

## **A FRAMEWORK OF INDUSTRIAL SUSTAINABILITY GOOD PRACTICES**

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### **ABSTRACT**

Global environmental problems, energy and raw material prices as well as their availability, increasingly demanding legislation and environmental taxes are some of the reasons that drive the consideration of sustainability concepts and practices into company operations. This paper presents the research carried out in order to capture industrial sustainability good practices and represent them into a framework to help companies increase their awareness and adopt practices to embed them within their operational processes.

**Keywords:** Sustainability, Industrial Framework, Best Practices.

### **1. INTRODUCTION**

Climate change, the unbalanced use of natural resources, extinction of many animal species caused by emissions and waste are results of unsustainable practices of consumption and production. This is a real threat to the global environment as well as to welfare. Traditionally, businesses were exclusively focused on generating revenue, not considering the impact of their activities on the environment. Adopting, sharing and continuously improving sustainability practices are the solutions to gain competitive advantages from environmental, economic and social points of view. This paper presents the research work undertaken to develop a framework of sustainability good practices with the aim to make such practices available in order to embed them within operational processes. This would reinforce commitment in supporting the global environment while maintaining their competitive advantage.

The research followed the methodology of three main phases as follows:

- 1) Synthesis of the good practices through intensive literature review
- 2) Performing industrial field studies by conducting face-to-face or telephone interviews
- 3) Development of a sustainability good practice framework.

### **2. IDENTIFICATION OF SUSTAINABILITY GOOD PRACTICES IN THE LITERATURE**

Sustainable development is defined as ‘the development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (Brundtland 1987). The main three pillars for sustainable development are economic prosperity, environmental quality and social equity, which need to be pursued simultaneously. 90 sustainability good practices were captured from the literature which are guidelines for this industrial field study. These are energy management,

community involvement, workforce culture, direct productivity enhancement, supply chain management, standards and regulations, decision tools as well as waste minimisation, and pollution prevention. Kutz (2007) presented many good practices regarding electrical power, combustion systems, thermal systems, motor systems, and maintenance and equipment control. Wang et al. (2006) focused their research on the categories of good practices related to the area of waste minimisation and pollution prevention, such as alternative fuels, abatement systems and waste treatments. In contrast, Beaufort-Jones et al. (2008) researched fuel generation from waste, water use and treatment, equipment control, alternative energy sources, and specially lighting, facility design and workforce culture. Other sources employed for the sustainability good practices synthesis were Ecocycle (2000), Rehan and Nehdi (2005) and the European Environmental Agency (2008).

### 3. SEMI-STRUCTURED SUSTAINABILITY QUESTIONNAIRE

A semi-structured questionnaire had been developed using the results of the literature review. Further information was collected from the ten participating companies' (Table 1) websites and published reports focusing on Environmental Health and Safety (EHS) and corporate reports.

Table 1: Industrial collaborators.

Company	Data collection method
Caltec - Service provider for the oil and gas industry	<ul style="list-style-type: none"> <li>• Face-to-face interview - Technical Director</li> <li>• Information from the company website</li> </ul>
British Waterways - Managing canals and rivers	<ul style="list-style-type: none"> <li>• Face-to-face interviews - environmental scientists and managers</li> <li>• Information from the company website and documentation</li> </ul>
Xerox - Document management	<ul style="list-style-type: none"> <li>• Face-to-face interview - Design Manager</li> </ul>
Aerospace	<ul style="list-style-type: none"> <li>• Observation</li> </ul>
Metsec - Cold roll-forming	<ul style="list-style-type: none"> <li>• Face-to-face interview - Quality Manager</li> </ul>
GlaxoSmithKline - Pharmaceutical	<ul style="list-style-type: none"> <li>• Telephone interview - Environmental H&amp;S Product Stewardship member</li> <li>• Information from the company website</li> </ul>
Edwards vacuum - Vacuum and exhaust management equipment	<ul style="list-style-type: none"> <li>• Telephone interview - Quality Manager</li> <li>• Information from the company website</li> </ul>
BHR Group - Research and consultancy	<ul style="list-style-type: none"> <li>• Face to face interview - Senior Project and Engineering Manager</li> <li>• Information from the company website</li> </ul>
Analytical instruments manufacturer	<ul style="list-style-type: none"> <li>• Face to face interview - Senior engineer responsible for the new environmental initiative</li> </ul>
CEMEX - Cement producer	<ul style="list-style-type: none"> <li>• Face to face interviews - senior and middle managers</li> <li>• Visits to two production plants in Spain and the UK</li> </ul>

The authors customised the questionnaire to suit different large companies. It was divided into the following key areas:

- 1) Energy Efficiency
- 2) Emissions, Waste and Wastewater Management
- 3) Standards / Legislation
- 4) General Enterprise Sustainability Practices
- 5) Health and Safety
- 6) Product Design Engineering and Development
- 7) Manufacturing Engineering.

An example question is the following:

**“Do you reuse the residual heat from the processes (to produce steam, preheat combustion air, heat the plant, etc)?”**

Also, details about the specific practices detected in the company were enquired as the example shows:

**“How do you reuse waste from the internal processes? The Company information stated that Waste-Free factory policy has increased the recycling rates by 90%; can you provide any specific measure that helped to obtain those results?”**

The company reports were also a source of good practices used for the generation of the sustainability framework illustrated in Figure 2. As the next step six face-to-face and three telephone interviews took place with four visits to the manufacturing or test facilities.

#### **4. A FRAMEWORK OF INDUSTRIAL SUSTAINABILITY GOOD PRACTICES**

The sustainability good practice framework was generated from the data acquired in the industrial field studies, and it consists of nine main sustainability areas which are the following:

- **Energy Efficiency:** represents one third of the sustainability good practices acquired and consists of machinery/processes, facilities, heat use/recovery, and organisational initiatives;
- **Emissions, Waste and Wastewater:** how to reduce, re-use and recycle internal wastes. In addition, examples of the use of recycled materials and external waste, initiatives to reduce water consumption, and initiatives on how to reduce and control waste, were also captured. An examples is developing a guide/workbook for waste reduction and recycling; Decision Tools and Improvement Programmes: includes approaches to implement decision/assessment tools such as LCA and EIA or managerial initiatives: using lean six-sigma programmes to increase energy efficiency;
- **Decision Tools and Improvement Programmes:** In this area, examples of improvement programmes regarding sustainability issues are provided as well as approaches to implement decision/assessment tools such as LCA and EIA. For example: 1) Using lean six-sigma programmes to increase energy efficiency, 2) Developing a web-based system to share cost saving and environmental improvement ideas among the geographically distributed companies;
- **Standards, Legislation and Regulators:** these practices describe ways to deal with regulators and fulfil standards so that the company improves its sustainability performance. One good practice that was captured is implementing cleaner technologies which lead to receiving incentives and recognition from the government as well as addressing the social and environmental issues at lower cost;
- **Health and Safety:** tools, assessments, management of initiatives and programmes to improve the health and safety of the employees. An example is a system available for employees to report any hazard related to work. As soon as a hazard is reported an engineer is assigned to address and solve the hazard within 30 days; if this does not happen, then it is considered a negative result against the site. The ‘lead safe programme,’ where staff is asked to upload onto the intranet at least one proactive measure a month regarding safety and environmental improvements. This is then to be shared by all. Implement internal guidelines and policies in the production sites to use proper equipment. Motivate its employees to eat healthy, sleep well and do exercise at least twice a week;
- **Supply Chain Management:** to reduce the impact of the company along the whole supply chain: the re-use of containers with the suppliers, or provide company’s expertise regarding energy efficiency to the suppliers;
- **Community Involvement:** initiatives with schools, universities, etc.: a company having its laboratories in a university in order to have mutual benefits in terms of cost, use of the facilities and generation of knowledge through the use of the lab by research students, as well as providing future human resources to the companies with the right skills. General Business Practices represent the corporate good practices that did not fit in the previously described areas, Formal meetings performed twice a year with information sharing purposes, involving key people from the environmental/sustainability area of the site and their equivalents in other business units, Creating an ‘Environmental Advisory Board’ to review the current practices and provide practical recommendations. The members of such a board are invited from universities, research and development centres, environment agencies, local government, etc.;
- **Product Development:** embedding sustainability in the product development stage: sustainability and environmental toll gates. The applications of design for X where X could stand for environment, re-use, recycling, services and safety, and Sustainability and environmental toll gates

to ensure the detail consideration of these issues during product development including the less use of material and energy.

This stage of the research has captured around 157 sustainable good practices. Only 25% of the captured good practices were obtained from the published reports, the remaining from the interviews. The distribution of good practices can be seen in Figure 1.

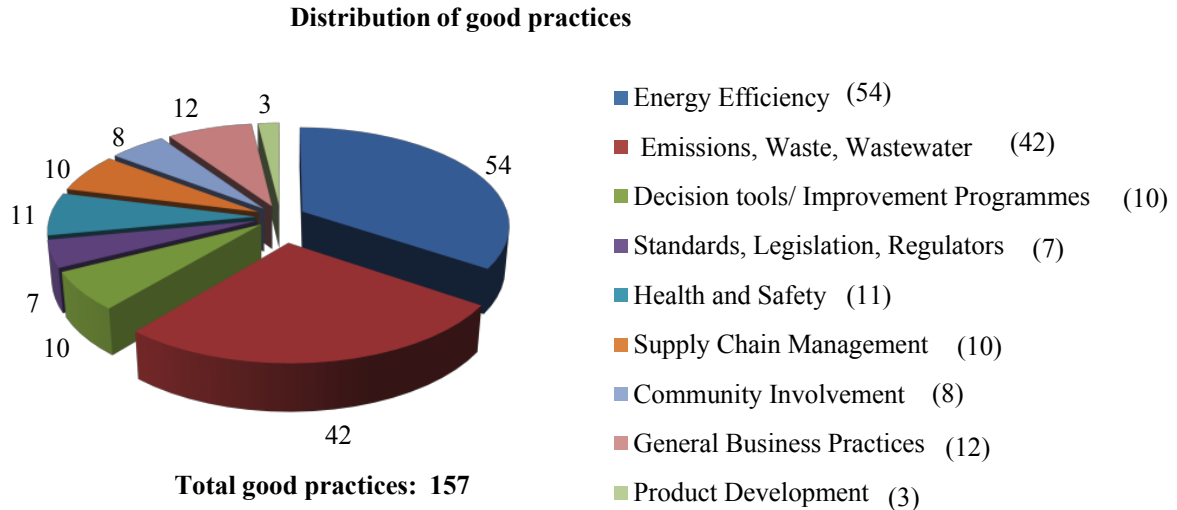


Figure 1: The distribution of the good practices among the nine main sustainable areas.

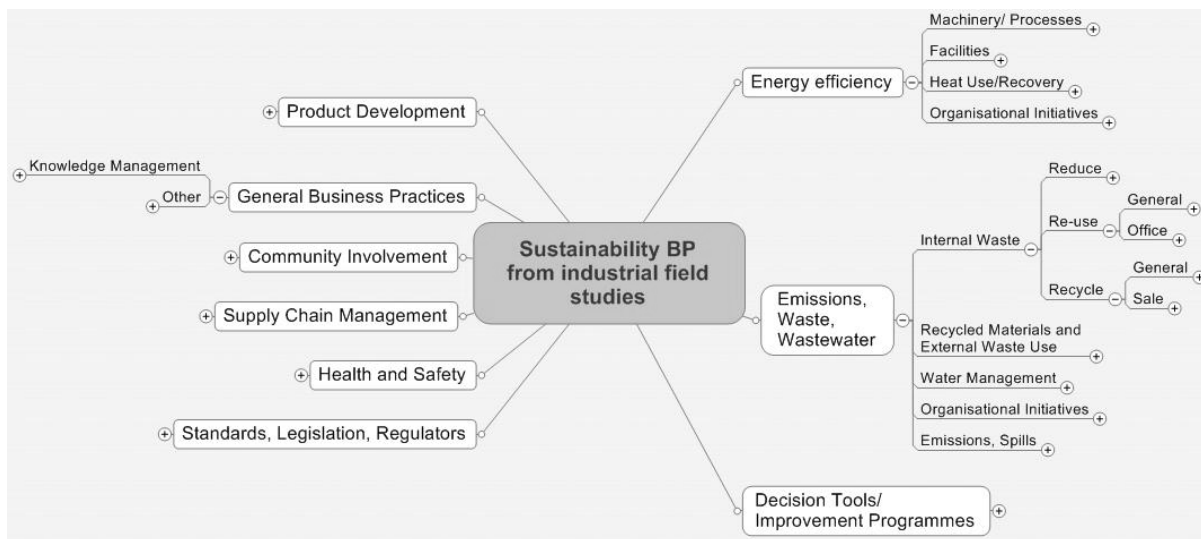


Figure 2: Sustainability good practices Framework - 1<sup>st</sup> and 2<sup>nd</sup> layers.

More than half of the sustainability good practices aimed at two areas: ‘Energy Efficiency’ and ‘Emissions, Waste and Wastewater management’. This clearly shows the attention that the industry is paying to the areas that have a major impact on the environment. A graphical representation of the framework is shown below as layers 1 and 2 (Figure 2) and as layer 3 and 4 (Figure 3) from the “Energy Efficiency” area. The first layer shows the name of the library and the nine main areas of good practices, the second layer the sub-topic structure of good practices inside each main area, the third layer relates to the Sustainability good practices titles and the corresponding brief explanation, and the fourth layer gives detailed examples of the good practices as employed by the company. The form could be text note, PDF file, table, photos.

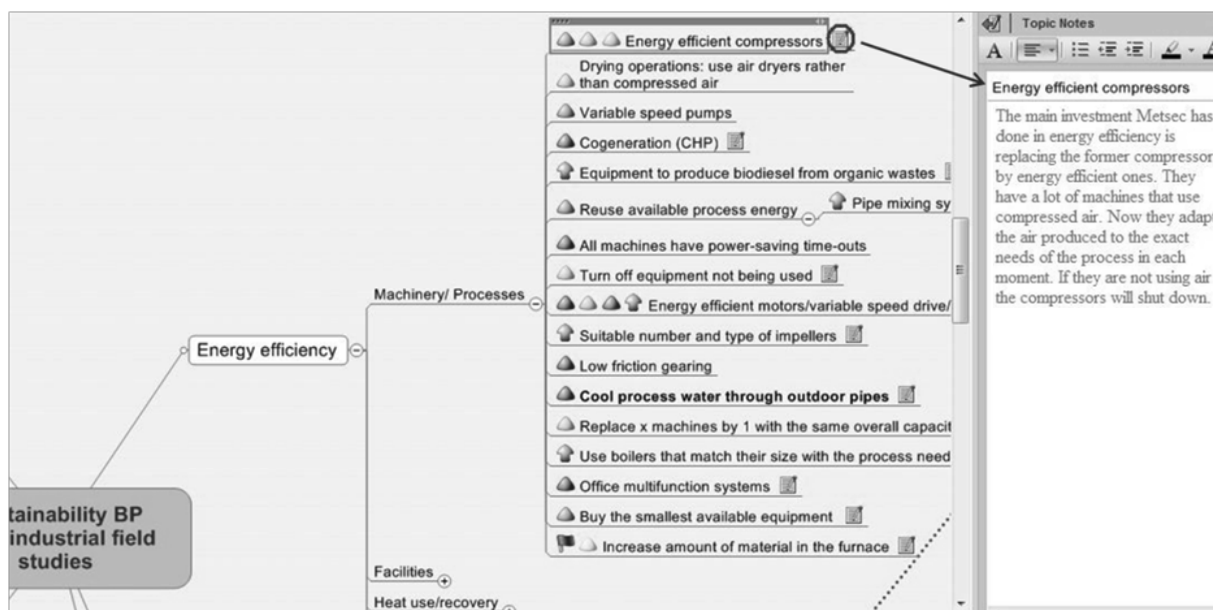


Figure 3: Snapshot of layer 3 and 4 from the “Energy Efficiency” area.

## 5. CONCLUSIONS AND FUTURE PLAN

Findings of this research show that the included industries pay a great attention to sustainability issues. The study shows that the implementation of the sustainability good practices is an on-going issue in many companies. Companies lack an efficient system for managing sustainability good practices within the business. The presented cross-sector sustainability good practices framework is a tool with potential use across all industry. The questionnaires developed in this project can be employed as a base for conducting more industrial field studies. Future plan is to involve acquiring and generating quantitative data regarding the good practices implementation in order to add value to the presented work.

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