A New Process-Based Approach for Implementing an Integrated Management System: Quality, Security, Environment

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Abstract—**This paper presents a new approach for implementing an integrating quality, environment and security management system on the basis of three aspects: process-based approach, risk management and a global monitoring system used as integrating factors to satisfy three important levels of integration, namely, correspondence, coordination and integration. The different steps of the proposed approach cover the whole PDCA (Plan, Do, Check, Act) scheme.**

Keywords: Integrated management system, Process-based approach, Risk management, Monitoring System.

1 Introduction

The evolution of the current industrial context and the increasing of competition pressure led the companies to adopt new concepts of management. This evolution started with focusing on control, customers requirements and continuous improvement, which leads organizations to be more oriented towards the standard ISO 9001 [8]. Later, the companies felt the need to consider the environmental requirements for civil society, which led them to focus on the environmental management system ISO 14001 [9]. Soon after, the safety of peoples and goods became a major concern as result of recurrent industrial accidents such as Chernobyl explosion and AZF. For this reason OHSAS 18001 [13] was formulated as the basis for certification of occupational health and safety management.

The major problem with these three management systems is that they were proposed separately and thus their combination is not an obvious task. Generally, parallel management systems are used, leading to separate and independent implementations of each system suffering from several weaknesses since they require many duplicate management tasks, such as written procedures, checking, control forms and other paper work suggested by the three standards.

Hence, proposing an integrated management system (IMS) including Quality, Environment and Safety management systems also known as QSE management system have drawn the attention of both academics and practitioners. These researches studied the integration of the three systems from various viewpoints, including examining the possibility of integrating, analyzing the potential benefits of it and exploring possible ways and criteria for its success. Nevertheless, a few studies have developed methodologies and approaches to implement an IMS.

This paper proposes a new process-based approach of implementing an integrated management system (IMS), on the basis of three aspects used as integrated factors namely, *process approach*, *risk management* and a *global monitoring system* and satisfies the three integration levels recently defined by Jorgensen et al. [10], namely, *correspondence*, *coordination* and *integration*. The different steps of the proposed approach cover the whole PDCA (Plan, Do, Check, Act) scheme.

The remainder of this paper is organized as follows: Section 2 presents a brief recall on international standards. Section 3 gives an overview on existing integrated management systems. Finally, Section 4 details our new approach for implementing an integrated management system.

2 A brief recall on international standards

This section gives a brief recall on quality, environment and security management systems.

2.1 Quality Management System standard (ISO 9001)

The first two editions of the standard series ISO 9001, relative to the quality system, were published in 1987 and revised several times. The most important revision was done in 2000 and the most recent one in 2008 [8]. With these versions, the standard has migrated from quality assurance to quality management. The eight main prin-

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ciples of the quality management system (QMS) are *customer focusing*, *organizations*, *leadership*, *involvement of people*, *process approach*, *continual improvement*, *factual approach* and *supplier relationship*.

Figure 1 shows the continual improvement of the quality management system which is a process-based approach composed by four types of processes i.e. *management responsibility*, *resource management*, *product realization* and *measurement analysis and improvement*. In fact, in order to maximize the customers satisfaction and the efficiency of the organization, this system considers the customers requirements as input for product realization process and their expectations as input for management responsibility. Then, a measure of their satisfaction and of the effectiveness and the efficiency of the organization will be considered as input for the measurement analysis and improvement process in order to ensure the continual improvement of the quality management system.

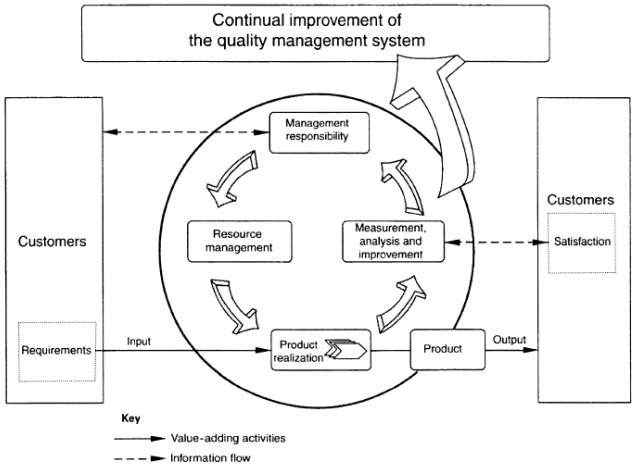

Figure 1: Model of process-based quality management system [8]

2.2 Environmental Management System standard (ISO 14001)

The standard relative to the Environmental Management System (EMS), known as ISO 14001, was first published in 1996 and revised in 2004 [9]. This system is used to develop and implement the environmental policy and to manage its aspects by providing tools to enable the organizations to control the impact of their activities, products and services on the natural environment aspect. Figure 2 shows different steps for continual improvement in EMS.

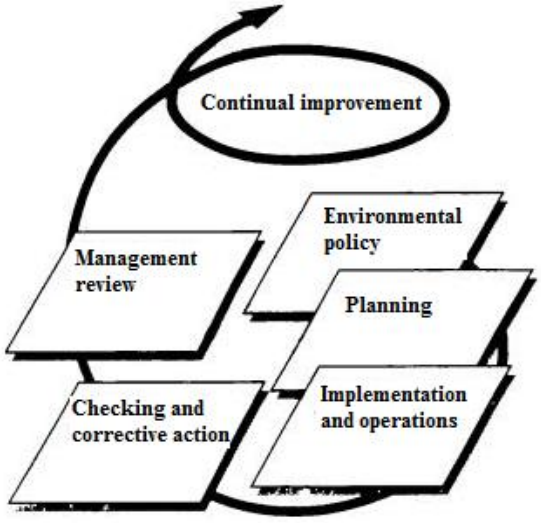

Figure 2: The environmental management system according to ISO 14001 [9]

2.3 Occupational Health and Safety Management System standard (OHSAS 18001)

The standard relative to the Occupational Health and Safety Management System (OHSAS), actually known as ISO 18001, was first proposed in 1999 [13] and revised in 2007 in order to create and maintain a safe working environment. This standard is applicable for any organization to establish an OHS management system, which will help it to minimize risks regarding its employees and customers. It is important to note that this standard has the same structure than the standard ISO 14001(see figure 2).

3 Related work

Research concerning integrated management systems, started at the same time with the publication of EMS in 1996 by Puri [14] where a set of guidelines were proposed in order to integrate the EMS and QMS. Once the OHSAS was formulated, the need to consider the three systems was resented and many researches have been carried out in order to build more sustainable integrated management systems.

Theses researches can be classified into three categories: the first discusses the relations among the three management systems as *similarities*, *compatibilities* and *differences*. On the basis of these three characteristics the second one proposes a set of guidelines including ideas and factors for a successful integration of the three systems. In this context, Fresner and Engelhardt [7] propose through the experience of two small companies in Austria

an immediate and visible improvement in OHS, service quality and EMS. Moreover, Jorgensen et al. [10], propose three ambitious levels of integration i.e. *correspondence*, *coordination* and *integration* for a more sustainable IMS, then, Zeng et al. [17] define the internal and external factors affecting the implementation of IMS through a structured questioner survey conducted in china and recently, Jorgensen [11] proposes more sustainable management systems through life cycle management on the basis of the three levels proposed in [10]. Using results and ideas from the second category, the third one proposes models and approaches to implement an IMS. In this context, Wilkinon and Dale [16] propose two approaches, the first consists in achieving integration including the emergence of documentation through aligned approach and similarities in the three standards and the second implements the integrated system through a total quality management approach.

Another important work is the one of Labodova [12] who proposes two ways of integration, the first consists of the introduction of individual systems followed by the integration of originally separate ones and the second is an integrating management system based on the risk analysis. Finally, Zeng et al. [17], propose a different approach based on the definition of specific integration factors extacted from questionnaires then they propose a synergetic multi-level model for implementing an IMS.

We can also mention the case of several countries which developed their own integrated management standard such as Australia [2] and France [1]. However, these local standards can not be intended for certification since they just represent guidelines and recommendations for the integration.

From this review, it is clear that the proposed approaches, are not still in coherence with the original and recent ideas proposed by Jorgensen et al. [10]. Indeed the approach proposed by Labodova [12] involves only the correspondence level, by introducing the risk management, which is not sufficient to deal with all management systems since it allows a separate evaluation of risks levels relative to each system and ignoring the interaction between them. Also the approach proposed by Zeng et al. [17] is only based on the internal and external factors affecting the implementation and does not take into account the three levels of integration. Thus, our idea is overcame the weaknesses of existing systems by proposing a new process-based approach for implementing an IMS dealing with the three integrating levels proposed by Jorgensen et al. [10]. This approach will be detailed in the next section.

4 New approach for total integration of IMS

We propose now a new approach for a total integration of the three management systems i.e. Quality, Security and Environment by considering different interactions between their policies, objectives and resources. Indeed, the three systems are based on the same continual improvement approach i.e. PLAN, Do, Check, Act (PDCA) as shown in table 1 and their consideration in the same organization can generate confusion, incoherence and incompatibility while integrating them. Thus, in order to implement a robust integrated management system, we propose the use of the three integration levels recently defined by Jorgensen et al. [10] and detailed as follows:

Table 1: The correspondence between the three standards

Standards	ISO 9001 :2008	OHSAS 18001 :2007	ISO 14001 :2004
Plan	Quality policy Quality objectives planning	Security and health policy OHS objectives planning	Environmental policy Environmental objectives planning
DO	Realization of product	Implementation and operation of OHS program	Implementation and operation of environmental program
Check	analysis and and improvement	Checking and corrective action	Checking and corrective action
Act	Management review	Management review	Management review

Correspondence: this level is important since it increases the compatibility between the three systems in order to reduce add-problems issued from parallel systems as bureaucracy and duplication of work tasks. In addition, this level minimizes duplication of paper work and confusion between standards. It also, simplifies the internal and external audits.

Coordination: this level is based on a common understanding of generic process and tasks management cycles (Plan-Do-Check-Act) and it, essentially, ensures synergies and tradeoffs between the three systems by aligning their policies and coordinating their objectives and targets.

Integration: this level leads to the interaction with stakeholders, continuous improvement of the performance, a better understanding of internal and external challenges and also to a responsibility culture.

To satisfy these three levels, our idea is to use three integrating factors, the first one is *risk management* to guarantee the correspondence between the three management systems, the second is *process approach* to coordinate between the activities and to reach more efficiently the objectives, and the third is a *monitoring system* to ensure the integration as continuous improvement of the performance around the same structure i.e. (Plan-Do-Check-

Act). Before detailing our approach, we just give some basic concepts regarding these three integrating factors.

4.1 Integrating factors

4.1.1 Risk management

The use of risk management as integrating factor, increases the compatibility and the correspondence between the three systems in order to reduce add-problems issued from parallel implementations since the same source of hazard can causes risks to targets in many management areas, as the risk on the environment, the risk for health and safety, and risk for quality and economic losses. For instance, an explosion in a plant (as the AZF one) can cause:
- a security problem sine employees can be injured,
- an environmental problem since it can blew the windows of nearby residents and pollute the air,
- and a quality problem since it can generate a supply disruption for customers.

The risk management is the common factor between each management system to identify each risk source and possible target system relating to quality, security and environment leading to a possible failure to reach up different objectives. Once, the sources of risks are identified, we have to evaluate each risk by the combination of the probability of occurrence and the consequences of it. This evaluation allows us to define the appropriate preventive, corrective and improvement plans to reduce the levels of risks. Finally, we should provide the personnel, technical and financial resources required for each program.

4.1.2 Process-based approach

To deal with coordination as integration level, we should consider all the activities of a company and their interactions in the same model. To satisfy this requirement, the process based approach seems to be an adequate tool. This approach is only a normative requirement of the standard ISO 9001 V2008, and our idea is to adopt it for the three standards to have a global process-based approach integrating the requirements of stakeholders and taking into account quality, security and environment aspects. The process based-approach consists in modeling all the whole process of a company and their interaction in the same model namely *process cartography*. Thus, this cartography allows us in one hand to identify the input and the output of each process, therefore it leads us to a common understanding of the generic process and the examination of synergies and trade-offs, in the other hand to the alignment of policy, objectives and targets. In addition, the process analysis allows the identification of sources of hazard. This identification is the starting point to control the process and to define the requirements such as personnel, technical, and financial resources to reach up different objectives. Also, the process approach provides an adequate framework to analyze the potential causes of risks and help decision makers to adopt the appropriate decisions for the three systems.

4.1.3 Monitoring System

To ensure the monitoring of the global system and the integration as a continuous improvement of the performance we have to evaluate the states of processes. An adequate tool to ensure this task is the use of performance indicators which are variables indicating the effectiveness and/or efficiency of a part or whole of any process or system in order to evaluate its state with regard to pre-set objectives. Typically, a model of performance indicators is composed of three main parameters i.e. objectives, measures and evaluations [4]. Measures can be provided from four different sources, such as customers, audits, controls and ouridea is to consider each of them as a performance indicator.

4.2 Proposed process-based approach for IMS

Our approach for integrating management system is illustrated by figure 3, where the different steps cover the whole PDCA (Plan, Do, Check, Act) scheme. The idea here is to gather these steps into three phases such that the first one concerns the *Plan* step, the second, the *Do* step and the third the *Check* and the *Act* steps. These three phases can be detailed as follows:

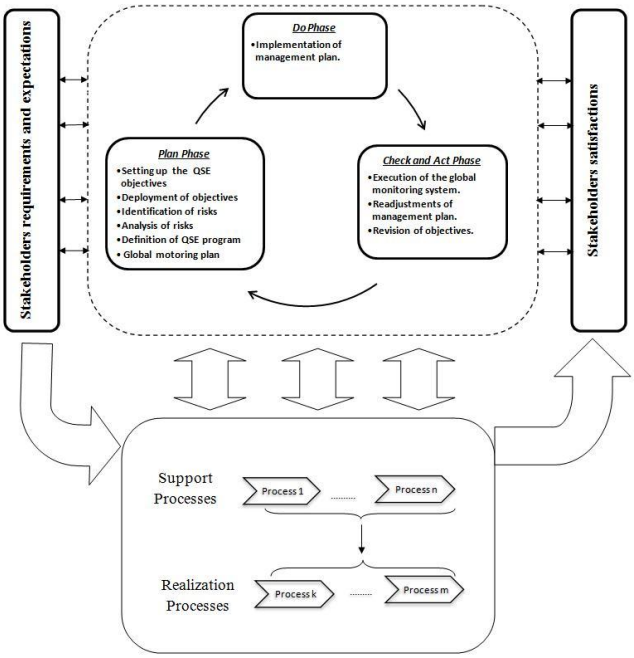

Figure 3: Proposed process-based approach for IMS

- **Plan phase**: This phase leads us to a better understanding of the current situation in order to carry out the objectives and to define for each process the requirements, tools, methods, responsibilities and the resources. To this end, we propose six steps, the first consists in setting up all quality, security and environment objectives issued from the requirements and the expectations of stakeholders (i.e. customers, employees, population, environment, etc.). In the second, we will deploy all these objectives in each process on the basis of the support and the realization process to coordinate and balance them, from this step each process will have its own objectives. The third step consists in the analysis of each process with respect to the pre-set objectives defined in the second one in order to identify the sources of hazard and possible targets leading to a possible failure to reach up the objectives. In the fourth step, each identified risk has to be analyzed in term of potential consequences in each management area. Unfortunately, existing approaches for risk evaluation as *preliminary risk analysis preliminary* (APR), *hazard operability* (HAZOP), *failure mode and effects analysis* (FMEA), *fault tree analysis*, *event tree analysis* and *bow tie* analysis are not appropriate to deal with many management areas simultaneously and they are usually limited to technical level. In a previous work, we have proposed an extension of the FMEA analysis method in order to take into account a risk level for each management area using a multi-criticity system based on a fuzzy logic [3], such an approach can be used in order to deal with many management areas, also the process-based approach provides an adequate framework to analysis the potential causes of risks. In the fifth step we have to define a global management plan QSE to implement selected treatments as preventive and corrective actions, in order to reduce levels of risks already identified and to improve the efficiency of the IMS. To this end, we have to consider the interaction between the different management areas, indeed some decisions can be beneficial for some management areas and harmful for others, for this, we propose to use the multi-criteria approach proposed by Ben Romdhane et al. [3], this approach is based on the Analytic Hierarchical Process (AHP) methodology to define the appropriate action plan when many criteria (as the management areas) should be considered. finally, the sixth step is devoted to the definition of an appropriate monitoring plan, in order to ensure the well implementation of the global management plan. This monitoring plan should, obviously, take into account the importance of different processes, their interactions and the level of identified risks . The global monitoring plan can be built by several tools such as: customers satisfaction, audits, controls and performance indicators of processes. The idea here is to consider of all these tools as performance indicators. Since they are heterogeneous, to this end we propose the use a system of performance indicators such as the one proposed by Berrah et al. [5] which considers several performance indicators allowing us to take into account different diversified objectives.

- **Do phase**: This phase has as input the global management plan QSE and the corresponding global monitoring plan generated from the plan phase and will implement the selected treatments. Note that we have to define the appropriate Scheduling to optimize the resources in order reach up the objectives more efficiently.

- **Check and Act phase**: Once the do phase achieved, this phase will finalize the process of integration by the measure of the effectiveness of different decisions and their readjustments via three steps. In the first one, we have to measure all the indicators already defined indicators in order to evaluate the effectiveness of selected treatments and to estimate the degree of achievement of objectives. For this reason, we have to aggregate the indicators of each objectives. In the second step, a readjustment of the management plan will be done in order to satisfy unreached objectives. To deal with these two steps, we can adopt the approach developed by Cliville et al. [6] which is based on Berraha et al. methodologies [5] to aggregate the performance measurements and to allow decision-makers to define appropriate corrective actions in order to reach up all the objectives. Although, some objectives may not be reached, that is why we should revise some of the initial assigned objectives in order to make their satisfaction possible, in this context we propose the third step (i.e. revision of objectives) in order to contribute to sustainable development.

5 Conclusion

This paper proposes a new process-based approach for implementing an integrated management system respecting *Quality*, *Security* and *Environment* standards. Our approach covers the whole PDCA (Plan, Do, Check, Act) scheme and ensures from its initialization a coherent and complementary design. This is visible from the definition of different objectives where we introduce a predictive step supported by adequate tools in order to ensure their coherence so that they so that they can control the three systems simultaneously. Using these objectives, we design a global management program through a controlled deployment. This is realizable on the basis of the process-based approach and the risk management. This program will integrate an optimized planning of all resources and methods needed for an effective management. It will be also consolidated by an adapted global monitoring system

respecting the three standards. Once the global planning is initialized on a *Plan phase*, a *Do phase* ensures its execution. Finally, the proposed integrated system will be controlled in a *Plan and Check* phase, by adopting the principles of the factual approach of decision-making. One of the main advantages of our approach consists in the fact that it is in adequacy with the eight fundamental principles of quality management, namely:

- The *leadership* and *customers' orientation* extended to stakeholders and that have been considered in the definition and the planning of the objectives.
- The *process-based approach* that we have used to define the global monitoring plan.
- The *factual approach of decision-making* and the *continuous improvement* which constitute the base to guarantee the cohabitation of the three systems in a unique one which is self- adaptive due to its dynamic aspect.
- The two remaining principles, namely, the *personnel implication* and the *mutually beneficial relations with the suppliers* will be considered as important criteria in the *Do phase* relative to the implementation of the integrated system.

In addition to these eight principles, we remain in coherence with the three integration levels recently defined by Jorgensen et al. [10], namely the correspondence, coordination and the integration which will be taken into account in the various phases of our approach. Finally, the concretization of our approach depends on its enrichment by adequate tools in order to ensure the effective and operational integration by objectives. This will be the subject of our future work.

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