ENVIRONMENTAL MANAGEMENT INDICATORS IN AN INDUSTRIAL ENGINEERING SCHOOL

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ABSTRACT:

The purpose of this paper is to discuss the experience of a school of industrial engineering that adopted an environmental management system that includes performance indicators that encompass metrics of the environmental implications of the research and education that the school offers, and measures of how this education is assimilated by the students, and taken into account both in their present and future life.

The paper underlines that environmental management systems are often centered on the continual reduction of the negative effects on the environment that an organization may cause, but, although it is not usual (and hence this is the originality of this paper), organizations can also take account of their positive impacts. Universities might do so because they create and transmit knowledge and, moreover, they shape attitudes.

The relevance of the paper lies on the performance metrics. These findings are useful for implementing an environmental management system in any knowledge organization.

Keywords: environmental management system, indicators, ISO 14001, knowledge organization, University

1.- INTRODUCTION

Since the Industrial Revolution, and especially in the second half of the 20th century, the impact of humanity on earth has increased dramatically. The growth of population, the search for natural resources, industrialization and infrastructure construction have changed and damaged the environment. Environmental problems are so serious that have aroused our interest in the environment and have made us aware of issues such as pollution and recycling. This environmental awareness affects business activity [1,2] and, in turn, makes laws more demanding.

As part of Total Quality Management (TQM), companies have to meet the expectations of target customers [3, 4] (assuming that customer satisfaction leads to better results for the company [5]) and currently , these expectations include certainly environmental issues, because today's society is becoming more aware of problems like water scarcity, global warming and climate change.
Evidence of this awareness is its presence in the media and in educational institutions, where environmental issues appear in the curricula, from primary school to university.

Consequently, legal and social pressure on companies are growing , so that companies must decide to what extent they are committed to environment. The minimum company contribution to sustainability is the management of its environmental impact and the compliance with the legislation in force [6, 7].

Many companies find that an environmental management system (hereinafter EMS) helps in achieving these objectives, since it allows identifying and managing environmental aspects and setting environmental objectives.

An environmental management system is defined [8] as “the part of the management system of the company that includes an organization, planning activities, responsibilities, procedures, processes and resources for developing, implementing, maintaining and revising the environmental policy of the company". The EMS should ensure that the environmental policy is appropriate to the type of business and that it includes a commitment to continuous improvement , prevention of pollution and enforcement . In addition, EMS allow companies to be more efficient since they allow them to renew their processes with lower emissions and reduce activities that do not add any value as

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handling and storage waste [9]. Finally, having an EMS improves the company's image among stakeholders [10] as it indicates that the company is making efforts to minimize its environmental impact and it attracts customers also committed to the preservation of the environment [11]. European organizations may choose between two ways to define its environmental management system, the ISO 14001 standard and the Eco -Management and Audit Scheme (EMAS) of the European Parliament.

If the ideas above are valid for any type of organization, they are also valid for a university. Furthermore, university and other organizations related to knowledge, training and research have a special characteristic that their activity can have positive impacts on the environment, understanding positive impacts for the consequences that training can have on the state of awareness and responsibility towards the environment of future professionals and the possible generation of knowledge oriented to the reduction of impacts on the environment. For this reason, in this work we present the experience of a School of engineering that has developed a system of indicators of environmental management whose main feature is to include indicators on positive impacts. The inclusion of these indicators should allow continuing and insisting on the activities that lead to enhance these positive aspects.

2.- UNIVERSITIES AND ENVIRONMENTAL ISSUES

" Environmental aspects" [12] are elements of the activities , products or services of an organization that can interact with the environment , especially if they significantly affect the environment (air emissions, recycling , use and pollution of the soil, use of natural resources and raw materials, effects on biodiversity, risk of environmental accidents, etc.). Although the EMAS scheme [13] defines environmental impact as any change in the environment, both adverse and beneficial, people tend to refer to the negative aspects. For this reason, companies consider the negative impacts and prepare programs to reduce, but an EMS can also consider the positive impacts. For example ISO 14031 [9] includes guidelines for evaluating the positive impacts.

Creighton [14] explained the pedagogical effects of "greening" a university in terms of recycling and reducing consumption of energy and waste, because universities teach and demonstrate the methods and consequences of environmental management to their students, while raising environmental awareness. The World Summit on Sustainable Development in Johannesburg in 2002 formally recognized education as a key mechanism for promoting environmental protection and conservation and stressed that education should help society to achieve higher levels of sustainability [15]. In the literature, different studies can be found where academics analyze the sustainable development of universities [16, 17, 18]. These studies indicate that universities have a moral obligation to work for the sustainable development of societies so that they are respectful with the environment. Thus, the university has an important role in the environmental performance of companies and the attitude of their leaders [19, 20], so it should help increase engagement of students with the environment and sustainability [21, 22] .

Universities around the world have undertaken all kind of practices such as recycling and saving water [23] and even the implementation of environmental management systems [24] . For example, in Spain, University of Granada's College of Pharmacy , was the first college that achieved the ISO 14001 certification for all its processes (other universities already had partial certifications). In January 2008, all units and all activities (teaching, research and services) of the University of Granada were fully certified according to ISO 14001:2004 . But in all the universities that we have analyzed, their EMS focus on reducing the negative impacts of their operations, as a manufacturing company would do. We could not find any case where positive impacts were quantified, as postulated by Keniry [25] , which is surprising because the positive impacts are so important that should not be ignored by the EMS , but measured and evaluated .

Examples of positive impacts, in the case of technical universities, are: development of clean technologies through research , awareness of future graduates who work in areas with strong environmental problems and therefore play an important role in reducing the environmental impact [26] which is conditioned by their commitment to the preservation of the environment and their environmental awareness, raised in their childhood at school.

As prescribed Van Berkel [27], educational programs should instill environmental awareness in order to be able to detect potential negative impacts on the environment and contribute to their minimization and proper management. For example, the Delft University of Technology has introduced sustainability into the curricula of future engineers through different actions like an introductory course called 'Technology in Sustainable Development', or a specialization in

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sustainability [17]. Another example is the Metropolitan Autonomous University of Mexico, which has been working on the implementation of an "Institutional Environmental Plan" [28].

3.- APPLICATION OF AN EMS IN A SCHOOL OF ENGINEERING

The Technical University of Catalonia (UPC) approved its first environmental plan in 1996. Among other aspects, it included the introduction of environmental issues in all the subjects and the promotion of research on environmental issues [29] . In 2004 , the University discussed whether to implement an EMS [30] and decided that two campuses would be the first ones to implement its own EMS, according to the EMAS scheme, one of them being the School of Engineering at Manresa (EPSEM), a 85 year old school that offers 8 different courses. Currently it has over 900 students and about 100 lecturers. The school has always shown great interest in environmental issues and as proof of this, in 2002 its ecological footprint was computed as a measure of environmental impact [31].

The implementation of the EMS began in 2007 when the school defined its environmental policy. An assessment of the initial situation was made and the main processes were identified, as well as their environmental aspects and impacts (Table 1) and compliance with the legal aspects was verified.

PROCESS	NEGATIVE IMPACTS	POSITIVE IMPACTS
Design and review of curriculum	-	Inclusion of environmental issues
Teaching innovation	-	Methods for environmental awareness
Promotion, student tuition and welcome	Resource consumption	-
official teaching	Transportation, resource consumption, waste	Information and awareness on environmental issues
Quality assessment in education	-	Increased environmental commitment
Further training	Transportation, resource consumption, waste	Increased environmental commitment
In-Company Training	Transportation, resource consumption, waste	Increased environmental commitment
international Mobility	Transportation	Exchange of experiences
Student assessment	-	Assessment of competence in sustainability
Research	Transportation, resource consumption, waste	Knowledge for a better environment
External activities	Transportation, resource consumption, waste	-
Resource Management	Resource consumption	-
Purchasing	Resource consumption	-
Facilities maintenance	Transportation, resource consumption, waste	-
Human resource management	Aggressive behavior towards the environment	Favorable behaviors towards the environment
Planning and control of EMS	-	Reduction of negative impacts and increasing positive ones
Document management and information	Resource consumption	-
Evaluation , analysis and improvement of the EMS	-	Reduction of negative impacts and increasing positive ones

Table 1: Identification of positive and negative environmental impacts of each process

The EMS was documented in 2008 and it included 16 procedures. Different instructions for each procedure were created, also covering topics related to research and teaching. Throughout 2008, training sessions and emergency drills were conducted. Objectives were set as well as a program that shows how to achieve them. In 2009, the corresponding internal system audits and resulting corrective actions were taken, leaving the system ready for external certification.
The EMAS system itself encourages organizations to use environmental performance indicators , in order to convert the collected data into comprehensible information for further analysis . These indicators are performance indicators to measure the development of the objectives of a program, project or institution, by comparing them in time with the corresponding internal or external references (ACAA, 1997). The UNE 66175:2003 Standard (Quality Management Systems. Guidelines for the implementation of systems of indicators) defines indicators as "data or data set that help to objectively measure the evolution of a process or an activity. " According to AECA (1997), these indicators should be sufficiently accurate and comprehensive to allow users to keep track of the most important aspects of the program, service or organization analyzed.

In fact, environmental performance indicators help organizations manage related environmental impacts of their activities and to better meet the requirements of mandatory reporting pursuant to Directive 96/61/EC concerning

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integrated pollution prevention and pollution control. Different publications have analyzed the use of environmental performance indicators such as the work of World Business Council for Sustainable Development entitled "Measuring eco -efficiency a guide to reporting company performance" published in 2000; the work of the British Association of Certified and Chartered Accountants entitled "An introduction to environmental reporting " published in 2001; or the work of the Association for Environmental Management in Banks, Saving Banks and Insurance Companies entitled "Time to act- Environmental Management in Financial Institutions -A survey of recent Developments including principles and guidelines for in- house eco - balances of financial service providers " published in 1997.

Thirteen performance indicators that fall into three categories were introduced in the EPSEM's EMS. Categories A and B are common to all EMS (although each organization must decide what to measure and how to measure it) while category C is specific of the school.

Each one of the categories responds to a specific continuous improvement objective. Indicators in category A are aimed at measuring the progress of the implementation and the performance of the EMS. Category B, meanwhile, aims to track the evolution of traditional environmental impacts that are identified in this article as negative impacts, such as resource consumption, waste generation, emissions, discharges, etc. By contrast, the indicators in category C should enable the understanding of the evolution of which are called positive impacts: the results of the contributions that knowledge-based organizations can do to the environment.

While there is a long and established record of use for measurement and continuous improvement of the indicators in categories A and B in all types of organizations, consolidated experiences for the purposes of category C are unknown. Therefore, it is in this specific field where experimentation described in this article is required.

When EPSEM implemented its EMS, a panel with the following indicators was designed:

3.1.- ENVIRONMENTAL PERFORMANCE INDICATORS

Group A is made up of three environmental performance indicators:

A_1: "Extension of the system." It tracks the overall level of compliance with legal requirements; the percentage of targets that have been covered during the year; the percentage of people involved in the system; the percentage of suppliers involved; the results of internal audits; the proportion of corrective actions that have been resolved and the proportion of providers that have implemented an EMS .

A_2: "Efficiency of the system." This performance index captures: The number of preventive activities that have been adopted; the number of instructions that have been put into operation; the number of hours that employees have been trained on environmental issues; the number of suggestions received and the number of activities or projects that have taken place. It monitors whether the objectives of the EMS are efficiently achieved throughout the year.

A_3: "Status of implementation of the system." It is a measure of the outcome of the annual internal audit, according to the methodology described in the corresponding procedure, and it is expressed by the number of non-conformities detected.

3.2.- INDICATORS OF ENVIRONMENTAL STATUS OF THE SCHOOL

The second group (B) consists of five indicators of the environmental situation of the school.

B_1: "Consumption of resources." It monitors the average consumption per person of each one of the resources involved in the everyday operation of the university. To construct this indicator, the total consumption of each resource has to be related to the number of equivalent full-time (eight hours a day and five days a week) lecturers, students or administrative staff. For example, a part-time lecturer who stays four hours in the school every day, is recorded as 0.5 equivalent persons.

Although it is necessary to measure the consumption per equivalent of each type of resource (paper, printer spares, water, electricity, gas, etc.) it is even more useful to consider how this consumption evolves over time, to verify the

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results of the containment measures adopted. The yearly environmental management program provides an expected rate of improvement (p) that the system should provide.

To guarantee an easy comprehension by all the people in the organization, this indicator is in the form of visual signal, such as a traffic light (Figure 1). Since the consumption of each resource is measured in different units (kilograms per person, kilowatt-hours per person, etc.), a synthetic indicator is calculated from the value that corresponds according to the color display.

Color	Value	Meaning
Red	0	Consumption increases more than p %
Amber	1	Consumption increases between 1% and p %
Yellow	2	Consumption remains constant (less than a 1 % variation)
Light green	3	Consumption reduced between 1 % and *p* %
Green	4	Consumption reduced more than *p* %

Fig. 1. Visual indicator on resource consumption

B_2: "Means of transportation for people to travel to the university." It takes into consideration the number of days per week (from 0-5) that each person commutes to campus driving a motor vehicle. In this case each individual is counted as a person, regardless of the hours remaining in the center. Equation 1 shows how the indicator is calculated , where *n* is the number of valid questionnaires obtained .

$$B_2 = 5 - \frac{\sum_{i=1}^{n} days_i}{n} \quad (1)$$

Additionally, each year, a more detailed survey of the percentages of the various means of transportation used by lecturers, students and administrative staff to move to the campus (including automobile, motorcycle, public transport, cycling and walking) is performed .

B_3: "Waste generation." It monitors the amount of waste (paper, plastic, glass, organic materials , cans, electronic equipment , batteries, laboratory waste, scraps) a person generates in a year. As in the case of B_1, a visual semaphore indicator is used. The value of a synthetic indicator is calculated from the values of the visual indicator for each type of waste (Figure 2).

B_4: "Emissions". It monitors the amount of air pollutants emitted into the atmosphere annually. In the university described in the study, the only significant source of emission is the heating system that uses gas boilers because gas combustion can generate pollutants depending on whether its operation is correct or not. The values of pollutants such as carbon monoxide or carbon dioxide (CO_x), sulfur oxides (SO_x) and nitrogen oxides (NO_x) are measured monthly, as part of the normal management of the boilers. The value of the indicator is the result of the measurement itself.

B_5: "Noise level generated by the workshops and laboratories of the university." A sound level meter is used to periodically control noise level at the most critical spots.

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Color	Value	Meaning
Red	0	Waste generation increases more than p %
Amber	1	Waste generation increases between 1% and p %
Yellow	2	Waste generation remains constant (less than a 1 % variation)
Light green	3	Waste generation reduced between 1 % and *p* %
Green	4	Waste generation reduced more than *p* %

Fig. 2. Visual indicator of waste generation

Since group B indicators are based on technical data, they are relatively simple to measure. It is not especially difficult to organize data collection or to perform the calculations. Conceptually they are not very different from those that might be found in the EMS of any other type of organization.

3.3.- INDICATORS ON TEACHING AND RESEARCH

The third group of indicators is related to education and research, the typical activities of a university. It is called group C [32]. It consists in four indicators and their associated sub-indicators.

C_1: "Indicator of ordinary courses." It tracks the contents of the subjects that focus on awareness and responsibility of students. It has three sub indicators:

• $C_{1.1}$: "Involvement of credits taught on sustainability." It counts (in percentage) how many subjects include in their syllabus a contribution to "Sustainability and Social Commitment ".
• $C_{1.2}$: "Involvement of lecturers in incorporating sustainability into teaching." It is based on an annual survey where teachers are asked about the extent to which the concepts of sustainability are present in their teaching. The survey consists of eight questions with closed answers. Each question is marked in order to achieve a possible maximum score of 100 marks per survey.
• $C_{1.3}$: "Involvement of teachers in sustainability." It is measured as the percentage of participation of teachers in the survey corresponding to indicator $C_{1.2}$.

C_2: "Internalization of sustainability by students." One thing is the effort made by lecturers to teach sustainability concepts to the students, and quite another is how much this training has been internalized by the students when they graduate. This indicator aims to measure this outcome. It starts by asking first-year students to draw a concept map [33] on "Industrial Engineering". A visual indicator called $C_{2\ start}$ (Figure 3) measures the importance of words like "sustainability" or "environment" shown in the conceptual map. The value of the indicator is the average of the different maps drawn by students. Similarly, when students complete their final project, they are asked to draw the same concept map, thus obtaining $C_{2\ end}$ (also Figure 3). It was proposed to measure the internalization by means of the difference between the values of this inflow and outflow metrics (Equation 2). This technique has been used in various fields by other universities [34].

$$C_2 = C_{2\ end} - C_{2\ start} \quad (2)$$

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Color	Value	Meaning
🔴	0	Words like "sustainability", "sustainable development" or "environment" are not present
🟠	1	Words like "sustainability", "sustainable development" or "environment" are present
🟡🟢🟢	2, 3 or 4	Besides the word "sustainability", words like "environmental, economic, social or human issues" are present

Fig. 3. Visual indicator of the importance of sustainability in concept maps

C_3: "Occupation of students, after graduating from university." When graduates return to college to get his official diploma, they are asked to describe the relationship between their job and the environment, and their level of personal involvement in the preservation of the environment, by a multiple response questionnaire. Each possible answer is scored (Figure 4). The value of the indicator is the average of the scores of the responses collected each year.

☐ My current tasks are not related to the invironment *1 mark*	☐ My current tasks are slightly related to the environment *2 marks*	☐ My current tasks are related to the environment, but my decisions do not have any impact *3 marks*
☐ In my job, I am free to take decisions that affect, or may affect, the environment *5 marks*	☐ In my job, my decisions take into account the protection and improvement of the environment, above all *7 marks*	
☐ The company I work for supports me and shares my interest in the protection and improvement of the environment *9 marks*	☐ The mission of the company where I work is the protection and improvement of the environment *10 marks*	

Fig. 4. Sample survey on the relationship between professional and business environment means

C_4: "Research activities conducted at the university related to sustainability and the environment." It is based on two sub-indicators:

• $C_{4.1}$: "Journal articles and conference presentations by university lecturers." They are taken from the annual reports of research centers, taking into account articles and presentations that include certain keywords (such as sustainability, social commitment, environment, sustainable development, environmental impact, etc.) in their titles.

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• $C_{4.2}$: "Doctoral Projects". The value of this indicator is the average score of all the projects submitted in the year and related to environmental issues. It is also expressed as a visual indicator or traffic light. Each project is scored according to the criterion of Figure 5.5.

Color	Value	Meaning
Red	0	Against sustainability
Amber	1	Not related to sustainability
Yellow	2	Some relation (i.e. an existing technique is improved)
Light green	3	Strong relation (a new technique, better than older ones)
Green	4	Very strong relation (elimination of negative impacts)

Fig. 5. Visual indicator of sustainability in research

These performance indicators are designed to achieve the objectives in the environmental policy of the School and are a part of the definition of the internal processes of the same. This correlation is described in Tables 2 and 3:

Indicators: C_1, C_2, C_3.

Long-term objectives: The future industry professionals are sensitive to environmental issues and have the knowledge to apply environmental criteria in their work.

Short-term objectives: To achieve the degree, students have internalized the knowledge necessary to assume their future environmental liability.

Indicator	Means	Process	Inputs	Outputs
C_1	Environmental content of the subjects	Design, review and validation of the curriculum	School's environmental policy. Proposals from society, professional associations, etc. and proposals	Syllabus; Curriculum
C_2	Activities during the training process	Official teaching	Educational program; Student enrollment; and faculty	Assessment and accreditation of students
C_3	Professional experience of graduates	External process (outside School)	Recruitment of graduate students	Environmental impact of professional activity

Table 2: Indicators relating to teaching

Indicator: C_4.

Long-term objectives: To generate and disseminate new knowledge related to sustainability and environmental improvement.

Short-term objectives: To publish articles and develop Doctoral Thesis concerning the research conducted

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at the School on industrial aspects that impact the environment.				
Indicator	**Means**	**Process**	**Inputs**	**Outputs**
$C_{4.1}$	Scientific publications and presentations at national and international conferences and congresses	Research	Social needs. School's environmental policy.	Publications, presentations, posters
$C_{4.2}$	Doctoral Theses in the School's doctoral program	Research	Social needs. School's environmental policy.	Doctoral dissertations

Table 3: Indicators relating to research

4.- RESULTS OF THE EXPERIENCE

As it might be expected, the application of indicators in categories A and B has not presented much problem, apart from the introduction of a series of records in order to have the necessary information in a systematic way. A category indicators are measured once a year in conjunction with the internal audit and the review-by-the-management meeting, while indicators in category B are measured either monthly (Indicators B_1, B_3 and B_4) or annually (B_2 and B_5 indicators) as appropriate. As a consequence of the improvement actions introduced, some of the indicators show significant improvements, such as the consumption of paper and toner cartridges -which has declined by 15 percent in the first year of managing the EMS- or the consumption of electricity, which has declined by 12 % in the same period, while others do not show any improvement, such as the consumption of natural gas, which in the same period, increased by 6%. However, in all cases the indicator panel has met its objectives and the path of continuous improvement is in place and consolidated.

By contrast, obtaining data for indicators of category C has presented a number of difficulties - insurmountable, in some cases - , which has forced a global rethink of the category, which is summarized in table 4:

Indicator	**Observations**	**Reconsideration**
$C_{1.1}$	It is easy to obtain. Basically trying to determine the quantity of subjects that specifically consider the competence "SUSTAINABILITY AND SOCIAL COMMITMENT" in their syllabuses. In the 2011/2012 year, out of a total of 168 subjects, only 18 were listed as supporting this competence. that represents a 10.71%	This indicator does not require any reconsideration. Results for course 2011/12 demand a review of the content of the different subjects because, from the point of view of the EMS, 10.71 per cent is considered low.
$C_{1.2}$	During 2011/12, 37 responses to the survey were considered, covering a 22 per cent of total subjects taught. For each subject, the value of the survey score (out of a possible 100) is determined and the average of the subjects tested is made. The result is 48.82.	This indicator does not require any reconsideration. Results for course 2011/ 12 suggest that a greening campaign should made among teachers in order to increase participation, which is considered to be insufficient.
$C_{1.3}$	View comments to indicator $C_{1.2}$	
C_2	This indicator has several difficulties. On the one hand, to ensure that the result is representative, the values obtained at the beginning and end must correspond to the same subjects. Therefore, until July 2013, when the first students complete their degrees it is not possible to start collecting values. Moreover, the ignorance of students about the	Convenience of comparing the results of Concept Maps among students of the same course is considered, in order to provide timely data because what we want to measure is the sensitivity of the group as a whole, and not individually . Moreover, it is necessary to make a presentation on how to draw concept maps prior to drawing the initial map.

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	Concept Map tool at the beginning of their studies makes their maps irrelevant.	
C_3	No data available until the first students complete their degree in July 2013.	This indicator does not require any reconsideration.
$C_{4.1}$	47 publications with environmental content whose authors are lecturers in the School where identified in 2011	This indicator does not require any reconsideration.
$C_{4.2}$	2009/10: 3 doctoral dissertations related to the preservation of the environment. 2010/11: 2 doctoral dissertations related to the preservation of the environment. 2011/ 12: 0 doctoral dissertations related to the preservation of the environment.	To assess the contents of the doctoral theses in the way described by the traffic light mentioned in section 3.3 is very subjective. Therefore, it is proposed to replace the current criterion by the one described for the $C_{4.1}$ indicator. Moreover, the number of doctoral theses in a year is too low to detect significant trends. Therefore, it is proposed to consider three years instead of just one year.

Table 4: Results of the experience

5.- CONCLUSIONS

The legal and social pressure on the environmental impacts of industrial activities is increasing in recent years as a result of increased awareness of society towards preserving the environment and the sustainability of economic development. Companies can adopt environmental management systems to ensure and demonstrate their awareness towards the environment. There are numerous advantages associated with the implementation of an EMS, such as waste reduction, increased efficiency in resource consumption, avoiding legal sanctions for breaches of environmental laws and regulations or even an increase in sales due to a better image of the brand.

However, the success of environmental initiatives lies basically in the decisions and behavior of people (managers, technicians and employees). To develop an EMS and put it into effect, all those people should be aware of their environmental responsibility, and to a large extent, this awareness towards preserving the environment depends on the education that they received. It therefore seems reasonable to use the educational potential of higher education to develop sensitivity towards the environment among current students, tomorrow's professionals.

In the world, there are several higher education institutions that have already implemented an Environmental Management System (ISO 14001, EMAS, etc.), but that is not enough. Universities should promote individual responsibility of the students in the sustainability of future economic development and encourage the development and diffusion of environmentally friendly technologies and techniques, resulting in a positive impact to the environment.

These positive effects require going beyond the usual scope of an EMS. Then the aim is not only to reduce or completely eliminate the pollution generated by the educational activity, but to investigate and develop cleaner and sustainable methods, and above all, to transmit to people that when they graduate they will be able to develop positive attitudes and decisions toward sustainability and the environment.

This is also the responsibility of knowledge organizations. Therefore, when EPSEM decided to implement an EMS, it was not looking for a low impact activity, but to establish a program to develop individual responsibility of lecturers and students in favor of the environment.

Since improvement plans are ineffective when improvement cannot be measured, a set of indicators were developed for the EPSEM's EMS. Some of them monitor behavioral aspects and environmental situations that are common to all environmental management systems in order to measure the negative impacts of the organization, but others include specific indicators to express the progress of the positive impacts explained in this paper. The latter ones, because they are absolutely innovative, have led to significant challenges in their design and implementation, and in some cases, they have required considerable reorientation, but in the end, they look promissory to be used to monitor multiple aspects of continuous improvement for the preservation of the environment.

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The story of the environmental management system of the School of Engineering at Manresa begins in 2007. It was documented in 2008 and passed its first internal audit in 2009. At that time, the university could have had the first colleges with an EMAS certification in Spain. However, following the outbreak of the economic and financial crisis in 2008, and the related subsequent reduction of available resources in the public university of our country, certification (neither EMAS nor ISO 14001) has not taken place because certification and its subsequent maintenance are very expensive, while at present the economic priorities are focused on other aspects. The system is effective, but it suffers from the lack of stimulus that external certification would guarantee, and as soon as economic circumstances allow it, the certification will be close at hand.

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