Extending certification to energy management systems: a contribution to improve energy efficiency in industry

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Abstract

Energy consumption is to continue increasing, moreover, developed countries should assume a moral compromise to safeguard energy supply to almost 2 billion people who currently have no access to commercial energy. Environmental problems are associated with energy problems; timed commitments emphasizing reducing pollutant emissions were stipulated and assumed by most countries in Kyoto (1997). One action meant for implementation, concerning industry, was increasing efficiency of energy use by applying energy conservation strategies and seeking major technological advances; another one would be performing routine controls on implemented Energy Management Systems. The acceptance and adherence of industry worldwide to certification in ISO 9000 (Quality Management System) initially, and later in ISO 14000 (Environmental Management System) and OHSAS 18001 (Occupational Health and Safety Management) is outstanding. This contribution recommends the joint certification of these standards' systems with energy auditing, and broaches intervention methodologies. Consequently, a company could only have ISO 9000, ISO 14000 and, or, OHSAS 18001 certification, had it conducted in parallel the process for certifying its Energy Management System (EMS). The goal is to establish a basal platform enabling the efficient use of energy resources and minimising their environmental impact. ISO 9000 and 14000 standards, presently a factor of competitiveness amongst many industrial sectors, already portray a limited set of issues related with energy. By having these standards systems' certification tied with the certification of EMSs (according to energy efficiency and environment conservation requirements), companies are "forced" to decrease their energy consumption and their pollutant emissions (directly or through electricity production).

Introduction

Some of the areas of industrial companies are increasingly being certified. These areas include Quality Management Systems (ISO 9000) [1,2,3], Environmental Management Systems (ISO 14000) [4] and Occupational Health and Safety Management Systems (OHSAS 18001) [5]. There is a correspondence, although it is not complete, between the requirements portrayed in the ISO 9000 standards (standards for the management of quality systems) and those explicit in the ISO 14000 standards (standards for the management of environmental systems) [6]. Therefore, ISO (International Standards Organization) proposes the integration of an environmental management system to an already implemented quality management system in a company that has attained ISO 9000 certification, in order to reduce costs. If a company has not yet been awarded the ISO 9000 certification, the audits for certification in ISO 9000 and in ISO 14000 can be performed simultaneously, with the auditing teams including environmental auditors, and, additionally, energy auditors, given the importance of the improvement of energy efficiency. Notice that, at the moment, CENELEC (European Committee for Electrotechnical Standardization, http://www.cenelec.org/) is launching the draft of a Standard for Energy Management. In the fu-

ture, it is expected that the two sets of standards (ISO 9000 and ISO 14000) be combined into a single one, yielding a single document. This has not yet happened because, according to ISO, while the quality standards have so far been voluntarily implemented, the environmental standards, although being also voluntarily implemented, portray a set of requirements that coincide with legal demands in many countries. In addition, while both the ISO 9000 and ISO 14000 standards are compatible with the standards for occupational health and safety (OHSAS 18001 standards), the latter have so far not been adopted by ISO. Hence, the unification of these three sets of standards by ISO in a single management system standard is not foreseeable in the near future. Moreover, certification to ISO 14000 or to OHSAS 18001 has so far not been the object of global dissemination to the extent that ISO 9000 has. In any case, the implementation of OHSAS 18001 varies to a bigger extent from country to country, given the lack of adoption by ISO (an international and independent organization with the credibility and support necessary to foster global dissemination of standards).

INTEGRATION OF MANAGEMENT SYSTEMS IN THE MANUFACTURING COMPANY

Given the absence of a single management system standard that brings together the presently separated standards for quality management, environmental management and occupational health and safety management, an alternative way to reap the benefits of a simultaneous approach to the management of the three systems should be pursued. It consists of integrating these systems in practice inside the manufacturing company. Given the increasingly recognized connection between energy and environmental issues, the Energy Management System should be added to these systems. However, it is inevitable that the benefits of such integration be greater than the sum of the partial benefits of the independently managed systems. Disadvantages should also be relatively smaller. It seems evident that there are barriers to such integration. Although an affinity can be found, generally, among the system requirements presently set forth in the existing management system standards, there are differences found in their internal requirements. Given that a company, or organization, has functioned with the systems as separate entities, fear of change may exist and manifest itself as opposition to the integration. Integration will affect company organization, and could lead to the loss of some power, even though theoretical, of some former directors. This situation is clearly more relevant for organizations that have attained success with previous systems. Change is easier when 'things are not working properly', or 'are not running so well'. Another problem can be the increase in bureaucracy, which may get larger given the complexity intertwined with system integration. However, and according to the advice given in ISO 9000 documentation [1,2,3], a company should tailor its management systems to its dimension and reality, only putting down to paper what is strictly necessary.

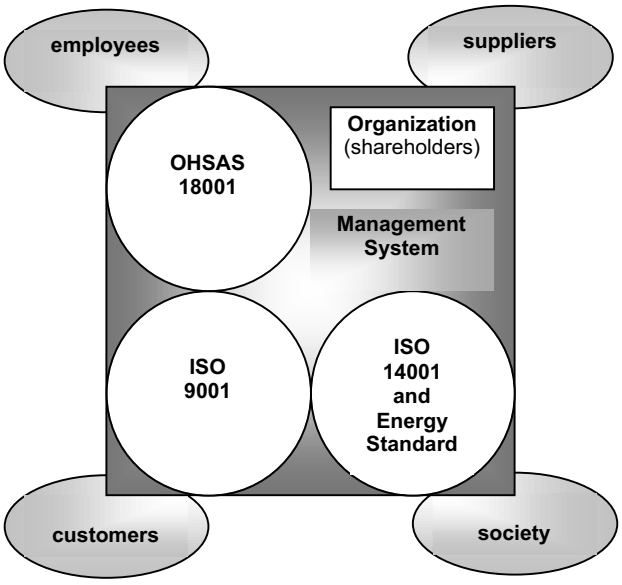

Figure 1. *The organization's stakeholders and the management system standards discussed.*

As far as benefits, or favourable arguments, are concerned for the integration of the different management systems discussed, these are above all linked to the advantages of integrating information. Information difficulties such as bottlenecks can pre-exist due to communication problems occurring in disperse systems. These disperse systems may however share common goals, such as continuous improvements, zero defects, or prevention of accidents. In this way, these activities can be integrated into a single system, and so avoiding the three-fold, or greater, increase of those documents and information channels. The interest in this integration is justified by the chaining of demand / supply inside an organization, which implies that the satisfaction of local and proper requirements would later turn these into general requirements. Worth mentioning is also the reduction of the individual certification costs, given the number of audits that are presently needed. The breadth of specializations represented in the auditing teams would conversely increase in the case of unification of the management systems and their implicit certification. In the vision of unification, the term Total Quality Management would represent, in formal terms, all the management systems in the organization, given that it is not possible to satisfy the external customers without satisfying the internal customers. Only in this manner, will the interests of all the organization's stakeholders (employees, customers, shareholders, suppliers and society) be conveniently satisfied (Figure 1).

WHY TIE UP CERTIFICATION OF QUALITY, ENVIRONMENTAL AND OH&S MANAGEMENT SYSTEMS WITH CERTIFICATION OF THE ENERGY MANAGEMENT SYSTEM?

The acceptance and adherence of industry worldwide to certification in ISO 9000 initially, and later and to a lesser extent in ISO 14000 or OHSAS 18001 is outstanding. Meanwhile, energy consumption is to continue increasing, following the growing trend of energy consumption per capita (Figure 2). Developed countries should therefore assume a moral compromise to safeguard energy supply to almost 2 billion people who currently have no access to commercial energy. Conversely, timed commitments emphasizing re-

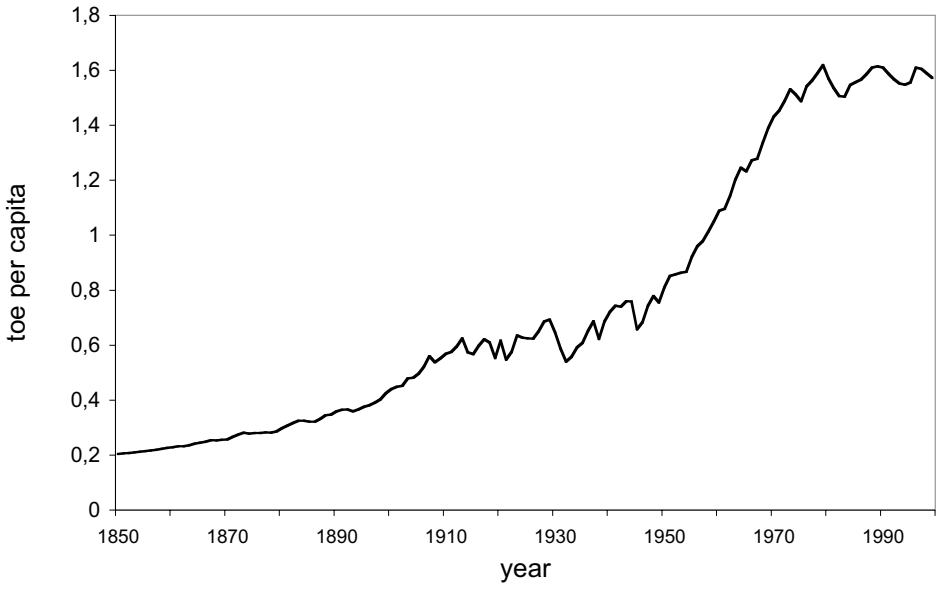

Figure 2. *Consumption of energy per capita between 1850 and 1999 [7].*

ducing pollutant emissions were stipulated and assumed by most countries in the Kyoto Summit of 1997. One action meant for implementation, concerning industry, was increasing efficiency of energy use by applying energy conservation strategies and seeking major technological advances; another one would be performing routine controls on implemented Energy Management Systems. Hence, an opportunity to bring energy conservation and pollution concerns to the top agenda of manufacturing companies resides in the joint certification of these standards' systems with energy auditing. As a consequence, a company would only have ISO 9000, ISO 14000 and, or, OHSAS 18001 certification, had it conducted in parallel the process for certifying its Energy Management System (EMS). The goal is enabling the efficient use of energy resources and minimising their environmental impact. ISO 9000 and 14000 standards, presently a factor of competitiveness amongst many industrial sectors, already portray a limited set of issues related with energy. By having these standards systems' certification tied with the certification of EMSs (according to energy efficiency and environment conservation requirements), companies are "forced" to decrease their energy consumption and their pollutant emissions (directly or through electricity production). However, the process of conducting simultaneous audits may be rather complicated, since four different auditing specialities must integrate the auditing teams and each speciality has a diverse inherent sensitivity.

The standards that define the guidelines for audit actions in Quality Management Systems (ISO 10011) and in Environmental Management Systems (ISO 14010, ISO 14011, ISO 14012) are currently being revised with the aim of creating a unique standard for auditing (ISO 19011), which enables simultaneous auditing. Therefore, if the carrying out of joint audits (quality and environmental) may be the source of controversy (because of, for example, the possibility of conflicts arising between diverse technical complexities), the occurrence of simultaneous audits in four diverse specialities (including occupational health and safety and energy) will assuredly attract more controversy, specially since there are yet no globally recognized auditing standards for energy or for health and safety. Even if hardships were envisaged, which threaten the viability of having four specialized audits performed simultaneously, a number of advantages would spring from this combined approach. Among these, the reduction of certification costs is paramount. Assistance in fighting opposition to this combined approach can be reaped from the integration of the four management systems mentioned in to one, while assuming and acting on the disadvantages of this approach and at the same time emphasizing its advantages. With the certification of the four management systems, the satisfaction of all the organization's stakeholders can be assured. Moreover, given the implementation of European projects concerned with the measurement of fuel cycle externalities (unaccounted costs of the final energy costs, for example in the production of electricity), as is the case of the EXTERNE project (http://externe.jrc.es), external customers shall probably require the certified Energy Management system, besides their requirements on quality and environmental management systems.

The following section describes strategies that may be helpful in guiding intervention in a manufacturing company towards increasing energy efficiency and conservation. Reducing energy dependence impacts natural resource utilization and pollution, with direct consequences on environmental sustainability.

The contribution of the industrial sector

Energy consumption continues to increase, leading, especially due to the continuous increase in consumption of fossil fuels, to the increase of pollutant emissions, such as those of CO_2. It is envisaged that the use of fossil fuels dominates up to the middle of the 21st century [7]. The dependency of organizations on fossil fuels brings them vulnerability. A possible way out is investing in the search for an increased

efficiency of energy use. With the rise in energy prices, the investments meant to increase energy efficiency become advantageous. In case the motivation towards energy efficiency increase is weakened because of the decrease in energy prices, environmental concerns are a motivation that should be much stronger, providing justification sufficient for investments aimed at increasing the efficiency of energy use.

The measures that should be applied in industries with a significant level of energy dependency, or even in households, have varying levels of cost and complexity. These measures can involve fitting measurement and control devices, the adequate monitoring and maintenance of equipment, or in a rather inclusive manner, the improvement of production processes, changes in facility lay-out or updating technologies to a level of increased energy efficiency. A great number of manufacturing companies have already certified their quality systems and are in the process of certifying their environmental management systems. If these companies were forced to include energy conservation procedures in their management systems, implemented with the guidance of the standards for the creation of management systems, environmental sustainability would be strengthened.

For a facility that has never been the object of an energy audit, having one done always represents a high potential for energy savings. In order to unveil this potential it is beneficial to broach the items discussed in the following subsections (initial analyses which serve as a basis for formalizing an energy conservation plan and data which is collected in an energy audit).

ON WHAT SHOULD AN ENERGY CONSERVATION PLAN BE BASED?

The determination to deploy an energy conservation plan should originate in the company's top management, in the same way as it is required for certification of Quality or Environmental Management Systems. Performing such task requires thus a very strong determination, but also the availability of human and material resources. As a starting point, in order to initiate the formalization of an energy conservation plan, the results obtained from analysing the following elements, shown here for the sake of example, can be used:

- analysis of the evolution of the history of energy use in the company in recently past years;
- determination of the influence of energy consumption in the company's financial performance;
- analysis of alternative energy sources;
- substitution or improvement in manufacturing processes.

When analysing the evolution of energy consumption, one notices in many cases that, a small increase in the level of manufactured production yields a sharp increase in energy consumption. This problem may result from diverse causes, including the inadequate maintenance of the installation, or the mismatch between the present manufacturing process and the process initially designed for the plant. The identification of this sort of problems is one of the main tasks energy auditors should perform.

Another important aspect to analyse is the level of intensity of energy use in the company, and how it influences the company's financial performance. Being able to reduce intensity of energy use through the deployment of conservation strategies will generally impact positively on costs, given a high return on the investment due to the relatively high price of energy.

Given that energy markets are becoming increasingly dynamic, it is only natural that energy prices often change. A strong dependency on energy puts the company at a serious risk of losing competitiveness in the market. A company will increase the degrees of freedom in decision making by performing an analysis of alternative energy sources, or whenever possible, by getting price quotes from different energy suppliers.

The decision of changing the production process of an industrial manufacturing company requires in many cases changing or renewing equipment. It may therefore represent a heavy cost burden for the company.

DATA COLLECTION IN AN ENERGY AUDIT

In order to perform an energy audit, one must possess detailed knowledge of both the installation and of the organization of work that is performed in the plant. For many manufacturing companies, sub-contracting the task of energy auditing to an external firm may be attractive. A decisive reason that leads to making this choice is the high quantity of specialized equipment that is necessary for data collection, besides the need of possessing the appropriately trained human resources for handling such equipment. An audit should consist of several interventions in the field, each of which has a concrete and defined objective. Four fundamental stages of an energy audit (Figure 3) are presented in the following paragraphs.

Preliminary study

The preliminary study is a way for the auditor to collect information that is needed to prepare the subsequent actions in an energy audit. The kinds of information collected at this stage include the assessment of the resources needed to carry out the energy audit, and unveiling the type of production process as well as the range of energy sources which it utilizes.

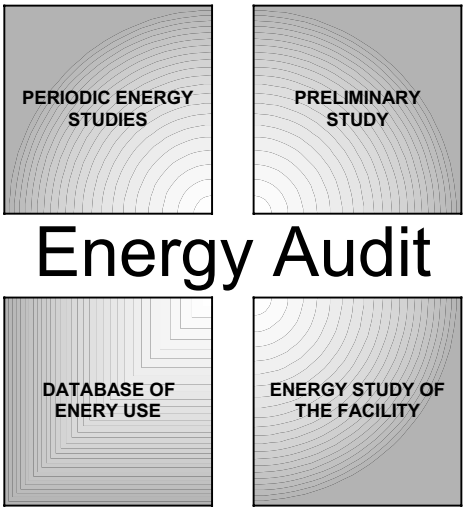

Figure 3. *Fundamental stages of an energy audit.*

Database of energy use

The database of energy use is built from information pertaining to energy expenditure of all equipment used in the manufacturing process. It may include values of voltage, current and power consumption for every entry, or concern the hourly flow of steam, fuel oil or natural gas expenditure.

Energy study of the facility

The complete energy study of the installation includes, but is not merely limited to, technical and economical aspects. The energy auditor should also recognize the existence of compartments and divisions within the organization, both production and authority wise.

Periodic energy studies

An energy study should not consist of a single event, with a beginning and an end. The energy study should be periodic, reoccurring cyclically, in a never-ending effort to optimise the use of energy resources in the company.

Conclusion

There is some evidence on the common orientation found in the systems of standards of Quality Management, Environmental Management and Occupational Health and Safety Management. In the course of the revisions that ISO 9000 has been subjected to, approaching the remaining standard systems mentioned (ISO 14000 and OHSAS 18001), increasingly this direction of approach is geared towards environmental issues. The external environment is considered in environmental management aspects and the internal environment is considered in occupational health and safety aspects. Given the common objectives, the reuniting of the independent documents in a representative document of the totality of the systems would be logical. However, this is not likely to occur in the very near future, given the aforementioned superimposition of requirements stated in ISO 14000 with legal demands of many countries and the fact that OHSAS 18001 have not yet been adopted or recognized by ISO (an international and independent organization with the credibility and impartiality necessary to foster global dissemination of the standards). An alternative way to reap the benefits of a simultaneous approach would thus consist in integrating, in practice inside the manufacturing company, the mentioned systems. This would be possible given a common structure, or backbone, that cuts through the three systems. Commonalities consist, among others, in continuous improvement, in accordance with Deming's cycle, which considers Plan, Do, Verify and Act upon the eventual non-conformities. However, in order to reap the benefits from this integration, which would consist of the efficacy of actions given the smaller spread and dispersion of information, it is necessary that organizations proceed in a form that is adapted to their dimension and characteristics. Otherwise they would take the risk of increasing bureaucracy, or having shocks of authority. Consequently, the organizations should only aim and go for such a process of management systems integration, after having acquired full conscience of the length and breadth of the steps that are necessary to be taken. This ought to be done in a systematic manner, weighing all the pros and cons springing from each part of the envisaged transformation and also from a holistic perspective.

Still, emphasis is drawn on the great interest that would be brought further by the publication of a document representing all the management systems in the company or organization. This interest is partially justified by the chaining of demand / supply inside an organization, on the one side, and the reduction of the individual certification costs, on the other. In the vision of unification, the term Total Quality Management would represent, in formal terms, all the management systems in the organization, conveniently satisfying the interests of all the organization's stakeholders (employees, customers, shareholders, suppliers and society). At present, many companies would probably benefit from linking their quality, environmental protection aspects, occupational health and safety aspects and aspects of organizational performance in their management systems. Working conditions influence product quality, while productivity improvement is dependent upon quality, ergonomics, occupational health and safety and environmental management activities. System performance can be improved by minimizing process deficiencies, accidents, environmental pollution, and increasing general well being of all employees / collaborators. This set of challenges to the organization (quality, environmental, occupational health and safety and energy management) needs to be integrated in order to be efficiently pursuable and cost effective. If energy auditors are included in the auditing and certification groups of auditors, there will be at least a formal guarantee that giant steps will be taken towards energy conservation, and consequently in the direction of a more sustainable development. Would the certification of the energy management system be bundled with the certification of the other increasingly certified systems, a more decisively important step towards sustainability would be taken. Given the increasingly severe impacts of the quality of electric energy supply on production costs, scraping, pollution and energy dependence, a collaborative effort involving suppliers, consumers, market regulators, device manufacturers, etc. is needed to assure the quality of electric energy supply, and hence also contributing to environmental sustainability.

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