Environmental tools as support of sustainable development

Chapter 17

ENVIRONMENTAL TOOLS AS SUPPORT OF SUSTAINABLE DEVELOPMENT

Valentina GECEVSKA, Fulvia CHIAMPO, Demos ANGELIDES, Franc CUS, Franco LOMBARDI

1. INTRODUCTION

The purpose of this chapter is to identify existing strands of research in the area of sustainability and the role of environmental tools with application in order to accomplish sustainable development. In particular, the analysis focuses on the available tools that the research community can provide to support sustainable development.

The first category of tools includes analytical methods and is based on model analysis, scenario analysis and risk analysis. The second one relies on procedural methods mainly referred to liability commitment or EU recognition. Since complexity is high, multiple diverse approaches are needed, including both analytical and procedural methods.

The following sections, first provide an insight on Sustainable Development, including an overview of its idea, iindicators, and then describe the tools that can help in identifying environmental sustainability. Finally, the possible tools application matrix is illustrated.

Considering the enormity of the topic, it is clear that there are a lot of subtopics that should be included, and it is enormously work, so this chapter will give a few notes of the concept of environmental sustainability, environmental tools and possible application. Some methods, procedural and analytical tools will be recommended in order to accomplish well – being aspects taking concrete steps and rolls of the participants in the production – consumption system.

Valenina GECEVSKA, Faculty of Mechanical Engineering, University Ss.Cyril and Methodius, Karpos II bb, Skopje, 1000, MACEDONIA, valentina.gecevska@mf.edu.mk; Fulvia CHIAMPO, Politecnico di Torino, Corso Duca degli Abruzzi 24, Torino, ITALY, fulvia.chiampo@polito.it; Demos ANGELIDES, Aristotle University in Thessaloniki, GREECE, dangelid@auth.gr; Franc CUS, Faculty of Mechanical Engineering, University of Maribor, Smetanova 17, Maribor, SLOVENIA, franc. cus@um.si; Franco LOMBARDI, Politecnico di Torino, Torino, ITALY, franco.lombardi@polito.it.

2. SUSTAINABLE DEVELOPMENT

The concept of *sustainable development* was introduced for the first time, by the World Commission for Environment and Development (WCED) in 1987 in a document entitled *Our Common Future*. Referring to the human well – being connection with the environment, sustainable development was defining as: *sustainable development is development that meets the needs of the present without compromising the ability of future generation to meet their own needs.*

This has implicated very important fundamental ethical principle – the responsibility of the present generations to the future generation. Combining the term “development” with adjective “sustainable” has resulted in an enormously important implication: it has pinpointed the impossibility of continuing with the currently indisputable idea of development, unique development without any adjectives.

2.1 Why Sustainable Development

In the past decades, there have seen provided unstable development in the world dimensions. Every day, there is increasing loads for the earth, suffering from the consequences of: climate change, inappropriate use of the resources and environmental systems instability, and increasing biodiversity loss.

A world disfigured by poverty and inequality is unsustainable. While increasing wealth is causing depletion of environmental resources, extreme poverty can leave people without access to necessary natural resources and a healthy environment. This is visible in three areas of life: social, economic, environmental, that gives the need for this concept to be developed and implemented to provide more secure future and to make decisive move towards real progress that is more sustainable, having a long – term interest for all nations in the world.

2.2 What is Sustainable Development

According to the WCED, sustainable development implies economic growth together with the protection of environmental quality, each reinforcing the other. Sustainable development does not focus solely on environmental issues. More broadly, sustainable development policies encompass three general policy areas: economic, environmental and social, (shown on Fig.1). Several United Nations documents refer to the "interdependent and mutually reinforcing pillars" of sustainable development as economic development, social development, and environmental protection.

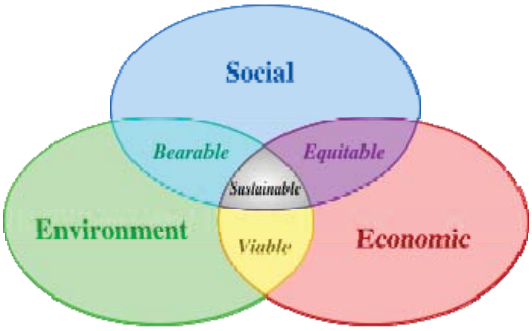

Fig. 1 *Scheme of sustainable development: at the confluence of three preoccupations [1]*

The essence of this form of development is a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life, at least as good as our own. Sustainable development is maintaining a delicate balance between the human need to improve lifestyles and feeling of well - being on one hand, and preserving natural resources and ecosystems, on which we and future generations depend, as shown on Fig. 2 [2]. The guiding principles are that people must share with each other, equally as possible, and take care for the Earth resources and ecosystems. This can be accomplished with common benefits for the nature and for industry development if there is sustainable development in all areas equally.

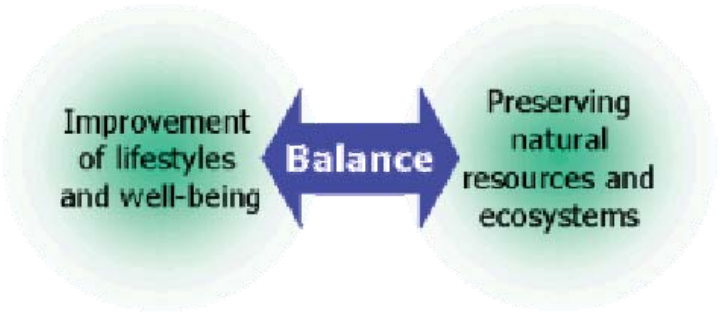

Fig. 2 *Sustainable development balance [2]*

2.3 Sustainable Development Indicators

Indicators are measures that are quantifying and measuring progress towards sustainable development in an effective way [9]. They help to create a verification of the meaning of sustainable development in everyday life – its implementation, maintenance, progress and continual improvements.

The UK Government used 15 ‘headline’ sustainable development indicators to track progress in the UK. The Government reported on the performance of these indicators in its annual *Achieving a Better Quality of Life* reports [3] in order “to ensure more rapid movement towards sustainability”. They

recommended that the Government brought forward a new, better, set of headline indicators with:

- key priorities that better reflected sustainability principles and policy;
- a radically different approach to measuring economic progress;
- challenging targets as to how they should move over time; and
- more effective machinery for acting on adverse trends.

The new UK Government Sustainable Development Strategy "Securing the Future" has the some way in meeting this challenge. It contains 68 indicators - 20 UK Framework indicators and a further 48 indicators to monitor progress. An extensive range of economic, social and environmental indicators are compiled by UK Government Sustainable Development Strategy to provide a statistical overview of the country's progress and to provide an overview of progress across four themes:

- Sustainable consumption and production,
- Climate change and energy,
- Protecting natural resources and enhancing the environment,
- Creating sustainable communities.

3. METHODS AND TOOLS FOR ENVIRONMENTAL SUSTAINABILITY

Decisions for environmental sustainability must consider appropriate information for the real situation in the environmental field, in order to make adequate decision. This is the reason for using the right instruments for analysis.

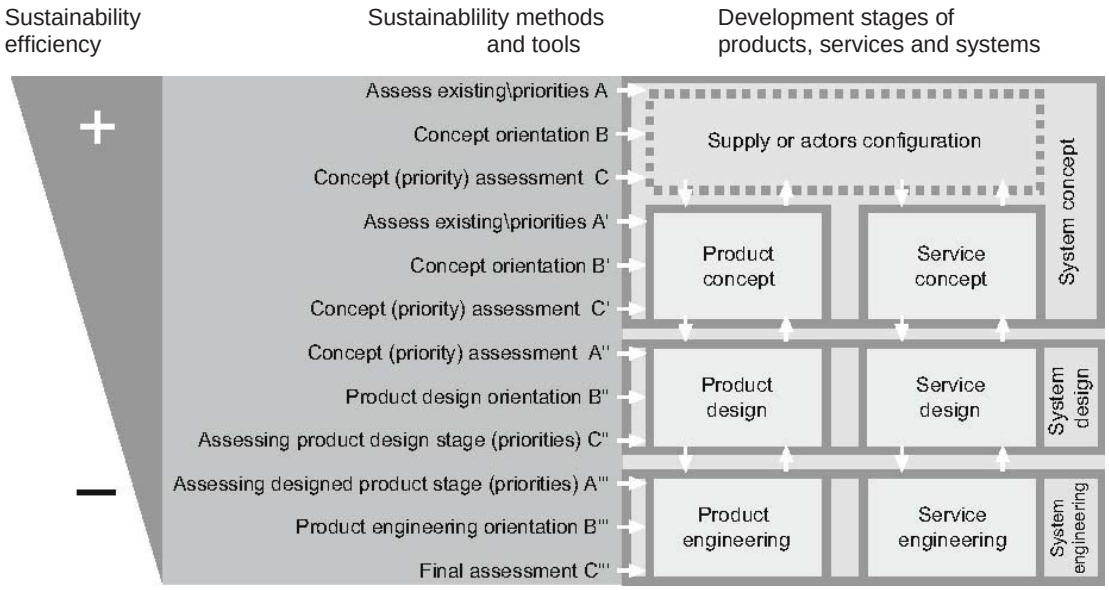

Fig. 3. *Sustainability methods and tools efficiency [4]*

There are different support tools in decision making process that could be useful and they are depended from the stages of the product, service or system, as it's shown in the Fig. 3.

In Fig. 3 there are three development stages that define product, service or system: the concept, design an executive project and engineering. This scheme describes product design, but could represent equally service development or in the more complex case of system development, which takes into account simultaneously different products and services along with the stakeholder configuration – their interactions really.

These methods and tools have been developed to solve at least three specific objectives and support the environmental sustainability decisions:

- In assessing the existing system and identifying the priorities;
- In orientating the decisions towards greater sustainability;
- In estimating the possible improvements, in sustainability terms, of ongoing development.

Development and continual improvement of methods and tools has objective to be included in sustainable product design in all stages of development process.

To integrate the sustainability requirements – the appropriate methods and tools – during the primary development stages becomes more effective (Fig. 3). It is exactly during these stages that some more influential decisions are determined. The obtainable degree of innovation would be greater and so would be the potential for reducing environmental impact.

In order to define the design priorities towards sustainability, certain products should consider the requirements for functionality and characteristics, as well as its environmental profile through environmental impact.

3.1 Environmental analytical and procedural tools towards sustainable development

The sustainable development concepts developed to direct environmental management, is quite abstract. This is why we need tools to transfer them into action and make environmental aspects more concrete, taking into account economical, social and technological information.
There are three kinds of tools: political instruments, procedural tools and analytical tools and in this chapter will be briefly defined analytical and procedural ones. The application of these tools provides consistent environmental information that facilitates adequate decision-making toward sustainable development.

3.1.1 Analytical tools

The following analytical tools are relevant methods for environmental management:

1. ***Design for environment (DfE)*** is concept that is used in the field of environmentally friendly product (re) design and development. DfE employs a variety of design approaches that attempt to reduce the overall human health and environmental impact of a product, process or service, where impacts are considered across its life cycle.[5]

2. ***Life Cycle Assessment (LCA)*** is a technique to assess each and every impact associated with all the stages of a process from cradle – to - grave (i.e., from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).

3. ***Environmental Risk Assessment (ERA)*** is a process for assessment of the negative effects or risks on human health or the environment as a result of exposure to one or more physical, chemical or biological agents [5].

4. ***Impact Pathway Analysis (IPA)*** estimates the overall damage, quantifying impacts, taking account of the sensitivity of receptors, and then monetize then (where possible) using the best scientific data and methods available.

5. ***The cost - effectiveness analysis (CEA)*** concerns assessment of the most – effective way comparing internal costs i.e., costs resulting from the emission reduction technologies, to the reduction of the environmental load due to the economic investment.

6. ***Cost-benefit analysis (CBA)*** is economic tool intended to provide decision - making support for long - term investments, investigating the relationship between costs and benefits [6]. The field for its application includes the environmental selection of technologies and legislation strategies, so that on the sustainable development sphere, the main objective is that external effects are considered as external costs.

7. ***Material Flow Accounting (MFA)*** refers to accounting in physical units (usually in tons); the extraction, production, transformation, consumption, recycling and deposition of materials in a given location (i.e., substances, raw materials, products,wastes, emissions into the air, water or soil).

8. Within the range of the present work, MFA encompasses methods such as ***substance flow analysis (SFA)*** and other types of balance of materials for a given region.

9. ***Input – output analysis (IOA)*** in environmental field describes the inputs of various natural resources and/or outputs of various emissions and wastes along the commodity production chains to determine the cumulative environmental pressures associated with a given commodity demand.

3.1.2 Procedural tools

The following procedural tools are relevant methods for environmental management:

1. ***Environmental Impact Assessment (EIA),*** as stated in the definition by the European Directives on EIA) is a set of research papers and technical systems used to estimate the effects on the environment of implementing a given project, work or activity [7]. Thus EIA is an analytical procedure oriented to determine objectively the consequences of impacts derived from a given activity on the environment.

2. ***Eco - Management and Audit Scheme (EMAS)*** is an EU – based system related to Council Regulation (EEC) 1836/93, management tool for continuously improvement of environmental aspects in business [8]. Internationally it corresponds in many features to ISO 14001, although the latter does not have the same recognition as that of the environmental authorities.

3. ***Eco - labeling*** is a system to guarantee the environmental quality of certain properties or characteristics of the products that obtain the eco-label. An "eco-label" is a label which identifies overall environmental preference of a product or service within a specific product/service category based on life cycle considerations [9].

3.3 Environmental tools application towards sustainable development

Applications of environmental (analytical and procedural) tools for sustainable development are site specificity, time scale and need for certainty, transparency and documentation [9]. Possible applications can be positioned in relation to these governing dimensions. In the Table 1, there are shown about 7 possible

applications areas, in which environmental tools could be used as tools for sustainable development, shown in tab. 1.

1. **Product development and improvement.** The concept used in the field of environmentally friendly product (re) design and development is called design for the environment (DfE). LCA provides the information to support it.

2. **Production technology assessment.** Some tools are helpfull to ensure that overall reductions are achieved and pollutants are not shifted elsewhere in the life-cycle (LCA) and other tools are needed for the assessment of the actual impacts of the technology (EIA).

3. **Strategic planning for a product or service line in business.** Strategic planning process could be assess with sustainable development tools providing economic and risk information.

4. **Public policy and legislation planning.** Studies can provide information for all relevant environmental aspects. Results will show the need of decreasing of the potential impacts.

5. **Environmentally friendly purchasing support.** Sustainable development tools can contribute in eco - labeling, giving information about emissions and resource indicators of sustainable performance.

6. **Marketing strategies.** By using Sustainable Development tools it is possible to develop an environmental profile of a product or service that can be communicated to the consumers.
7. **Environmental performance and liability evaluation.** The combination of an environmental management system with LCA is an interesting topic for the future. For this reason, it is necessary to use the same pressure and management indicators.

Table 1. *Tools application in environmental management and sustainable development practices*

	Application	**Applicable tool (s)**
1.	Product development and improvement	- DfE, DM & DT; - LCA
2.	Production technology assessment	- CBA, IPA - ERA, EIA - LCA

3.	Strategic planning for a product or service line in business	- CEA - ERA - MFA, SFA - LCA
4.	Public policy and legislation planning	- IOA - CEA - CBA, IPA - ERA, EIA - SFA, MFA
5.	Environmental friendly purchasing support	- IPA, EMA - ELG
6.	Marketing strategies	- LCA
7.	Environmental performance and liability evaluation	- EMA; LCA

Legend: 1. **CBA**: Cost - Benefit Analysis; 2. **EIA**: Environmental Impact Assessment; 3. **IOA**:Input - Output Analysis; 4. **CEA**: Cost - Effectiveness Analysis; 5. **ELG**: Eco - labelling; 6. **IPA**: Impact Pathway Analysis; 7. **DfE**:Design for Environment; 8. **ERA**: Environmental Risk Assessment; 9. **LCA**: Life-Cycle Assessment; 10. **DM**: Dematerialization; 11. **EMA**: Environmental Management; 12. **MFA**: Material Flow Accounting; 13. **DT**: Detoxification and Audit; 14. **SFA**: Substance Flow Analysis

4. Conclusion

The assessment and the decision-making process are two separate but mutually influencing activities and that the assessment needs to start at an early stage of the decision-making process in order to be effective.

It also illustrates that impacts related to the three dimensions of sustainability are not captured completely by all sustainability tools. There is a need to use combine tools in any place that is possible, in order to get a full picture for sustainable development possibilities.

The tools have to make assessment with providing a set of quantitative and qualitative variables on both positive and negative impacts that will guide and support policy-makers in taking decisions.

Before comparing the costs and benefits of a policy proposal, the impacts should be estimated. This is done with the help of specific tools, both quantitative and qualitative. Concerning the demand for developing such tools and instruments that are case – specific, according to the producer or product, it could be said that the methods, tools and general information on the design for environmental sustainability have their importance on a theoretical level, but might become more efficient if they are transformed according to specific design contexts. Here, contexts refer to both commodity sectors and socio-economic-environmental characteristics of a certain space/locality.

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