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INTEGRATED MANAGEMENT SYSTEMS IN CONSTRUCTION PROJECTS (IMSINCONS)

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Abstract

The implementation of integrated management systems in construction, together with cost and time controls, is recognised as an effective tool to optimise the resources to implement and maintain environmental, quality and occupational safety and health systems. The objective is to promote the improvement of the quality of the constructed facility (a building, a bridge, a road), to reduce the environmental pollution and to reduce the occupational accidents and professional diseases. Societal demands (environment), client's demands (quality, including cost and time constraints) and workers' demands (occupational safety and health), as well as legislative requirements, are the primary forces leading the industry to a better quality of life for all parties. To achieve this objective on a construction project there is a need to act, beginning at the inception, design and planning phase of the project through its execution and utilisation/exploitation phases. Owners and company managers play a strong role in this objective. They should define the policy for each project, considering and prioritising their concerns, not only on cost and time as traditionally, but also taking into account the environmental, quality and occupational safety and health issues. They should also give the authority and power to those who are assigned by them (or acting on their behalf) the responsibility to implement and maintain their policy, and allocate the human and material resources that are needed to carry out the policy. The practical implementation of any policy is mainly a problem of organisation and responsibility - the two "columns" of any management system. In this paper, an approach to implementing an integrated management system in relevant construction projects based on ISO 9001:2000 is presented and discussed taking into the standards ISO 14001:1996 (environment) and ISO 10006:2003 (quality management in projects), as well as the ILO/OSH 2001 guide for the implementation of safety and health management systems.

Keywords

Construction; ISO 9000; ISO 14000; ILO/OSH 2001; EU Directive 92/57/EEC.

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Abbreviations used in this document:

CM – Construction Management
CPM – Construction Project Management
ILO – International Labor Organization
IMS – Integrated Management Systems
ISO – International Organization for Standardization
OSH – Occupational Safety and Health

1 INTRODUCTION

Construction Project Management (CPM) and Construction Management (CM) are two concepts very well known by all construction experts, but some times different meanings are used in some countries. The first (CPM) considers the management of the entire cycle of the development of a construction project, from inception, design and planning to project startup, sometimes, to the end of the "period of warranty" (usually, 5 to10 years after the execution phase, largely depending on the country). The second (CM) typically includes the management effort during the execution phase, and sometimes it may include the contract award phase (it usually does not include the design phase). In the CPM format, the owner designates the so-called "Project Manager" and in the CM format the owner designates the so-called "Construction Manager". In both cases, this manager could be the owner's in-house personnel if the owner has such capabilities, but often it is an external expert (single person or an organization, acting on behalf of the owner). In some cases (e.g. European Union Directive 92/57/EEC), these professionals are also called "Project Supervisors" being responsible for supervising the design and/or the execution of the project. When their responsibilities are restricted to the design phase, they are usually called "Project Supervisors for the design phase/stage" and when their responsibilities are restricted to the execution phase they are usually called "Project Supervisors for the execution (or construction) phase/stage".

When a CM approach is considered, the construction manager, acting on behalf of the owner, has the primary duty of overseeing (and to assure the accomplishment of) the contracts established between the owner and the various contractors. In many cases, they do not participate in the formulation of these contracts and, additionally, they have no responsibility in the quality for the design documents. They supervise the construction of the project based on the owner's requirements included in the contract with the contractors. If the requirements are not appropriate or the design documents are poor, the construction manager usually has a reduced responsibility for the quality of the final product. If this condition exists, it may be more difficult for the project execution to be successful and the objectives defined by the owner may also be more difficult to be achieved.

On the other hand, in a CPM approach the project manager will have the responsibility for the entire process, including design documents approval and the supervision of the contract documents with the contractors. The implementation of an integrated management system has, in this case, a greater probability of being successful depending on the commitment and the skilfulness of the project manager team, of the design team and of the contractor team (staff personnel, subcontractors, workers). In some cases, the CPM approach is also complemented with a CM team, acting under the responsibility of the project manager.

This paper is organised in three main sections. In the first, some requirements for implementing an integrated management system (IMS) in construction are presented. The following section refers to the identification of the main documents and the hierarchy of an IMS in construction. The next section refers to a proposed structure for the main documents identified in the previous section, which is based mainly on the ISO 9001:2000, taking into account the ISO 14001:1996, the guide ILO/OSH 2001 and the ISO 10006:2003. Finally, some conclusions and recommendations are provided, to assist in the generation of a discussion that is needed on these matters between all construction experts.

2 REQUIREMENTS TO IMPLEMENTING AN IMS IN A CONSTRUCTION PROJECT

The successful implementation of an integrated management system for a construction project using the CPM approach, relies on the ability of the design team and of the construction team and must be planned at the very beginning of the contract award process. It is then essential to evaluate the team's ability to assure a high probability of success of the management system.

The parties to the construction process should be prepared and organised in two sections: (i) requirements for the implementation of the IMS to be considered in the contract award phase; and (ii) requirements to be considered during the design and execution phases.

The first "requirements" should be included in the "competition programme", which contains the rules for awarding the contract and they must be followed by all potential competitors. The second "requirements" should be included in the "specifications", which contain the rules during the design and execution phases of the construction project and they must be followed by the successful contractor.

2.1 Requirements to be considered in the contract award phase

During the contract award phase, the ability of the competitors should be evaluated prior to final selection. This can be done through the inclusion of the requirements needed for this evaluation. The competitors must demonstrate their ability to use the appropriate management techniques integrating the environment, the quality and the occupational safety and health issues, as well as cost and time controls. Within the guidelines of the compulsory legislation, the international standards ISO 9001:2000 (quality) and the ISO 14001:1996 (environment) may be considered, together with the guide ILO/OSH 2001 and, when applicable, also the European Union Directive 92/57/EEC.

This demonstration should be based on the integrated management system that the competitor proposes to implement for the construction project under consideration. For this purpose, a technical note with a brief description of the proposed system may be required considering the following: (i) a declaration of the formal management policy to be implemented in the construction project under consideration, which must include statements related to the environmental, quality and occupational safety and health issues, as well as cost and time; (ii) the need to show the accuracy of the system to assure a correct and adequate environmental performance, the quality of the services to render, and the occupational safety and health concerns, having in mind the design, the execution and the utilisation/exploitation phases; (iii) it should be based on the standards and guidelines referred to above, and also on the legislation applicable to the construction project under consideration; in the case of changes of any of these documents during the process of the construction project the system shall be updated as necessary; (iv) it should include a nominal organisational chart for the construction project under consideration, together with the curricula and the functions of all relevant personnel that have an influence on the management of the system; the expert that will assume the responsibility for the management of the integrated management system must also sign a declaration to act with dedication, assiduity and proficiency; (v) it should consider the different and specialised work to carry out the construction project under consideration; (vi) it should include the structure of the IMS and also the list and a brief description of the formal procedures to be developed for the project (applicable to quality, environment, safety and health); (vii) it should include the structure of specific plans needed, namely, monitoring, measuring, and controlling environmental, quality and safety and health issues.

2.2 Requirements to be considered during the design and execution phases

The potential competitors must adhere to the previous requirements on presenting their proposals to carry on the project.

The implementation of any management system involves resources and their related costs. This means that during the contract award phase, the specifications must define the requirements to develop the integrated management system.

The specifications must then state, for example, that the contractor has the obligation to establish, maintain and implement an IMS based on the technical information presented during the contract award phase and taking into account any comments made by the owner's staff. This system must be in conformance to all the applicable legislation related to the environment, quality, safety and health, and it must fulfil all the elements of ISO 9001 (quality), ISO 14001 (environment), ILO/OSH 2001 and, when applicable, the European Union Construction Sites Directive 92/57/EEC (safety and health). It can also be stated that the system must be based on the structure of ISO 9001 introducing the necessary adaptations to fulfil all the above mentioned elements.

The IMS should: (i) include an adequate plan to cover the three areas (environment, quality and safety and heath) and the associated procedures, and include the specific monitoring, measurement and prevention plans, work instructions, and audit program, taking into account the different work involved in the project; (ii) consider the creation of IMS working commission for each construction site and for the project as a whole (in this case representatives of the owner will be included); this commission is intended to follow up the implementation of the system; (iii) take into account and be compatible with the organisational structure of the owner.

The specifications must also include some statements to clarify the relationship between the owner (or owner's representative) and the contractor as, for example, the followings: (i) during a fixed period (e.g., two months) after the contract is signed, the contractor must present the IMS according to the above mentioned requirements, as well as an implementation plan, allowing the owner sufficient time (e.g., one or two months) to introduce changes to the proposed system ; (ii) without prejudice of the above mentioned periods, no relevant activity related to the design or to the execution phase can start before the contractor presents the plan for assuring the accuracy of that activity, concerning the environment, quality and safety and health; (iii) the owner has the power to audit the IMS in any time beginning three months after the contract is signed and the contractor has the obligation to implement the changes needed as a result of any recorded non conformity; the owner may also participate in the audits carried out by the contractor with any subcontractors; (iv) the owner may order the creation of new records or redefine the scope and extent of the traceability, and the contractor must reformulate the system within one month or within an agreed period depending on the extent of the changes to be introduced; (v) the owner is entitled to access to all documentation and records of the IMS (including that of the contractor and the subcontractors), including internal audit reports and the owner may also ask for hard copies of this documentation; (vi) the contractor must propose the assignment of a responsible (manager) for the IMS, who is subject to approval by the owner; this manager is responsible for the implementation, maintenance and the continual improvement of the system; this individual's qualifications must be specified for each project (e.g. requirement to be a civil engineer, possess at least 10 years of documented experience, etc.); in the case of very important projects, it can also be required that this manager be assisted by an expert for each of the areas (environment, quality and safety and health); these assistant managers must also be qualified in the respective area of expertise; (vii) the contractor must bear the costs of assigning all the resources needed to implement an effective IMS; the owner may also require, at the expenses of the contractor, the installation or use of any collective or personnel equipment

recognised to be essential for the improvement of the system; (viii) at the end of the project, the contractor must provide all the relevant IMS documentation, including, the records generated, the tracking documents, safety and health plans, safety and health files, maintenance plans, etc.; (ix) the contractor must conduct a survey of all situations related with work that can affect third parties, namely, of the existing buildings and other installations in the area of influence of the project; this survey must include inspections of buildings or installations, the use of documentary reports of the initial situation and the follow up; (x) the contractor must present a monthly report summarising the situation on the implementation of the IMS during the project (design and execution phases); this report must be organised for each construction site and for the project as a whole; it is intended to evaluate the performance and progress of the IMS during the period of the contract; the model of this report must be proposed by the contractor within 2 months after the contract is signed; the owner may order the introduction of changes, namely, other relevant information needed for this evaluation.

3 DOCUMENTATION IN AN IMS IN CONSTRUCTION AND ITS HIERARCHY

An integrated management system may be organised and structured in different ways. It is the author's belief that a system involving the areas of quality (including cost and time controls), environment, and safety and health, must include the elements of the international standards ISO 9001 and ISO 14001, and also the elements of the ILO/OSH 2001 on safety and health and, when applicable, they should also meet the requirements of the European Union Directive 92/57/EEC. It may also consider the ISO 10006:2003 on quality management in projects.

Of the mentioned areas, the implementation of quality systems is the most widely known and the most widely used in the construction industry, where considerable experience has already identified many of the strong and weak points. Therefore, the author believes that in the construction industry an integrated management system should be based and aligned to the ISO 9001, which must be adapted to accommodate the elements for the other areas that are not included or related to any element of this standard.

The documentation of an integrated management system in construction and its hierarchy could be similar to the one shown in Figure 1, which is briefly described below.

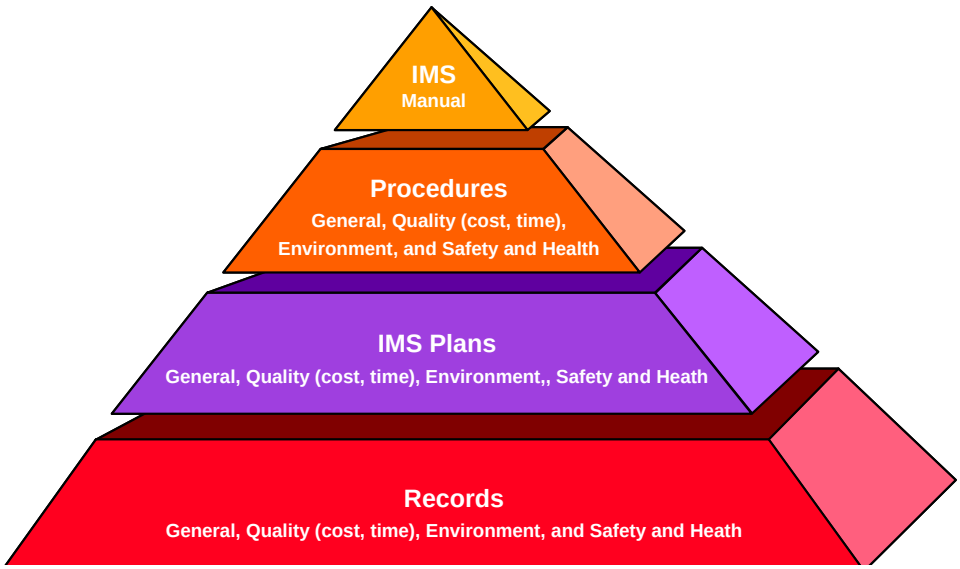

Fig. 1 – Documentation of an IMS in construction and its hierarchy

According to this figure, the IMS includes the following main documents:

- IMS Manual (for the whole organization);
- IMS Procedures (those that are common or general to the three areas, those related specifically to quality including cost and time, those related specifically to the environment, and those related specifically to safety and health);
- IMS Plans (for each construction project, which may include and/or be related to specific plans on quality, environment, and safety and health);
- IMS Records (documentation of the implementation of the system).

The IMS Manual is the main document of the integrated system and should be prepared when the system is to be implemented by a construction company, i.e. for the whole organization. It defines the general rules for the entire organization and it contains the management policy, the structure of the organization and the responsibilities of all personnel of the organization that influence the management of the organization. This manual can be developed to meet the elements presented in section 4, i.e., it may be organized by following the elements considered in the proposed structure.

The IMS Procedures must complement the information of the manual. They must be detailed with the necessary information needed for the most relevant elements of the manual, including the procedures mentioned in the ISO 9001 and ISO 14001 standards. For example, the “control of a nonconforming product” requirement may refer to a written procedure describing the operational process for this control. It is recommended that all procedures be grouped in one single dossier, usually called the “Procedures Manual”.

The IMS Plans are documents with particular information concerning each construction project of the organization. They must conform to the IMS manual and to the applicable laws and regulations, in particular in the areas of environment and safety and health. They must set up the specific preventive measures to be implemented for a particular construction site, taking into account the construction processes and the working methods that will be used. There will be as many plans in an organization as there are construction projects undertaken by the organization.

The IMS system will also include the work instructions, documents describing the work process concerning each construction operation. These working instructions are the basis to identify and assess the monitoring, measurement and hazards involved in the execution of any construction operation and to define the appropriate corrective and/or preventive measures that must be implemented to avoid or reduce the risk of poor quality work and the occurrence of injuries/diseases. They are essential documents for the definition of the monitoring, measurement and hazard prevention plans.

For the implementation of the IMS in the construction industry, there are two situations to be considered: (i) the system is to be implemented in an organisation (a construction related company) or; (ii) the system is to be implemented on a specific construction project. In the first case, the organisation should consider developing all the above mentioned documents. In the second case, it should consider developing just the relevant plans (and their related documents, e.g. procedures, monitoring, measurement and hazard prevention plans, etc.). In some cases the organisation and the construction project may be the same entity (as is the case when a group of companies join to perform a specific project, e.g. consortiums, joint-ventures, groups of economic interests). In these cases, the organisation should decide on developing either an IMS Manual or an IMS Plan for that specific construction project, but not both.

Once the documentation and its hierarchy are identified, the next step is to establish the contents of the IMS manual and/or plan, as described further in the next section.

4 PROPOSED STRUCTURE OF THE MAIN DOCUMENTS IN AN IMS IN CONSTRUCTION

On the practical level, the IMS Manual (for an organisation) and/or the IMS Plan (for a specific construction project) should consider all the applicable elements of the standards and/or guidelines related to the three areas as mentioned above: ISO 9001:2000 for quality, ISO 14001:1996 for environment and ILO/OSH 2001 for occupational safety and health. As the issue is construction, the ISO 10006:2003 (quality management in projects) should also be considered.

Of the above-noted standards or guidelines, ISO 9001:2000 is the broadest, i.e. it includes the most detailed list of elements related to management. So, this standard (Figure 2) will be taken as a basis for the comparison to the others in view of identifying and analyzing their relationships.

Elements of the ISO 9001:2000	
1 Scope	**7 Product realization**
1.1 General	7.1 Planning of product realization
1.2 Application	7.2 Customer-related processes
2 Normative reference	7.2.1 Determination of requirements related to the product
3 Terms and definitions	7.2.2 Review of requirements related to the product
4 Quality management system	7.2.3 Customer communication
4.1 General requirements	7.3 Design and development
4.2 Documentation requirements	7.3.1 Design and development planning
4.2.1 General	7.3.2 Design and development inputs
4.2.2 Quality manual	7.3.3 Design and development outputs
4.2.3 Control of documents	7.3.4 Design and development review
4.2.4 Control of records	7.3.5 Design and development verification
5 Management responsibility	7.3.6 Design and development validation
5.1 Management commitment	7.3.7 Control of design and development changes
5.2 Customer focus	7.4 Purchasing
5.3 Quality policy	7.4.1 Purchasing process
5.4 Planning	7.4.2 Purchasing information
5.4.1 Quality objectives	7.4.3 Verification of purchased product
5.4.2 Quality management system planning	7.5 Production and service provision
5.5 Responsibility, authority and communication	7.5.1 Control of production and service provision
5.5.1 Responsibility and authority	7.5.2 Validation of processes for production and service provision
5.5.2 Management representative	7.5.3 Identification and traceability
5.5.3 Internal communication	7.5.4 Customer property
5.6 Management review	7.5.5 Preservation of product
5.6.1 General	7.6 Control of monitoring and measuring devices
5.6.2 Review input	**8 Measurement, analysis and improvement**
5.6.3 Review output	8.1 General
6 Resource management	8.2 Monitoring and measurement
6.1 Provisition of resources	8.2.1 Customer satisfaction
6.2 Human resources	8.2.2 Internal audit
6.2.1 General	8.2.3 Monitoring and measurement of processes
6.2.2 Competence, awareness and training	8.2.4 Monitoring and measurement of product
6.3 Infrastructure	8.3 Control of nonconforming product
6.4 Work environment	8.4 Analysis of data
	8.5 Improvement
	8.5.1 Continual improvement
	8.5.2 Corrective action
	8.5.3 Preventive action

Fig. 2 – Elements of ISO 9001:2000

4.1 ISO 9001:2000 versus ISO 14001:1996

In figure 3 the main elements of ISO 9001 are compared with those of ISO 14001, which elements are also presented to facilitate the analysis. From this figure, it is possible to identify some of the elements of ISO 14001:1996 that have a clear similarity to one or more of the elements of ISO 9001:2000, while others have some similarity. Where the contents and focus are different, some adaptations need to be considered and introduced. This is the case, for example, of the Policy which is focused on quality in ISO 9001 and on environmental issues in ISO 14001. The integration of these two issues in the same policy does not offer any difficulty and even sounds appropriate. The same approach should be followed concerning the objectives and targets which are different for quality and for environment.

On the other hand, some elements of the ISO 14001 do not appear to be related, i.e. they have no explicit reference counterpart although they could be considered in one or more elements of the ISO 9001. This is the case, for instance, of the legal and other requirements (ISO 14001 - 4.3.2), which could be included in the “customer-related processes” (ISO

9001 – 7.2). Another case is the topic of "emergency preparedness and response" (ISO 14001 - 4.4.7), which could be considered for example in "control of non conforming product" (ISO 9001 – 8.3).

Main elements of ISO 9001:2000	Elements of ISO 14001:1996																
	4.1	4.2	4.3.1	4.3.2	4.3.3	4.3.4	4.4.1	4.4.2	4.4.3	4.4.4	4.4.5	4.4.6	4.4.7	4.5.1	4.5.2	4.5.3	4.5.4	4.6
4 Quality management system																		
4.1 General requirements	X																	
4.2 Documentation requirements										P						P		
5 Management responsibility																		
5.1 Management commitment							X											
5.2 Customer focus																		
5.3 Quality policy		X																
5.4 Planning					P	P												
5.5 Responsibility, authority and communication							P		P									
5.6 Management review																		X
6 Resource management																		
6.1 Provisition of resources							X											
6.2 Human resources							X	P										
6.3 Infrastructure							X											
6.4 Work environment							X											
7 Product realization																		
7.1 Planning of product realization												X						
7.2 Customer-related processes			P	P					P			P						
7.3 Design and development											P	X						
7.4 Purchasing												X						
7.5 Production and service provision												X						
7.6 Control of monitoring and measuring devices														X				
8 Measurement, analysis and improvement																		
8.1 General														X				
8.2 Monitoring and measurement														X			P	
8.3 Control of nonconforming product													X		X			
8.4 Analysis of data														X				
8.5 Improvement							P								P			

X Identified relation (explicit reference) P Partial relation (non explicit reference although may be implicit)

Elements of ISO 14001:1996	
4.1 General requirements	4.4.4 Environmental management system documentation
4.2 Environmental policy	4.4.5 Document control
4.3 Planning	4.4.6 Operational control
4.3.1 Environmental aspects	4.4.7 Emergency preparedness and response
4.3.2 Legal and other requirements	4.5 Checking and corrective action
4.3.3 Objectives and targets	4.5.1 Monitoring and measurement
4.3.4 Environmental management programme	4.5.2 Noncorformance and corrective and preventive action
4.4 Implementation and operation	4.5.3 Records
4.4.1 Structure and responsibility	4.5.4 Environmental management system audit
4.4.2 Training, awareness and competence	4.6 Management review
4.4.3 Communication	

Fig. 3 - Relation between ISO 9001:2000 and ISO 14001:1996 elements

Consequently, the elements of ISO 14001 that ISO 9001 should accommodate in an explicit way (whether considered in one or more elements of this standard) are: legal and other requirements (4.3.2); communication between management and the population (4.4.3); and emergency preparedness and response (4.4.7).

4.2 ISO 9001:2000 versus ILO/OSH 2001

A second step is to compare the elements of ISO 9001 with those of ILO/OSH 2001 and analyse their relationship with a focus on identifying duplications between them (Figure 4). The elements of this guide are also presented to facilitate the analysis.

This figure shows that most elements of ILO/OSH 2001 could be covered by one or more elements of ISO 9001, although some unclear relationships can be identified in some elements, i.e., there is no obvious counterpart of some elements. This is the case of the "worker participation" (element 3.2), which is a very important element of ILO/OSH 2001. The "emergency prevention, preparedness and response" (element 3.10.3) and the "investigation of work-related injuries, ill health, diseases and incidents and their impact on safety and health performance" (element 3.12), are elements that have no obvious counterpart in ISO 9001, but they could be considered as one or more elements of ISO 9001 extending the concept to accommodate theses issues.

Consequently, the elements of ILO/OSH 2001 that ISO 9001 should accommodate in an explicit way (whether in one or more elements of the standard) are: worker participation (3.2) through at least the recognition by management of the workers' representatives and the promotion of the safety and health committees; communication (3.6) between management and the workers and their representatives; prevention and

control measures (3.10.1) at the level of the management responsibility and at the level of product realization; management of change (3.10.2); emergency prevention, preparedness and response (3.10.3); procurement and contracting (3.10.4 and 3.10.5); investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance (3.12).

Main elements of ISO 9001:2000	Elements of ILO/OSH 2001 GUIDELINES															
	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16
4 Quality management system																
4.1 General requirements																
4.2 Documentation requirements					X					P						
5 Management responsibility																
5.1 Management commitment																
5.2 Customer focus																
5.3 Quality policy	P															
5.4 Planning								P	P							
5.5 Responsibility, authority and communication		P	P			P										
5.6 Management review							X							X		
6 Resource management																
6.1 Provisition of resources																
6.2 Human resources				P												
6.3 Infrastructure																
6.4 Work environment																
7 Product realization																
7.1 Planning of product realization								P								
7.2 Customer-related processes										P						
7.3 Design and development								P								
7.4 Purchasing										P						
7.5 Production and service provision																
7.6 Control of monitoring and measuring devices																
8 Measurement, analysis and improvement																
8.1 General																
8.2 Monitoring and measurement											P	P	P			
8.3 Control of nonconforming product										P			P			
8.4 Analysis of data														X		
8.5 Improvement															P	P

X Identified relation (explicit reference) P Partial relation (non explicit reference although may be implicit)

Elements of theILO/OSH 2001 Guidelines	
Policy	3.10.2 Management of change
3.1 Occupational safety and health policy	3.10.3 Emergency prevention, preparedness and response
3.2 Worker Participation	3.10.4 Procurement
Organizing	3.10.5 Contracting
3.3 Responsibility and accountability	Evaluation
3.4 Competence and training	3.11 Performance monitoring and measure
3.5 OSHMS documentation	3.12 Investigation of work-related injuries, ill health, diseases and
3.6 Communication	incidents, and their impact on safety and health performance
Planning and Implementation	3.13 Audit
3.7 Initial review	3.14 Management review
3.8 System planning, development and implementation	Action for improvement
3.9 OSH objectives	3.15 Preventive and corrective action
3.10 Hazard prevention	3.16 Continual improvement
3.10.1 Prevention and control measures	

Fig. 4 - Relation between ISO 9001:2000 and ILO/OSH 2001

4.3 ISO 14001:1996 versus ILO/OSH 2001

It should be noted that ISO 14001 and ILO/OSH 2001 are similar on the core issues as both are hazard prevention oriented, although in many cases these hazards are different. For example, the element 4.3.1 of ISO 14001 is referred to as "environmental aspects" ("an element of an organisation's activities, products or services, which can interact with the environment") which is related to environmental hazard identification (e.g. noise emission may cause an "environmental impact", such as noise disturbance). In ILO/OSH 2001 the element 3.10.1 (prevention and control measures) includes safety and heath hazards identification as a basis for the definition of prevention and control measures. It can be said that both ISO 14001 and ILO/OSH 2001 have the same concerns, although with different contents and objectives.

It should also be noted that on construction sites, it is not easy to distinguish an environmental hazard from a safety and health hazard in many situations. For example, noise emissions or dust on a construction site are hazards that should be evaluated, eliminated or reduced to address the safety and health of the construction workers, but this effort will also provide an environment improvement as it relates to the population.

4.4 ISO 9001:2000 versus ISO 10006:2003

Another important standard that should be considered in this analysis is ISO 10006:2003 (Guidelines to quality management in projects), which is related specifically to the construction sector, although the author does not know any construction project where it has been implemented in a practical manner. In figure 6 the main elements of this standard, which are also presented to facilitate the analysis, are compared with those of ISO 9001.

Main elements of ISO 9001:2000	ISO 10006:2003 - Guidelines for quality management in projects																
	4.1	4.2	5.1	5.2	5.3	6.1	6.2	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	8.1	8.2	8.3
4 Quality Management system																		
4.1 General requirements								X										
4.2 Documentation requirements	X	X					X											
5 Management responsibility																		
5.1 Management commitment			X	X														
5.2 Customer focus				X														
5.3 Quality policy		X																
5.4 Planning		X							X									
5.5 Responsibility, authority and communication				X														
5.6 Management review				X	P				P									
6 Resource management																		
6.1 Provisition of resources						X	X											
6.2 Human resources				X		X	X											
6.3 Infrastructure																		
6.4 Work environment				X														
7 Product realization																		
7.1 Planning of product realization									X	X	X							
7.2 Customer-related processes													P					
7.3 Design and development										X								
7.4 Purchasing				X						X					X			
7.5 Production and service provisition										P								
7.6 Control of monitoring and measuring devices																		
8 Measurement, analysis and improvement																		
8.1 General																		
8.2 Monitoring and measurement																	X	
8.3 Control of nonconforming product																		
8.4 Analysis of data																	X	
8.5 Improvement				P												X		X

X Identified relation (explicit reference) P Partial relation (non explicit reference although may be implicit) Non identified relation

ISO 10006:2003 Quality management systems - Guidelines for quality management in projects	
4 Quality management systems in projects	7 Product realization
4.1 Project characteristics	7.1 General
4.2 Quality management systems	7.2 Interdependency-related processes
5 Management responsibility	7.3 Scope-related processes
5.1 Management commitment	7.4 Time-related processes
5.2 Strategic process	7.5 Cost-related processes
5.3 Management reviews and progress evaluations	7.6 Communication-related processes
6 Resource management	7.7 Risk-related processes
6.1 Resource-related processes	7.8 Purchasing-related processes
6.2 Personnel-related processes	8 Measurement, analysis and improvement
	8.1 Improvement-related processes
	8.2 Measurement and analysis
	8.3 Continual improvement

Fig. 6 - Relation between ISO 9001:2000 and ISO 10006:2003

This figure shows that most elements of ISO 10006 could be covered by one or more elements of ISO 9001, although at least two of them were more difficult to identify as having a clear counterpart, namely elements 7.5 – Cost-related processes and 7.7 – Risk-related processes. These elements together with others (such as 7.4 - Time-related processes) are indeed very important when dealing with construction – they are part of

the core business of construction project execution. Most of the other elements can be identified in other elements of ISO 9001 although in some instances this requires some adaptation. Consequently, the elements of ISO 10006:2003 that ISO 9001 should accommodate in an explicit way include: project characteristics (element 4.1); time-related processes (7.4); cost related processes (7.5); and risk-related processes (7.7).

4.5 Proposed elements of the main documents of an IMS in construction

The elements of ISO 9001:2000 (quality) were compared with those of the ISO 14001:1996 (environment), of the ILO/OSH 2001 (occupational safety and health) and of the ISO 10006:2003 (quality management in projects). For each of these comparisons, some considerations were presented regarding the elements that should be included in an explicit way when dealing with management concerning construction: cost and time, as well as quality, environmental and occupational safety and heath issues.

Based on these considerations, the issue now is to adapt the elements of ISO 9001:2000 by expanding the contents of some of the elements to accommodate or include the important elements that should be explicit.

ISO 9001:2000 should include environmental and occupational safety and health issues by incorporating a few changes that are needed. The first is to substitute the word “quality” with "management", the word "customer" with "client" or, where appropriate, by “client, workers and population”. In this context, the word "client" could also be used with different meanings depending on the area. Concerning the environment the client would be the population or the society, concerning quality the client would be the customer and concerning safety and health the client would be the workers.

Some examples of this adaptation include: the element 4.2.2 would be “management manual” instead of “quality manual”; the element 5.3 would be “management policy” instead of “quality policy”; the element 8.2.1 would be “satisfaction of client, workers and population” instead of “customer satisfaction”. The proposed adaptations are shown in figure 7 and denoted with * next to the element.

Related to the elements of each standard or guide (ISO 14001, ILO/OSH 2001 and ISO 10006) that should be added, the issue is to decide where they should be integrated in the actual structure of ISO 9001:2000. The proposed integration is shown in figure 7 and denoted with ** next to the element.

In this figure, the hazard prevention and control measure was considered in two different sections of the ISO 9001:2000 modified. The first one was considered in section 5 (management responsibility), under 5.4 (planning) and, more precisely, in 5.4.3 which was called “general hazard prevention and control measures”. The reason for this option is due to the fact that the main concerns on hazard prevention should rely on management responsibility, which has the power and authority to decide the level of prevention that should be considered on each construction project. The second section where hazard prevention was also included is 7 (product realization) under 7.1 (planning of product realization), and more precisely, on 7.1.3 (hazard-related processes and control measures) as each construction activity involves hazards that should be identified, assessed and prevention measures taken.

A final comment is related to the "application" (1.2) as ISO 9001:2000 allows the exclusion of the requirements that do not affect the organisation's ability (limited to those within requirement 7 - Product realisation). In spite of this, for the development of the IMS Manual and the Plan, all requirements should be considered for inclusion at least by level 2 (the 26 elements 4.1 to 8.5) of the proposed structure and, where appropriate, excluded elements should be noted as "not applicable" together with a justification for the exclusion.

1 Scope
1.1 General
1.2 Application
2 Normative reference
3 Terms and definitions
4 (~~Quality~~) Management system
4.1 General requirements
4.2 Documentation requirements
4.2.1 General
* 4.2.2 (~~Quality~~) *Management* manual
4.2.3 Control of documents
4.2.4 Control of records
** *4.3 Project characteristics*
5 Management responsibility
5.1 Management commitment
* 5.2 (~~Customer~~) *Management* focus
* 5.3 (~~Quality~~) *Management* policy
5.4 Planning
* 5.4.1 (~~Quality~~) *Management* objectives *and targets*
* 5.4.2 (~~Quality~~) Management system planning
** *5.4.3 General hazard prevention and control measures*
** *5.4.4 Legal and other requirements*
** *5.4.5 Emergency prevention, preparedness and response*
** *5.4.6 Management of change*
** *5.4.7 Management committees*
5.5 Responsibility, authority and communication
5.5.1 Responsibility and authority
* 5.5.2 Management *and worker's* representatives
5.5.3 Internal communication
5.6 Management review
5.6.1 General
5.6.2 Review input
5.6.3 Review output
6 Resource management
6.1 Provision of resources
6.2 Human resources
6.2.1 General
6.2.2 Competence, awareness and training
6.3 Infrastructure
6.4 Work environment
7 Product realization
7.1 Planning of product realization
** *7.1.1 Time-related processes*
** *7.1.2 Cost-related processes*
** *7.1.3 Hazard-related processes and control measures*
* 7.2 ~~Customer-related~~ Processes *related to the client, the workers and the population*
7.2.1 Determination of requirements related to the product
7.2.2 Review of requirements related to the product
* 7.2.3 Communication with the client, the *workers and the population*
7.3 Design and development
7.3.1 Design and development planning
7.3.2 Design and development inputs
7.3.3 Design and development outputs
7.3.4 Design and development review
7.3.5 Design and development verification
7.3.6 Design and development validation
7.3.7 Control of design and development changes
7.4 Purchasing
7.4.1 Purchasing process
7.4.2 Purchasing information
7.4.3 Verification of purchased product
** *7.4.4 Procurement and contracting, including subcontracting*
7.5 Production and service provision
7.5.1 Control of production and service provision
7.5.2 Validation of processes for production and service provision
7.5.3 Identification and traceability
* 7.5.4 Property of client *and other parts*
7.5.5 Preservation of product
7.6 Control of monitoring and measuring devices
8 Measurement, analysis and improvement
8.1 General
8.2 Monitoring and measurement
* 8.2.1 ~~(Customer)~~ satisfaction *of client, workers and population*
8.2.2 Internal audit
8.2.3 Monitoring and measurement of processes
8.2.4 Monitoring and measurement of product
** *8.2.5 Investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance*
8.3 Control of nonconforming product
8.4 Analysis of data
8.5 Improvement
8.5.1 Continual improvement
8.5.2 Corrective action
8.5.3 Preventive action

* Elements of ISO 9001:2000 modified ** Elements added to the ISO 9001:2000

Fig. 7 - Proposed elements of the main documents of an IMS in construction

5 CONCLUSIONS

In this paper a structure for the implementation of an integrated management system in construction was presented and discussed. It attempts to contribute to the discussion on the need for a single methodology to implement the areas under consideration in the construction industry including cost and time concerns. The proposed structure is based on the ISO 9001:2000 elements, taking into account the specific environmental and occupational safety and health issues included in ISO 14001 and ILO/OSH 2001, and also the ISO 10006 on quality management in projects. The result is a combination of elements whose contents were extended and others were added to more fully address the needs of the construction process.

Although more work will be done on this subject, it is the author's belief that the benefits that can be achieved with such an alignment warrants an open discussion.

The recent publication of the internationally recognised guide ILO/OSH 2001 to be applied to the implementation of occupational safety and health management systems, together with the other mentioned standards for quality and environment, strengthen the need for this discussion.

The alignment of these standards and guide may have a circular benefit between the areas involved, as the improvement of one will also improve the others due to their inter-relationships. It may also favour the international market and facilitate the growth of relationships between construction companies of different countries, in particular those of the same region, as is the case of the European Union.

It is well known that competitiveness and productivity in construction goes hand by hand. They are key elements for the success of any construction company and construction project. However, it is the author's belief that this is achieved by improving the quality of life of those who will use the constructed product and through better working conditions for those who will build it. After all, people are the most valuable resource in any organisation. The improvement of effective management systems surely helps to achieve these objectives, as they are also a key factor that should not be underestimated.

REFERENCES

International Labour Organisation – ILO (2001) - Guidelines on Occupational Safety and Health Management Systems (ILO/OSH 2001).

International Organisation for Standardisation - ISO (1996): Environmental Management Systems – Specification with guidance for use (ISO 14001:1996).

International Organisation for Standardisation - ISO (2000): Quality Management Systems – Requirements (ISO 9001:2000).

International Organisation for Standardisation - ISO (2000): Quality Management Systems – Guidelines for performance improvements (ISO 9004:2000).

International Organisation for Standardisation - ISO (2003): Quality Management Systems – Guidelines for quality management in projects (ISO 10006:2003).