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SELF-EVALUATING AND BENCHMARKING ENVIRONMENTAL PERFORMANCE OF BUSINESSES: A WEB-BASED APPROACH

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ABSTRACT

A Web-node has been created in order to address the specific needs of the small and medium enterprises (SMEs) of three important economic areas in the Mediterranean region, the food, textile and hotel sectors. The node provides important information on the market structure in the relevant sectors, environmental technology issues and legislation, as well as Diagnostic Tools allowing the self-evaluation and benchmarking of SME's environmental performance.

Environmental performance is evaluated on the basis of the business operational data. A limited set of environmental indicators is being calculated, and performance is compared to that of its business competitors, as well as to international standards and "*Best Available Techniques*".

The diagnosis procedure identifies potential environmental problems in the daily operation of the companies. The system suggests actions of minor and/or greater cost which could improve environmental performance and calculates the potential benefit from the decrease of the operational cost. The overall objective is to assist SMEs in increasing their competitiveness and thereby their position in the market.

KEYWORDS: Environmental performance, indicators, environmental benchmarking, Web-System, competitiveness, SMEs.

INTRODUCTION

Most economic activities impose a heavy burden on the environment, as they involve the consumption of primary resources and raw materials, while generating waste. In the previous decades, regulatory measures of "*command and control*" type have been mainly used to dictate a certain approach for companies and other organizations towards the environment. Recently a major change has emerged as businesses began to realize that a more conscious and pro-active environmental behavior would result in economic and competitive benefits, ensuring in the same time their legislative compliance.

Leading companies have learned over time that only by systematizing and integrating environmental protection into overall management prac-

tices can achieve affordable, consistent compliance with internal and external requirements (Epstein and Roy, 1998). The trend is being expanded to smaller companies struggling to survive in the highly competitive global market. The benefits from adopting and implementing improved environmental management may fall into two broad categories:

- The first addresses the fact that improved environmental management is beneficial for the planet and a fundamental requirement of global sustainability.
- The second addresses the fact that improved environmental performance could be seen as a future requirement for sustainable commerce.

Parallel to the evolution of environmental management systems, the development of environmental performance evaluation models was initiated. Environmental Performance Evaluation (EPE) is the process of selecting environmental indicators and measuring, analyzing, assessing, reporting and communicating an organization's environmental performance against well defined criteria (ISO, 1999). Businesses must satisfy their growing needs to obtain more detailed insight into their environmental performance and to benchmark against competitors on one hand, and also to respond to the increasing pressures from the part of regulatory authorities, local communities, employees, NGOs and other stakeholders. This led to a request for developing environmental evaluation systems (Kolk and Mauser, 2002). In the near future, companies will be asked to evaluate and assess their environmental performance, in addition to their financial results.

As a consequence, an increasing need for tools allowing the reliable quantification and measurement of companies' environmental performance, has emerged. Environmental Performance Indicators (EPI) are used to depict the environmental data of a firm in a comprehensive and concise manner and have the purpose to:

- compare environmental performance over time,
- highlight optimization potentials,
- pursuit environmental targets,
- identify cost reduction potentials, and to
- allow comparison of environmental performance between firms (benchmarking).

In addition to the above, environmental indicators are used as a communication tool in environmental reporting both externally and internally and they can provide technical support in the establishment of an Environmental Management System (Xin, 2000; Jasch, 2000)

In the process of developing suitable measurement and evaluation systems and tools, some critical questions that require answers have arisen:

- Which variables and indicators should be included in a comprehensive and flexible system for the measurement of environmental performance?
- Should environmental indicators be generic (applicable to all sectors and industries) or sector specific?
- Could a rather restricted set of environmental indicators efficiently assess a company's environmental performance and its evolution over time?
- How could environmental performance benchmarking be achieved within industries at a national, regional or international level?
- How could environmental performance measurement and benchmarking be used as a managerial tool to help companies in decision making?

Multiple initiatives have been undertaken for the development of environmental performance measurement and reporting frameworks by governments, industries, international organizations, NGO's and academics, such as the Global Reporting Initiative (2000), the National Academy of Engineering (1999), the World Business Council for Sustainable Development, (2000), the National Round Table on the Environment and the Economy, (1997) and the International Organization of Standardization, (1999). The scope of these initiatives is different and there is obvious divergence in their perspectives. However, a remarkable convergence in the final proposed set of environmental performance indicators is evidence of a partial answer to the above questions.

A rather restricted set of generally applicable environmental indicators, complemented by a few sector or company specific indicators, can sufficiently measure and evaluate companies' environmental performance. EPI can be expressed in absolute or relative measurements, and can be aggregated and/or weighted depending on their use and application (Jasch, 2000).

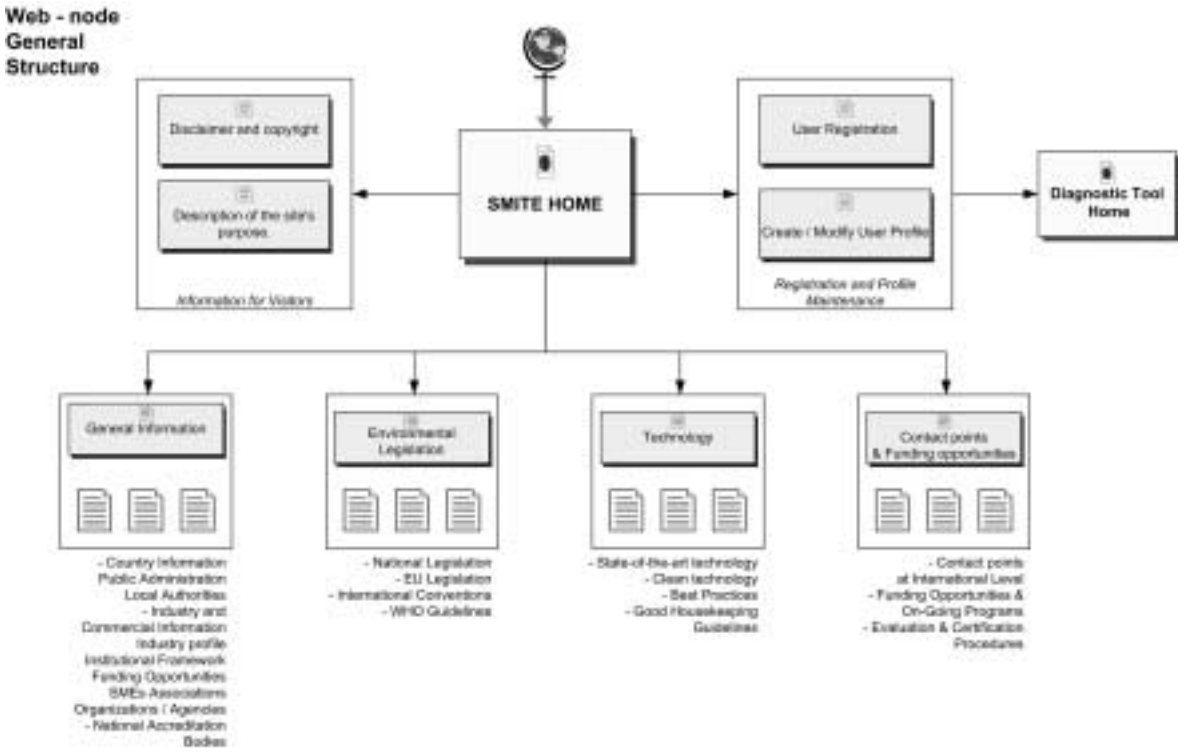


Figure 1. Structure of the Web-System Public Area

METHODOLOGICAL APPROACH

In the above context, a model has been developed to stimulate SMEs conducting environmental audits and self-evaluating their environmental performance. The Internet-based System that has been developed is supporting SMEs to:

- Evaluate their environmental performance and assess its evolution over time.
- Benchmark their performance against competitors at regional and international level.
- Adopt "Good Practice" and/or Cleaner Production Guidelines for improving their environmental performance.
- Evaluate economic benefits from the adoption of the above measures.

Structure of the Internet-based Tool

The Web-based System consists of two major domains.

The *Public Area* of the Web-System (Figure 1) is addressed to all the Internet visitors and provides information and knowledge on issues related to:

- The structure of the targeted sectors and the operational framework of the industry.
- The governing environmental legislation.
- The latest developments on the technology used worldwide in similar businesses.
- The main contact points where the SMEs would receive assistance on their daily business operation.

The *Members Area* is addressed to the registered users only and provides access to useful tools and online services for the targeted SMEs and the Consultants of the region.

The *SMEs Area* contains online Diagnostic Tools for the SMEs (Figure 2) allowing the evaluation of their:

- Environmental performance
- Administrative performance
- Legislative compliance

Upon completion of the diagnostic sessions, the users receive guidance on improving their performance by the adoption of simple measures that do not require major capital investment. In addition, registered SMEs have the possibility to post questions on the consultancy network and seek for assistance from the registered consultants.

Finally, the *Consultants Area* consists of an online forum where registered Consultants propose solutions to the questions raised by the SMEs.

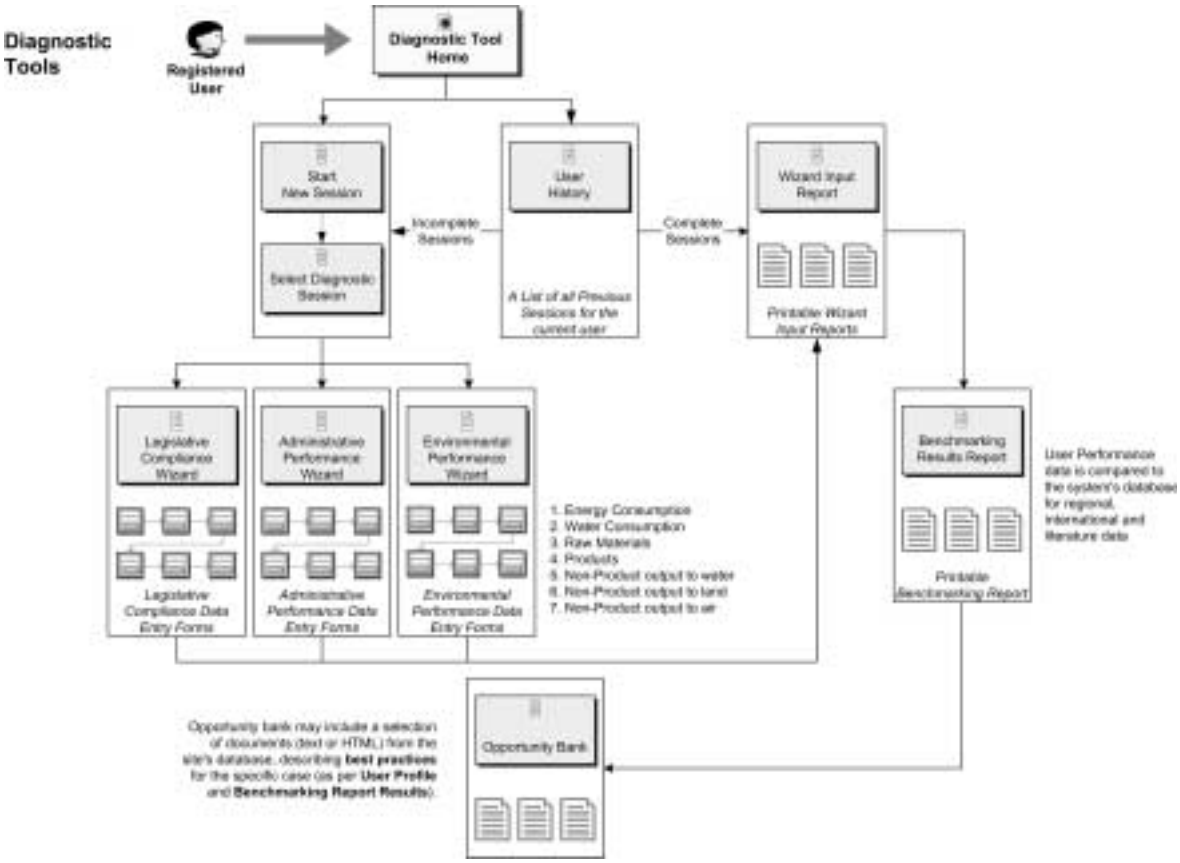


Figure 2. Structure of the online Diagnostic Tools

Performance variables and indicators

The evaluation of the environmental performance of the targeted industries is based on a simplified set of performance indicators, which allow individual industries to be benchmarked on a regional and international scale. The indicators are estimated on the basis of *performance variables* provided by companies. These are distinguished in *organizational* variables (management and business variables) and *environmental* variables (Table 1).

The above variables are expected to be available for companies, and they can be used as inputs for the estimation of *performance indicators.* Performance indicators are normalized measures of performance, in essence simple ratios of two variables (Tyteca *et al.*, 2002). According to the so far proposed measurement framework, the most common variables used as denominators to construct environmental performance indicators are:

- A standardized unit of production for a given sector (e.g. tonnes of product).
- Total sales for a given company.
- Number of employees.
- Value added (total value of sales minus total cost of materials).

The derived indicators can be *generic* or *sector specific*. In this approach, a set of generic indicators, complemented by sector specific ones, is considered a reliable representation of a company's environmental performance. The proposed set of indicators has been proven representative, while reducing complexity and retaining flexibility too.

Aggregation of different dimensions of performance

Industries interact with the environment in multiple ways. These include:

- Consumption of renewable and non-renewable resources,
- Water consumption,
- Energy consumption,

- Waste and wastewater discharge,
- Air pollution, etc.

The multiple dimensions of Environmental Performance Evaluation and assessment are evident. One of the most difficult issues that arise is selecting whether to proceed in producing aggregated measures of environmental performance or not. The multidimensional evaluation of environmental performance is avoided by presenting the proposed set of performance indicators separately. The challenge is to produce simple environmental indicator figures, which allow the comparison of individual industries on a regional and international scale.

Comparison is further complicated by changes over time, in the business production. These changes may affect the environmental indicators of individual industries. The challenge posed is handled through the selection of few generic indicators. The indicators are applicable to the specific sector allowing for some unexplained variations, thus permitting a general comparison without too much complexity.

"*It is argued that environmental performance cannot be compared because companies are different. However, the same could be said of company finances, yet the reporting of financial performance is a matter of routine. Distinctiveness should not stand in the way of comparison between competitors, be it in terms of profitability, market value or environmental performance*" (Berkhout *et al.*, 2001).

ENVIRONMENTAL PERFORMANCE EVALUATION AND BENCHMARKING

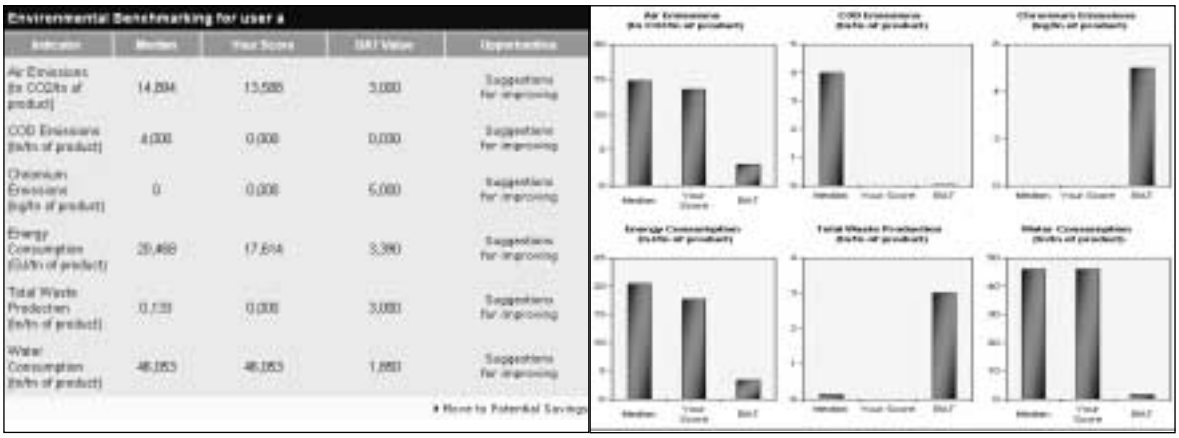
Inputs for the model

Inputs are data and other operational information of the companies, which are usually available. These data are required for the calculation of environmental indicators and include other relevant information for further studies on the environmental performance of the sector. Inputs are distinguished in:

- *Company profile data*, such as:
  - o Type of products and processes,
  - o Number of employees,
  - o Sales value,
  - o Raw materials cost, e.t.c.
- *Technical data*, such as:
  - o Energy consumption (all types of energy resources reported),
  - o Water consumption,
  - o Raw materials used,
  - o Products produced,
  - o Non-product output to water, land and air

Table 1. Organizational and environmental variables

Organizational Variables	***Management Variables***	ISO registration
		Number of non-compliance events
		Environmental investment reported
	Business Variables	Total sales
		Profit
		Number of employees
		Raw material
		Products
Environmental Variables	***Waste***	Total solid waste
		Recycled waste
		Hazardous waste
	Air Emissions	CO_2
	Wastewater	COD
		BOD
		Toxic Metals
	Water consumption	Total Waster Consumption
	Energy consumption	Total Energy Input



(a) (b)

Figure 3. Environmental Performance Evaluation and Benchmarking Results

Evaluation of environmental performance and benchmarking

Environmental performance evaluation is implemented through a restricted set of environmental indicators, as they have been previously described. Indicators are calculated by the model, and their current as well as previous values are presented to the user.

Environmental performance evaluation is followed by benchmarking. Companies are guided to compare their current performance to the median values of the same set of indicators, for the same sector, from a sample of competitors in the region (regional benchmarking). Regional values of environmental indicators are produced and updated by the model, based on the input database.

It is worthy to note that the users have the possibility to select the users against which will be compared, for the purposes of benchmarking at regional level.

Criteria for clustering of users are:

- The size of the enterprise
- The location
- The products or the services offered
- The main processes
- The technology used

However, benchmarking reliability will be limited if the user selects the complete set of clustering criteria during the benchmarking procedure.

Benchmarking is completed by BAT values, which represent the Best Available Technology - state of the art performance (international benchmarking). BAT values are provided by the relevant literature and case studies at the international level, relevant to each one of the targeted sectors.

Following the environmental evaluation and benchmarking, technical interventions and practical measures are suggested to the users to reduce environmental impacts and consequently improve business competitiveness through cost savings. The basis for recommendations is the current environmental performance recorded at the previous step and the comparative evaluation with best practices and target values. For each indicator, there is a reference to an "Opportunity Bank" containing suggestions on how to improve performance. The Opportunity Bank serves as a guide for the SMEs aiming to improve environmental performance by means of cleaner technology.

The set of environmental performance indicators calculated by the model for a textile company (a) and the benchmarking results (b) are presented in Figure 3.

Potential cost savings from improved environmental performance

Having evaluated the business environmental performance, at the final step, the model estimates the costs related to their current performance, and the potential cost savings achieved when applying BAT. These cost savings are calculated individually for each environmental performance indicator (Figure 4) and their sum represents the total potential operational cost savings.

Figure 4. Estimation of potential cost savings

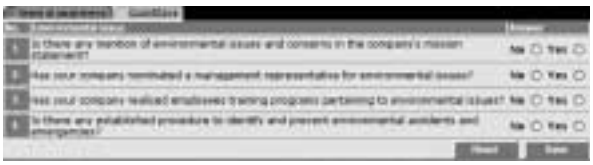


Figure 5. Inputs for general awareness on environmental issues

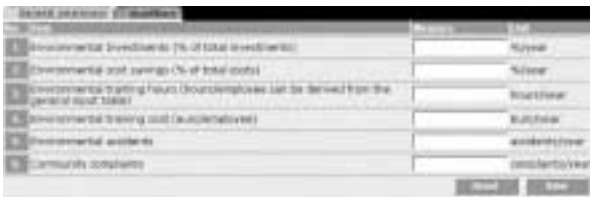


Figure 6. Inputs for Administrative / Operational Performance

ADMINISTRATIVE PERFORMANCE EVALUATION AND BENCHMARKING

Administrative/operational performance indicators

The improvement of environmental performance requires effective control of a company's activities, products and processes that may cause significant environmental impacts. Consequently, current management practices that influence environmental performance should be identified so that required changes could be introduced.

Management decisions and activities that influence a company's environmental performance, e.g. implementation of an Environmental Management System or environmental training of employees, are generally evaluated by "effort" indicators. Qualitative and quantitative effort indicators are registered and evaluated by companies to assess their administrative/operational performance. At the next step, companies' performance is being benchmarked against other industries of the same sector at a national / regional and international level.

Administrative/operational performance evaluation and benchmarking

Qualitative or General Awareness Performance

The inputs required by companies (Figure 5), simplified in order to be easily available, are processed by a *weighted score method* in order to evaluate the company's level of general awareness on environmental issues. After identifying which criteria will be used for performance evaluation, each criterion is assigned with a *relative importance* and a *weighting factor*. These factors are used for measuring the company's final score.

Quantitative Performance

Quantitative evaluation of administrative performance is implemented by input data, referring to management practices towards environmental performance improvement and the results of their implementation (Figure 6). These data can be easily processed to give a set of administrative performance indicators, which are directly comparable and can be further used for benchmarking.

Administrative Performance for user: ●

Indicator	Median Value	Your Score	Best Practice
Community Complaints	2	1	0
Environmental Accidents	N/A	0	0
Environmental Cost Savings	4,95	6,4	17
Environmental Investments	6	3,1	6,5
Environmental Training Cost	240	250	217
Environmental Training Hours	28,5	8,4	12
General Awareness on Environmental Issues	2,5	3,2	4

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Figure 7. Administrative Performance Benchmarking Results

Administrative/operational performance benchmarking

The calculated values of administrative performance indicators, as well as the weighted total score of environmental awareness, are communicated to the companies compared to the median value of all inputs at the regional level and to the Best Practices values at an international level (Figure 7).

DISCUSSION

The developed Web-System is a powerful tool assisting the SMEs in the self-evaluation and benchmarking of their environmental and administrative performance. The Web-System provides easy access to information on environmental technology and legislation issues and contributes at the formulation of environmental awareness within the SMEs. The Diagnostic Tools are simple to be used by the business owner or the manager, without the intervention of an environmental expert. The requested data for the evaluation of the environmental performance can be found at the business records, and the only constrain is the availability of the Internet.

The evaluation of enterprises via the Diagnostic Tools is based on a restricted set of Performance Indicators. The supporting database has been designed in such a manner that it is easy to add new indicators, whenever necessary. Moreover, at this stage, the system evaluates the performance of SMEs of two industrial sectors (textile and food industry), and the hotel sector. Addition of new sectors of activities has been foreseen and can be done without significant changes in the system design. Reliability of results is based on the quality of the input data, from the users. As the number of registered users increases, and the necessity for valid data becomes evident, it is expected that evaluation of performance in the future will improve, in terms of reliability.

An additional advantage of the Web-System is the provision of suggestions at technical level on what should be done within the business, in order to improve its environmental performance.

One of the most important issues arising through this approach is the reliability and the validity of the available data (Ilinitch *et al.*, 1998). Evaluation of performance is based on a limited amount of operational data. Minor or major variations in the production line (or the services offered) within the same economic sector cannot be reflected in the values of the calculated indicators.

Although a detailed registration of all the processes is foreseen by the model, the calculation of a single median value for each indicator would lead to misleading results, if the identified variations in the production line are ignored. On the other hand, if these differences are taken into consideration, the number of businesses on which benchmarking should be based would be very limited, and the median values would not be reliable. The same applies to the data taken from the literature. The actual values of the environmental performance indicators form the "BAT" approach that are used for benchmarking at international level may hide the same uncertainty, as not all the details are always available. Therefore, it is not always possible to know the specific characteristics of the enterprises included in previous surveys, and if these characteristics are similar to the users of the Diagnostic Tools.

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