5. Towards a design for ecological management and product sustainability - European and Brazilian approaches

5.1. Introduction

This chapter aims to present and compare two major EMS - Environmental Management Systems: The system ISO 14001 and the EMAS - Eco-Management & Audit Scheme, established by European Union countries. Although these systems share a common goal, to provide practice for environmental management, there are differences between them. Currently, EMAS can be seen as a refinement of the ISO 14001concepts, because its application seeks continuous improvements, through modernization of processes, focusing on environmental protection. Among the benefits of implementing EMAS are: increased efficiency in resource utilization reduced waste, improved corporate image, the development of an environmental awareness among employees, a better understanding of the environmental impacts of business activities and improved environmental performance.

One of the most strategic targets from the European Union (EU) it is to become the community's most dynamic and competitive as well as to continue as a knowledge - based economy. In order to achieve these ideals, the EU seeks to engage more actively in the development of economic, social and environmental. From an environmental standpoint, this implies the need to clearly separate the concepts of environmental degradation and level of economic growth by introducing rules for sustainable production and consumption, protection and management of resources [71]. One of the mechanisms that enable these aims is EMAS - Eco-Management and Audit Scheme [72].

The first conceptions of environmental management systems date back to the 1980s. Since then, these ideas have been developed. The main common goal of the current environmental management systems is to achieve a continuous reduction of the impacts of human activities on the environment. As an example of the formalized environmental management system it can be mentioned that they need to meet the ISO 14001 [73].

The European Union, taking into account the guidelines of Agenda 21, introduced in 1993 EMAS - Eco-Management and Audit Scheme. The proposal was a voluntary system for the industries of the countries who wanted to work actively to reduce the negative influences on the environment [74]. In 2001 we carried out a review of EMAS and made modifications in order to extend its range of application [75].

Today, ISO 14001 and EMAS are the two most important standards in the field of environmental management and should retain this feature for many years [76, 77]. Thanks to these Environmental Management Systems (EMS - Environmental Management Systems), that organizations could consistently organize their strategic actions for environmental protection. Through the review and modernization of technological processes, in accordance with the requirements of the EMS, is obtained by the reduction or complete elimination of negative environmental impacts, thus enabling an improvement in the activities at the various organizations that are employing it [78-79].

5.2. EMS conforming to requirements of the ISO 14001

In 1992, after the success of ISO 9001 in relation to quality management, the organization created the ISO Technical Committee TC 207, whose aim was to provide an initial proposal of what would be the international standards for environmental management. The first series of standards ISO 14000 (ISO 14001, ISO 14004, ISO 14010, ISO 14011 and ISO 14012) were published in late 1996.

In Brazil, it was created the Brazilian Committee of Environmental Management - ABNT / CB-38 supported by the ABNT (Brazilian Association of Technical Standards), whose structure was similar to the ISO TC 207 committee, and this first Brazilian version of the ISO 14000 was also published in 1996. The first revision of ISO 14001 was introduced on November 15th 2004, being adopted in Brazil in the same year by ISO 14001:2004. The standard ISO 14001:2004 specifies the requirements regarding the environmental management system. This approach enables organizations to work and introduce policies and goals taking into account current legislation and other requirements that affect them, as well as information on significant environmental aspects. The standard addresses these environmental issues, who identify them, who can and who oversee these environmental influences.

The following changes were implemented in the EMS & ISO 14001 [73, 80]:

- Definition: harmonized with ISO 9001:2000;
- General requirements: scope (limits) of the EMS must be clearly identified;
- Planning: EMS policy needs to be communicated to employees on behalf of the organization;
- Implementation and operation: enhanced competency requirements for persons working on behalf of the organization and method for external communication of relevant environmental aspects;

- Verification: documented procedure is no longer required for operational monitoring and measurements; new emphasis on assessing compliance with legislation and other requirements and meeting requirements for records storage;

- Management Review: input and output requirements added;

- Annex A: Annex has been enhanced to include cross reference to ISO 14004:2004 and ISO 19011:2002;

- Destination general: it can be applied to any type of organization;

- Pro-activity: the new standard tends to prevent harmful influences to the environment through the expectation of the risk of environmental damage;

- Development: the effects of improvements in environmental activities are its goal;

- Voluntary Appearance: requirements become valid when the standard is received;

- Base systems, supported by documentation procedures.

The benefits of adopting ISO 14001, we can mention [77] to reduce labour costs through improved efficiency in the use of raw materials and energy consumption, decreasing the amount of waste (waste), the replacement raw materials for other without deterioration in the final product, the optimization of raw materials, selection of materials and products, increasing the efficiency of the infrastructure used, the preparation process of storage, packaging and transport of materials and waste reduction , eliminating costs and payments related to the use of the environment.

Other benefits are related to compliance with legal requirements related to environmental protection through waste management, improvement of competitiveness through environmental awareness, reduction of environmental risks through the identification and preparation prior threats against the emergence of these threats, to meet the customer requests, improving the assessment together with the environmental protection services and better insight into the development of society and the increased engagement by employees.

5.3. European Ecological Management & Audit System (EMAS)

The member countries of the European Union must meet the regulations of the European Parliament and Council, called EMAS (n. 761/2001 of the European Parliament and dated of March 19th 2001), which rules on the voluntary participation by the various organizations in the management system and environmental audit of the European community. This is the most important European Union statutory act as regards the sphere of environmental protection.

This regulation applies to all organizational units, although not specifically aimed at industrial enterprises, but also all kinds of public institutions, schools, associations, etc. [81-83].

To obtain registration in EMAS, the organization must meet the following conditions [82]: meet the requirements of environmental protection law, start the environmental management system described in Annex I of the EMAS Regulation, carry out regular environmental audits and present environmental statements, as required by environmental auditor under certain time limits set by regulations.

The implementation of environmental management and audit an organization is related [83] with the completion of environmental reviews in accordance with Annex VII of the EMAS regulation, and the introduction of an environmental management system fully compatible with the requirements of the Annex I Part. The requirements and related environmental management system. Add to this the environmental audits, preparation of environmental statement and verification, recording and publication. For the Brazilian organizations that produce products for export to the zone of influence of the European Union, it is important to be aligned with these procedures in order to remain current and competitive with other organizations following these regulations will have more time.

5.4. Differences & similarities between ISO 14001 & EMAS

As it is released today, the EMAS regulation includes the environmental management system according to ISO 14001 [81]. The structure of environmental management systems, compatible with both ISO 14001 and the EMAS Regulation is based on the model "PDCA - Plan, Do, Check and Act." This model leads to continual improvement through [84]:

- **Planning:** planning, including identifying environmental aspects and establishing goals;
- **Do:** implementation, including training and operational control;
- **Check:** Checking, including monitoring and corrective actions;
- **Act:** review, including monitoring of progress and actions to implement necessary changes to the EMS.

The EMAS is done similarly to the environmental management system, whose requirements are described in ISO 14001. However, some essential elements that occur in the EMAS Regulation and are not explicit in ISO 14001 are, for example, the requirement of publication of the environmental statement and the follow up/environmental review. Thus, the introduction

of a system compatible with ISO 14001 is the first step in activities related to registration in EMAS Regulation.

These systems take into account the results received, of which the registration and control are different for each. Similarities and differences between systems are presented in Table 5.1 and Table 5.2.

5.5. Role of EMS in search procedures for sustainable technology

The ISO 14001 and EMAS are general and universal, in order to enable the implementation and use of same in any organization. They are also proactive in that tend to prevent through studies and projections, and are voluntary, progress and based systems and procedures. The requirements of continuous improvement for environmental projects through the continuous reduction of the negative influences in the environment are common principles that unite all environmental management systems.

Table 5.1. *Brazilian comparisons between the Ecological Management systems*
Adapted from [83-85]

Characteristic	EMAS	ISO 14001
Type	Formal	Formal
Applicability	European Union	International Standard
Most important Requirements	Continuous Improvement on the ecological management systems through BAT ("Best Available Techniques")	Continuous Improvement on the ecological management systems through the achievements of environmental goals.
Evaluation of the results	Validation by an accredited person indicated by an authority of an EU member state	Certification Auditor
confirming documents	Certificate confirming the participation on EMAS	Certificate issued and signed by an accredited branch of certification.
Register	Register at European Union by the number of the concession.	There is no international register. In Brazil the ISO standards are linked to the Brazilian Institute of Metrology – INMETRO.
Monitoring & Surveillance	Ecological Control and compliance to the laws of environmental protection carried out each 3 years.	Internal Auditors, Annual External auditors, renew certification each 3 years.
Specification	Needs to publish environmental report addressed to public opinion	Possibility of fast introduction based on the others ISO management systems

Table 5.2. Comparisons between the Ecological Management systems Adapted from [83-85]

	EMAS	ISO/EN ISO 14001
Status	Under legal bases (EU Member States & EEA countries). Regulation of the European Parliament and the Council under public law	Under no legal bases. (International: worldwide) ISO standard under private law
Organisation	The entity to be registered shall not exceed the boundaries of the Member State, and it is intended to go towards entities and sites	Does not go towards entities or sites
Environmental policy	Included commitment to continual improvement of environmental performance of the organisation	Doesn't include commitment to continual improvement of environmental performance but of the performance of the system
Initial environmental review	Obligatory preliminary review, when is a first time that the company sets its environmental status	Initial review is recommended, but not required
Environmental aspects	Identification and evaluation of the environmental aspects (direct & indirect). Establishment of criteria for assessing the significance of the environmental aspects	Required only a procedure able to identify environmental aspects
Legal compliance	Obligatory to demonstrate it. Required full legal compliance. There is a compliance-audit	Only commitment to comply with applicable legal requirements. There is no compliance-audit
External communication	Open dialogue with the public. Public Environmental Statement (validated for verifiers)	Not open dialogue with public. Only is required to answer relevant communication from external interested parts. Control by public is not possible
Continual improvement	Required annual improvement	Required periodically improvement without a defined frequency
Management review	Is wider and requires an evaluation of the environmental performance of the organization, based in a performance-audit	Required an environmental performance in the management, but not through a performance audit
Contractors and suppliers	Required influence over contractors and suppliers	Relevant procedures are communicated to contractors and suppliers
Employees involvement	Active involvement of employees and their representatives	No
Internal environmental auditing	Includes system-audit, a performance - audit (= evaluation of environmental performance) and an environmental compliance-audit (= determination of legal compliance)	Included only system audit against the requirements of the standard

	EMAS	ISO/EN ISO 14001
Auditor	Required the independence of the auditor	Advised the independence of the auditor
Audits	Check for improvement of environmental performance. Frequency required: 3 years are verified at least once.	Check environmental system performance. No frequency required.
External verification	Accredited environmental verifiers	No
Verification/ Certification Scope	Verifiers accredited according to NACE codes	Certifiers accredited according to EAC code.
Authorities are informed	Obliged by validation of Environmental Statement	No obligation
Logo	yes	yes

The EMAS Regulation and the ISO 14001 standard are formalized systems that lead to the creation of management systems. They meet the requirements for improving the environment, but need not include its results in actions of preventive strategies for environmental protection. As a consequence, they lead to the creation of systems according to requirements set without necessarily applying the concepts of sustainable development.

Both systems allow and recommend the use of preventive environmental protection methods for the reduction of resources and minimization of energy consumption and waste generation (or even elimination of), all connected with the production process.

These recommendations related to reducing negative environmental impacts are the basis of a "sustainable technological process - STP." Under the definition of STP technologies are understood [15] aiming at the rational use of energy sources, and the use of renewable sources. Similarly, STP emphasizes the use of the minimum amount of resources per unit of product produced, giving priority to the use of renewable resources. Elimination of the use of toxic chemicals that can cause damage to humans or the environment is also considered, as well as considerations of the life cycle of the product and the same biodegradability and recyclability at the end of its projected life. Finally, we considered the elimination of waste formation process and safety for employees of corporations to the people living close to them

5.6. Technology acting to serve the environment

The automotive industry is a great 'consumer' of technology. Opportunistic by nature, she seeks in each new scientific discovery an opportunity to create and develop new products. One

example is an alternative fuel cell power generation. The main appeal is the fact generate electricity cleanly, have high efficiency and no need to recharge, as in conventional batteries.

The USA government estimates that by 2025, even though all vehicles running on the American roads would be the economic hybrid vehicles, including a mix of electric and internal combustion engines. This is very important as however all these initiatives, they still needing to import more oil today than they did before. They consider that hybrid cars are an alternative solution that only prolong the use of oil, extracted from non-renewable, but not a definitive solution.

Another device that reduces automobile emissions levels is the catalytic converter. Installed in the exhaust system of the vehicle, this device has the purpose of treating toxic gases, prior to release to atmosphere. The catalytic converter metals are platinum, rhodium and ruthenium, all elements being rare and very expensive. Studies in nanotechnology with carbon nanotubes showed that it is possible to reduce the concentration of these elements and still increase the efficiency in reducing emissions. Since the Nano film promises to make the surface of the windshield and hydrophobic self-cleaning, thus eliminates the traditional cleaners that are made of steel, rubber and plastic.

Some stickers contain magnetic nanoparticles which react when subjected to a thermal electromagnetic field, and this activates the adhesive properties. A major advantage is that the counterpart does not get very hot, the tools are simple, the process is fast and he spends little energy. Furthermore, it is a reversible process, i.e. when reheated the glue is released (DFD). It is believed that this may be replaced with some bolt assemblies also aesthetically undesirable, sometimes are difficult to access traditional screwdrivers.

5.7. Conclusions

The implementation of environmental management systems (ISO 14001 when both EMAS) provides a number of benefits to organizations, such as maximizing the efficient use of resources, waste reduction, demonstration of good corporate image, environmental awareness of employees, gains in understanding the impacts environmental impacts of business activities and increase profitability through improved environmental performance.

Moreover, the formal environmental management systems ISO 14001 and EMAS help companies adopt the increasing requirements of environmental protection directed to sustainable development.

These benefits mentioned make it possible to search for sustainable technological processes that are not yet achieved in practice today.

According to the principles of environmental management systems, continuous improvement is necessary for all processes and technology companies wishing to implement the EMS should take into account these principles.