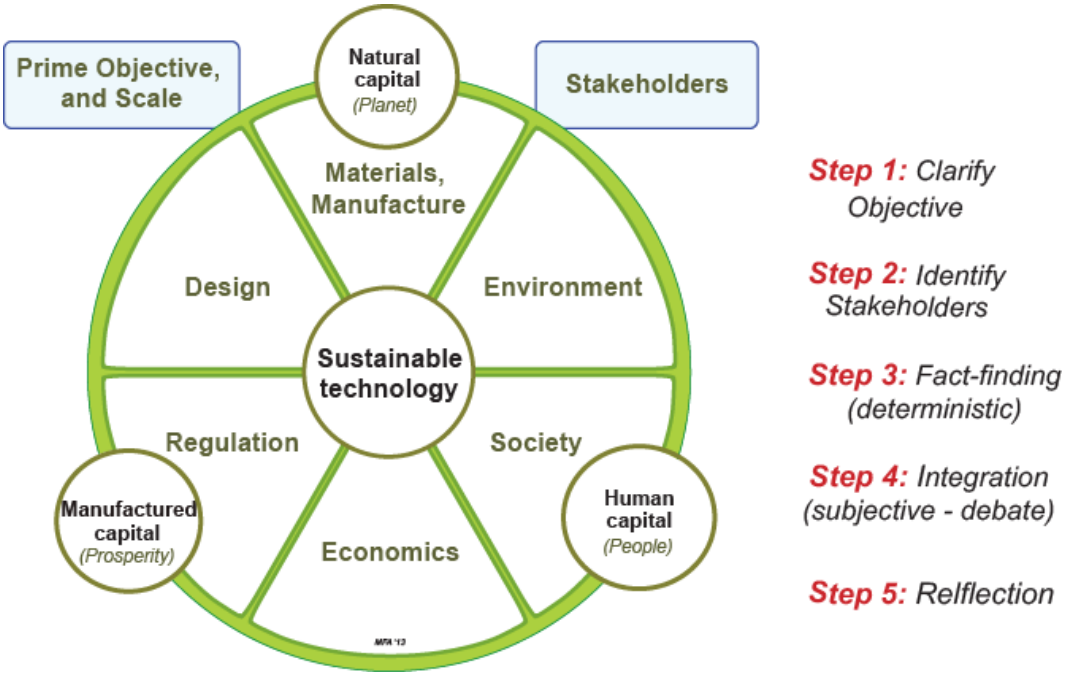

Fig. 2. The 5-step assessment of a Sustainable Development

3 THE CES SUSTAINABILITY DATABASE

The SUSTAINABILITY database [3] is designed to help with the fact-finding step It contains six linked data-tables (Fig. 3). At the center is the Materials data-table containing data for materials, their properties, eco-profile and nations from which they are sourced. It is linked to two data-tables relating to energy: one with records for *Electric-Power generating systems (conventional, nuclear, renewable)*, the other for *Energy Storage systems (chemical, potential, kinetic, electric)*. It is also linked to the data-table of *Regulation*, listing legislation, regulations and incentives to encourage or restrict the use of materials or of practices such as recycling that relate to material use; and it is linked to the *Nations of the World* data-table, which contains records for the world's 210 nations, with data for population, governance, economic development, energy use and engagement with human rights, together with information that may bear on security of supply. The links connect related records; thus each material record is linked to records for the nations from which it is drawn and legislation bearing on its use.

The analysis method and the database are fully documented in the Granta Design White Paper called *Materials and Sustainable Development* [4]. The White Paper illustrates the use of each of the data-tables and demonstrates the method by using the database as a whole as a fact-finding tool to explore two major articulations of sustainable development: wind farms, and electric cars. The White Paper and SUSTAINABILITY database help contextualize the role of materials in sustainable

development and to expand competences in critical thinking about complex issues including resource use, legal barriers, ethical considerations and societal concerns.

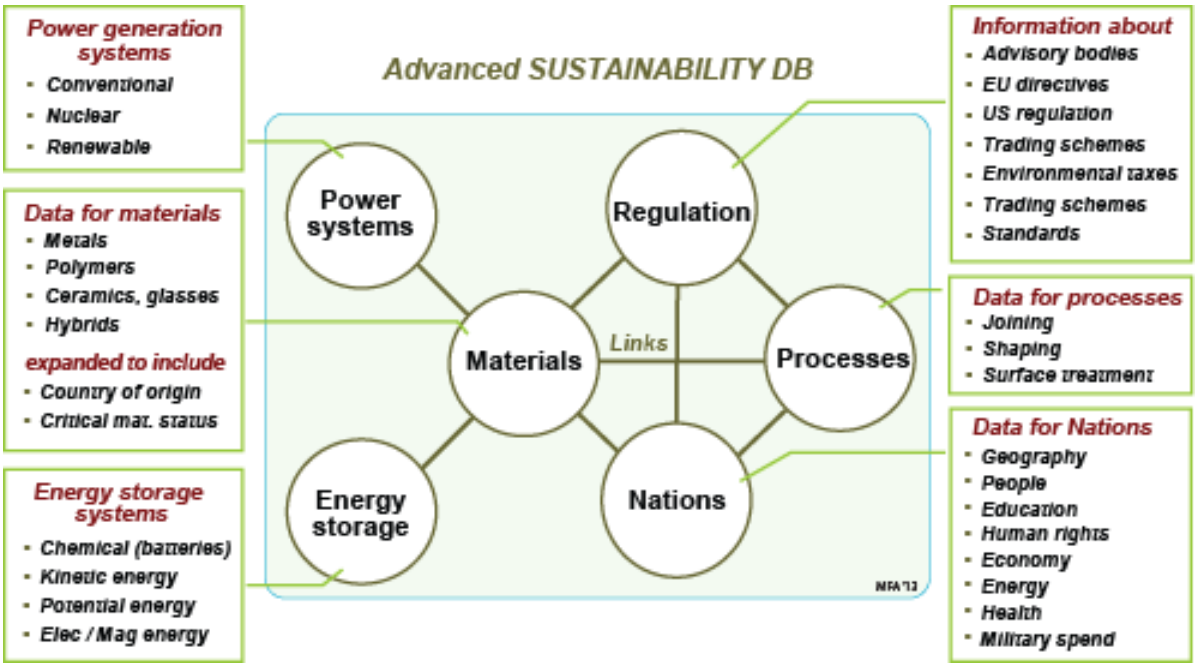

Fig. 3. The structure of the CES Sustainability database.

4 SUMMARY AND CONCLUSIONS

"Sustainable technology" has many interpretations. Central to all is the concept of the value of natural capital (the planet's natural resources), of human capital (the health, education and social development of the human population of the planet) and of manufactured capital (the value of man-made institutions, infrastructure and wealth). The many different articulations of sustainable technology aim to support one or another of these but few support all three. Progress is possible only with well-balanced trade-offs and compromises between them.

Fig. 4. Sustainable-technology assessment as a group activity.

Introducing students to this complexity is challenging. The 5-step method and the SUSTAINABILITY database described here are contributions towards meeting it. It can be used for individual or for group projects. As a group activity, the role of a stakeholder and the responsibility for one fact-finding task can be assigned to each member of the group, the individuals research their assignation and report back to the group as a whole (Fig. 4). This is then followed by a group "debate" seeking consensus on the impact of each of the fact-finding searches on the three capitals. The analysis as whole has a purpose and conclusions: while the underlying problem may be complex, it is important to report the result in a simple manner, making them accessible to non-experts. This teaching method can be suitable for different levels of depth, ranging from a session of few hours on sustainability, to a full semester course or a final project. In its pilot phase, the method is being tested in different universities.

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