

# Sustainable Development Projects

## Assessing Sustainable Developments – a summary

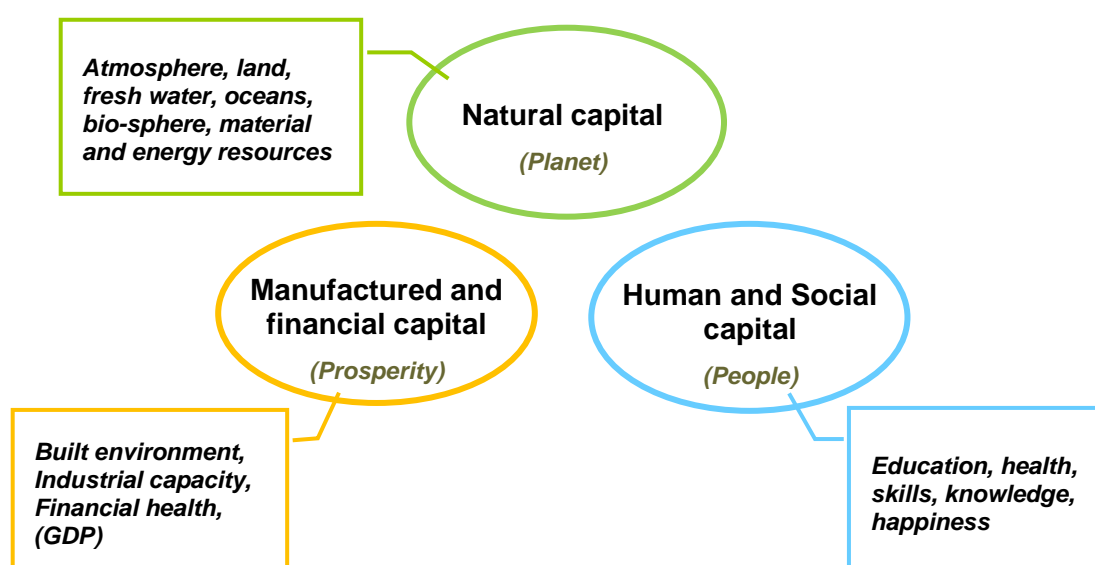
Mike Ashby, 2014

### 1. Introduction

“Sustainability” is an absolute term – something sustainable survives, something that is unsustainable does not. “Sustainable development” is a relative term: it is development that moves us from the present state towards a more nearly sustainable state. Thus the base-line is today’s technology; the “development” refers to a change in that technology. These notes summarize the layered method for exploring proposed sustainable developments<sup>1</sup> and illustrate its use in a number of worked case studies.

**The three capitals.** 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* (Figure 1). We seek to assess the impact of the proposed development on each capital. They are defined like this:

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



**Figure 1.** The three capitals.

<sup>1</sup> “Materials and Sustainable Development” by M.F. Ashby, D. Ferrer-Balas and J. Segalas Coral, Butterworth Heinemann, Oxford (2015) and the White Paper with the same title, published by Granta Design, Cambridge ([www.Grantadesign.com](http://www.Grantadesign.com)).



## 2. Assessing a sustainable development

There are five steps.

**Step 1: Problem definition.** Any articulation of sustainability has an underlying motive that we will call its *Prime Objective*. If the articulation is going to make a difference it must act on a scale that is significant in comparison with that of the problem itself. Thus legislation requiring supermarkets to provide only bio-degradable plastic bags will make a difference only if plastic bags from supermarkets constitute a significant fraction of *all* plastic bags. Similarly, an articulation has a time scale. Insisting on bio-degradable bags within 12 months presupposes that the supply chain for the bio-degradable film used to make them can cope with the resulting demand within that time. It is not possible to judge the viability of the articulation without knowing how large it will be and how soon it should happen (Figure 2).

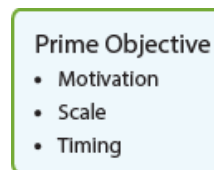


Figure 2. The articulation

The first step, then, is to *clarify the Prime Objective and its scale, physical and temporal*.

**Step 2: Identify stakeholders and their concerns.** Stakeholders are individuals, groups or organizations that are in any way affected by the articulation. Some, like the originators of the articulation in question, wish to see it succeed. Others may have reservations or voice outright opposition. It is important to identify the stakeholders and their concerns. If the concerns are not addressed the articulation will face obstacles and may fail to gain acceptance. If this happens the articulation is not sustainable.

How are stakeholders identified? The National Press can provide background: controversial articulations (building land-based wind farms, for instance, or fracking for shale gas) cause stakeholders to express their concerns through Editorials, News and Business reports, Letters to the Editor and commentaries in the Press and on radio and television. Ultimately, however, stakeholder concerns are best identified by face-to-face meetings, phone interviews or questionnaires.

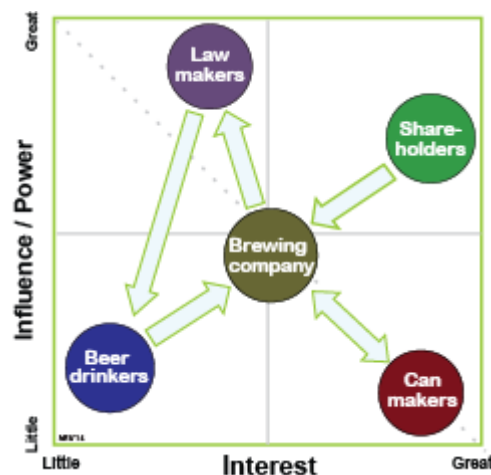


Figure 3. The stakeholder diagram with paths of influence.

Stakeholders differ in their level of interest and the influence or power that they can exert. Figure 3 is a diagram with Stakeholder Interest and Influence as axes. The likely behavior of a particular stakeholder depends, to some extent, on the position they occupy on this diagram. Once positioned, it is possible to reflect on the mutual influence or dependence of the stakeholders, shown here by arrows.

The second step, then, is to *identify the stakeholders and their concerns* – they set the context in which the assessment is carried out.

**Step 3: Fact finding.** To get further we need facts and facts need research (Figure 4). What sort of facts?

- Facts that establish what the articulation is and what materials and energy are required to make it happen. What environmental impact will it have? Is it legal? Are there regulations with which it must comply? Is it fair and equitable? What will it cost?

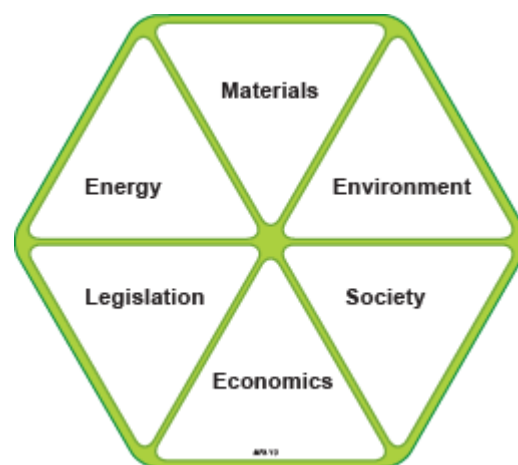
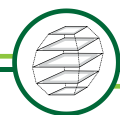


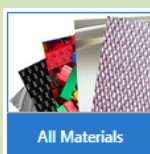
Figure 4. Fact-finding – an aid-memoire.



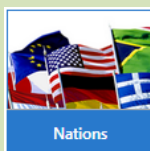
- Facts that relate to the stakeholder concerns. Are the concerns justified? What information is needed to confirm or refute them?
- Facts relating to essential infrastructure. What products or services will have to be in place to support the articulation if it goes ahead?

Each of these questions can be researched in an objective way using CES EduPack<sup>2</sup> and generally-available sources: books, databases and the Internet, guided by check-lists.

## Where can the CES EduPack Sustainable Development Edition help with Fact-finding?



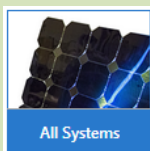
The Materials data-table contains property data for materials. It also contains eco-data for embodied energies and carbon footprints.



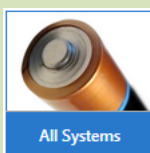
The Nations data-table provides background on the prosperity, environmental performance, and governance of countries from which materials might be sourced or products produced.



The Regulation data-table identifies government incentives and restrictions that relate packaging, waste, and the use of chemicals.



The Power Systems data-table contains data for the carbon footprint of both fossil fuels and low carbon electricity generating plants.

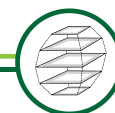


The Energy Storage data-table contains data that allows you to compare the efficiency of energy storage methods in different dimensions.

**Step 4: Synthesis.** The fourth step, *synthesis*, is one of drawing together the facts from Step 3 to form a balanced judgment about the impacts on the three capitals using color or (+) and (-) signs to indicate a positive or negative impact (Figure 5). Each capital has a base-value – its value today. The articulation, if implemented, will change these values.

It is here that values, culture, beliefs and ethics enter more strongly. An environmentalist might argue that the impact on natural capital ranked most highly: after all, the natural environment is the support system of all life. Humanist might see understanding, reason, humanity and happiness as the central pillars of a civilized society and feel that any impact on human capital was unacceptable. To an economist, economic stability and growth of manufactured capital could seem to be the first priority, arguing that these provide the resources

<sup>2</sup> CES EduPack, Granta Design, Cambridge, [www.grantadesign.com/education](http://www.grantadesign.com/education)

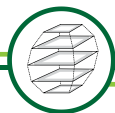


needed to protect the environment, enable innovation and support a vibrant society. Each of these groups recognizes the cases made by the others; indeed they have many concerns in common. But their final judgment will be influenced by their underlying beliefs and values, cultural, religious and political. It is no surprise that one set of facts can be interpreted in more than one way.

		<b>Human capital - People</b> Health? Wellbeing? Convenience? Culture? Tradition? Perceptions? Equality? Morality?	<b>Natural capital - Planet</b> <i>Can prime objective be met? Are stakeholder concerns addressed? Unintended consequences?</i>	<b>Manufactured capital - Prosperity</b> Cost – Benefit? (Cost facts vs. Eco facts) Legitimacy? Conformity with law?
The six sectors	<b>Materials</b>	(+) Fact 1 (-) Fact 2		
	<b>Energy</b>	(-) Fact 3	(+) Fact 3	(-) Fact 1 (-) Fact 3
	<b>Environment</b>		(+) Fact 3 (-) Fact 4	
	<b>Legislation</b>	(-) Fact 4		(+) Fact 4 (-) Fact 5
	<b>Economics</b>		(-) Fact 2	(-) Fact 6
	<b>Society</b>	(+) Fact 5 (+) Fact 6	(+) Fact 6	
<b>Synthesis</b> (the most telling facts)		<b>Net gain or loss?</b>	<b>Net gain or loss?</b>	<b>Net gain or loss?</b>

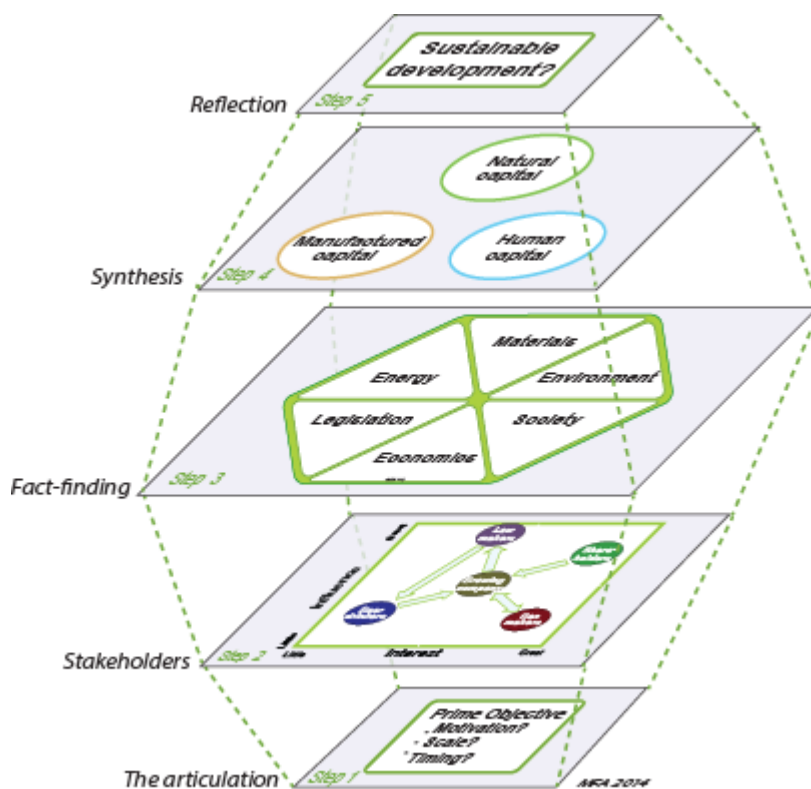
Figure 5 . The synthesis matrix

**Step 5: Reflection.** The fifth and last step is that of *reflection on alternatives*. Is the Prime Objective achieved? Is it achieved on a scale that makes a significant difference? Do the benefits to the three capitals outweigh the negative impacts? Have the stakeholders concerns been met? Can the analysis suggest a new, more productive, way of achieving the Prime Objective?



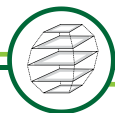
### 3. Assembling the layers

The layers are stacked in Figure 6 in the ascending sequence. The lower layers inform the ones above, so that the approach has a direction and a sequence. As explained earlier, the layer-based approach clearly separates the objective, fact-based aspects of the problem that can be explored in a systematic, scientific way from the more difficult value-based aspects. It encourages thinking about interaction within each layer, and gives a logical path to explore the interaction between layers.



**Figure 6.** The layered approach to analyzing an articulation of sustainable development.

The method developed here is illustrated in a set of Case Studies that illustrate its use for project-based teaching. Three of these are available from [www.teachingresources.grantadesign.com](http://www.teachingresources.grantadesign.com), the rest from the book cited on page 1.



## Sustainable Development Projects

### ■ Projects

- Project 1 : Greener Beer Cans
- Project 2 : Expanding Biopolymer Production
- Project 3 : Electric Cars

### ■ Resources

#### Students

- Problem statement
- Templates
- **Assessing Sustainable Development**

#### Educators

- Summary Presentation
- Sample Analysis
- Related Projects

A White Paper called Materials and Sustainable Development and a book of the same name describe this methodology and the rationale behind it in more detail.

[http://teachingresources.grantadesign.com/Edition/Sustainability\\_Development](http://teachingresources.grantadesign.com/Edition/Sustainability_Development)

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