

DESIGNERS AND SUSTAINABILITY

IVANA MAZÍNOVÁ

University of West Bohemia, Department of Machine Design
Czech Republic, Plzeň (Pilsen)
mazini@kks.zcu.cz

Abstract: The article deals with Sustainable Development from the point of view of the designer who selects materials for a given product. Is it possible to objectively assess the impact of our actions on the environment 100 years from now? One of possible methods for assessing the impact of the selection of materials on the environment is given in the case study.

Keywords: *Sustainability; Triple Bottom Line accounting; analysing sustainable developments; Corporate Social Responsibility*

1. Introduction

The concept of sustainable development is understood in different ways by different people, often depending on their needs for pursuing their own interests. Some politicians abuse the term for political purposes, and some large corporations use the term ‘sustainability’ only for purposes of growing their business. On the other hand oil companies understand the term sustainable development in relation to their future as a ‘time after oil’. Generally it can be said that the majority of people think of sustainability as the unlimited use of all available technologies for the growth of gross domestic product whilst reducing the undesirable effects on the environment (for example, reduction of carbon emissions). And then there are those who do not trust this approach, who see the free market as the cause of environmental problems, which is the continuous driving force behind the growing threat to an unsustainable future. Sustainable development is seen as equilibrium, not growth. Between these two points of view there are many other opinions. We are living at a time when neither conclusive proof – nor one side of the argument, can be obtained – only time will tell.

2. Sustainability

So what then is sustainability? It depends on your point of view – the scale, whether it is local or global, and the time frame – whether it is weeks, years, or centuries.

Sustainable development is a means of developing human society which is carried out in agreement with economic and social progress whilst fully preserving the environment. The main objective of sustainable development includes the preservation of the environment for future generations with as little change as possible. The principles of sustainability are set out in standard CSN 01 0391, which was released in October 2013, entitled ‘Corporate social responsibility management system – Requirements’ [4]. The introduction of this standard states:

‘Specifically, the integration of social responsibility manifests itself by integration of positive attitudes, practices and programmes into an organization’s strategy at the level of top management. It requires a shift in the view of their social role from the level of “profit

only” to a broader perspective in the context of the often-mentioned three pillars “P” – People – Planet – Profit’.

Unfortunately many firms see social responsibility as a fashionable trend a means for self-promotion.

The Figure 1 shows sustainability represented as the ‘Triple Bottom Line’.

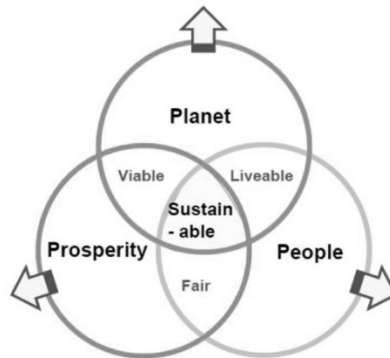


Figure 1. Triple Bottom Line [5]

This apparently simple diagram is very hard to implement in practice. It demands a detailed analysis of single actions (‘articulations’) in a system and a subsequent synthesis of the facts and, most significantly, a large dose of common sense.

How should engineers approach the issue of sustainability? What and how should we teach students? Thanks to a certain Czech president (and not only him), the overwhelming opinion in the Czech Republic is that there is no threat. Technical specialists tend to see this issue as something for philosophers. Questions such as the following are regarded by technical specialists as, at the very least, strange:

How long can economic growth, which is always exponential, be sustainable?

Is strong economic growth compatible with the needs of today’s and future population?

Is sustainable development (in the context of the continuously widening gap between rich and poor countries) actually achievable?

And is it really in our interests to worry about what comes after us?

3. Sustainability from the viewpoint of engineers

I would like to share with you a rational analysis of sustainability issues, conducted by Professor Ashby et al. from the perspective of material selection [5]. How is it done? By separating the rings and developing their meaning (Figure 2).

There are many different proposals (‘articulations’) that are used to promote a ‘Sustainable Development’. Proposals are submitted from various stakeholders. Among the stakeholders include governments, the public, local communities, owners, manufacturers, suppliers, trade unions, customers, lobbyists, investors, national press, managers. They have their interests and their power of influence. Thereby get their proposals logically into conflict. Due to the length of the contribution skip lists the main proposals of individual stakeholders. Their interests can be derived following main categories (meaning still in terms of material selection):

- Materials(manufacture supply chain, life cycle)
- Environment(carbon release, air, water, land)
- Design-energy (energy efficiency, function, performance, safety)
- Legislation(awareness, compliance, reporting)
- Society(social equity, education, health)
- Economics (cost, benefit).

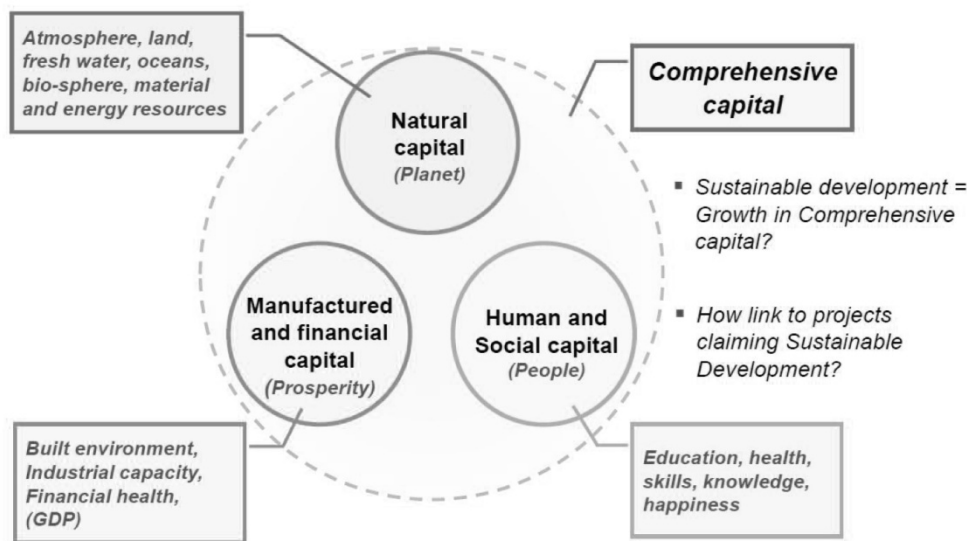


Figure 2. Macro-economic view: the Three Capitals [5]

Individual proposals (“articulations”) of stakeholders must be systematically explored. Generally, you can define a method to assess the sustainability of these five steps:

- Step 1: Clarify objective
- Step 2: Stakeholders analysis
- Step 3: Fact finding (objective)
- Step 4: Debate impact (subjective)
- Step 5: Reflection

4. Case study: the electric car

Practical application of the method is demonstrated on the electric car. Is the electric car sustainable?

Step 1: Clarify objective

Based on these facts (background): Global car production is 60 million units per year; 15% of CO₂ release comes from car; Governments targets are 10% electric by 2020. Prime objective is decarbonize road transport. Scale is 8 million cars/year by 2020.

Step 2: Stakeholders and concerns

- National and local government – carbon targets
- Car makers and distributors – sales
- Battery makers – supply chain, recycling
- Labour Unions – employment, rights
- Drivers, Automobile Association – range anxiety, cost
- Environmental campaigners – carbon footprint

Battery makers have strongest influence and greatest interest.

Step 3: Fact finding

The strongest stakeholder interests split into major categories stakeholder interests, which have been described above:

- Material supply chain – Lithium
- Energy – batteries
- Legislation – battery directive
- Environment – CO₂ footprint
- Society – range anxiety
- Economics – acceptance of cost

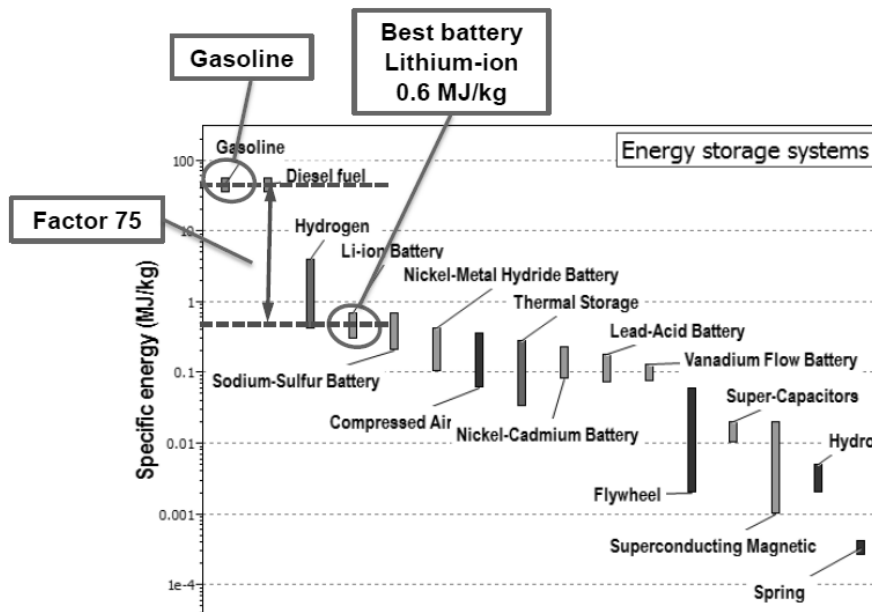


Figure 3. Bar chart – Energy storage systems [2]

Material – Consumption per car is 7.3 kg Lithium, if the goal of 8 million cars per year, consumption is 58,400 tons per year Lithium. Annual world production of Lithium in 2011 was 34,000 tons. From these facts it follows that the requirement for 2020 would be 160% of current world production.

Energy – What are alternative batteries? Bar chart in Figure 2 created using the CES software (link) shows the energy density of materials. The graph shows that the Lithium-ion battery has the highest energy capacity. Energy density of batteries is much smaller than gasoline.

Regulation – EU battery directive is no batteries to landfill.

Society and stakeholders concerns – The travelling distance is limited by the battery weight and cost. 500 km range requires more than half tonne Li-on battery. It follows that battery weight is proximately 1 kg/km. Cost at todays prices \$42,000 (<http://evobsession.com/electric-cars-2014-list/>)

Environment – Can prime objective be met? Will be decarbonizes road transport?

The battery must be recharged from the National Grid (gas/coal fired) – the carbon footprint resulting in the production of electricity from gas is 140 g/MJ.

Delivered energy to propel small car is 0.6 MJ/km.

Efficiency of battery – electric motor set is 85%.

It follows that carbon footprint of electric car is $140 \times 0.6 / 0.85 \approx 100$ g/km.

Step 4: Impact on the three capitals

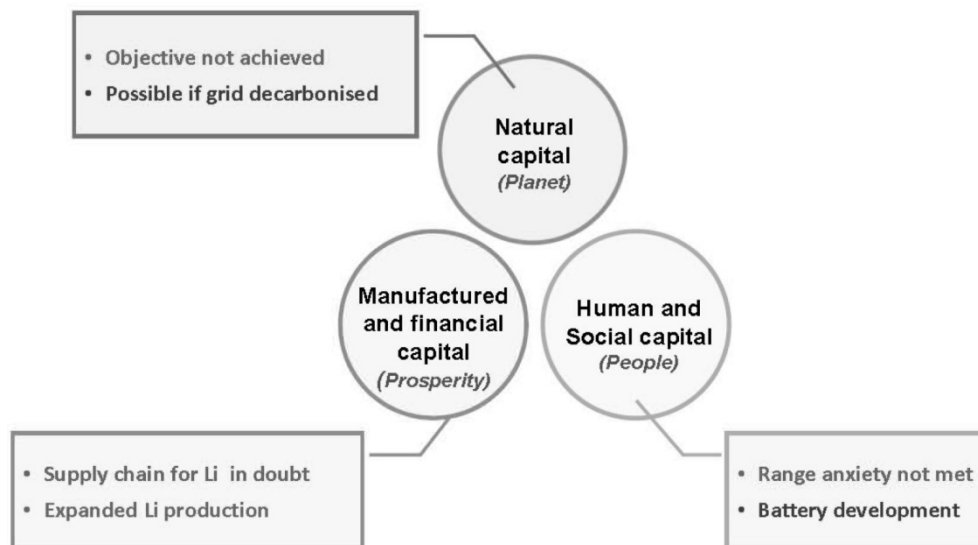


Figure 4. Assessment impacts [5]

Planet – the prime objective will not be met without grid decarbonized.

Prosperity – now is inadequate infrastructure for the production and recycling of Lithium.

People – their expectations of range anxiety are not currently met.

Step 5: Reflection

The issue of electric vehicles can be seen in the short-term (7 years), in this case, the electric car are not sustainable. In long-term (25 years), it is necessary to establish the infrastructure. Alternative strategy (for sustainability) is rethink car use.

5. Conclusion

Designers should not think about the design of the product only from a technical point of view, but in a broader context, as indicated in this contribution.

6. Acknowledgement

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