Entwicklung und Implementierung eines integrierten technischen Managementsystems

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Development and Implementation of an Integrated Technical Management System

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Preface

This doctoral thesis is my performed task as a doctoral student during the past five years at the Institute of Manufacturing Technology and Quality Management (IFQ) at Otto-von-Guericke-University Magdeburg.

Firstly, I would like to give my particular thanks to my first advisor Prof. Dr.-Ing. Martin Molitor, Managing Director of the Institute of Manufacturing Technology and Quality Management (IFQ) for making me able to write and finish this doctoral thesis during the last five years of my studies and for giving me the overall boundaries of the research area.

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Abdulkhalek M. Kadir
Magdeburg, September 2005

Abstract

Today organizations of the manufacturing business and service industries are facing higher quality requirements, more standards for environmental protection and increased regulations for occupational health and safety (OH&S). With the permanent increase of manufactured products, energy consumption and losses, these three requirements become more stringent and this makes it necessary for organizations to design a new method for achieving them by means of integrating the QMS, EMS, and OH&S-MS.

Up to now there are no unified national or international standards for quality, environment and OH&S and there are no specific standards concerning integrated management systems. Even in the current studies this imperfection still remains. The solution for removing any lacks and achieving the quality, environment and OH&S requirements for customers, products, and society is given by the constitution of an integtrated technical management system "ITMS", the design of which is the main task of this work. It comes by entering each face of related technical activities, technology and engineering principles into the process.

The framework for designing this "ITMS" constitution consists of five procedures - portioning, unification, integration, standardization, and implementation - assisted by the establishment of a computer-aided collection data centre (CACDC) accompanied by data modelling and standardized documentation (SD). All used methods are developed according to ISO 9000:2000, ISO 14000:2003, and OHSAS 18001:1999 & OHSAS 18002:2000. Under the "ITMS" design offered in this thesis new definitions of customer, organization and product are developed, technical elements are demonstrated, and it is shown how gaps in the quality, environment and OH&S requirements could be filled.

Zusammenfassung

Produktions- und Serviceorganisationen sehen sich heutzutage hohen Qualitätsansprüchen ausgesetzt. Zusätzlich steigen die Anforderungen und Vorschriften für den Arbeits- und Umweltschutz. Durch eine ständig steigende Produktion, hohem Energieverbrauch und Verlusten aller Art, steigen die genannten Anforderungen weiter und können von den Organisationen mit neuen Methoden nur dann weiterhin erfüllt werden, wenn QMS, EMS und OH&S-MS integriert werden.

Bis zum jetzigen Zeitpunkt existieren keine einheitlichen Qualitäts-, Umweltschutz- und Arbeitsschutzstandards für den nationalen und internationalen Raum. Desgleichen gibt es keine spezifischen Standards für integrierte Managementsysteme. Selbst aktuelle Studien bieten nur unvollkommene Ergebnisse. Die Bildung eines integrierten technischen Managementsystems ermöglicht es, vorhandene Mängel zu entfernen und den Anforderungen von Kunden, Produkten und der Gesellschaft an

Qualität, Umwelt und Arbeitsschutz gerecht zu werden. Die Entwicklung eines integrierten technischen Managementsystems „ITMS“ ist Hauptbestandteil dieser Arbeit, welches durch Implementierung passender technischer Aktivitäten, Technologien und Ingenieurgrundlagen in den Prozess realisiert wird.

Das Grundkonzept für den Aufbau dieses „ITMS“ besteht aus den fünf Verfahren: Fragmentierung, Vereinigung, Integration, Standardisierung und Implementierung, unterstützt durch eine zentrale rechnergestützte Erfassung von Daten (CACDC), einhergehend mit Datenmodellierung und standardisierter Dokumentation (SD). Die verwendeten Methoden wurden anhand ISO 9000:2000, ISO 14000:2003 und OHSAS 18001:1999 & OHSAS 18002:2000 angefertigt. Basierend auf das in dieser Doktorarbeit vorgestellte „ITMS” werden neue Definitionen für Kunden, Organisationen und Produkte entwickelt, technische Elemente präsentiert und es wird dargestellt, wie vorhandene Lücken in den Qualitäts-, Umwelt- und Arbeitsschutzanforderungen gefüllt werden können.

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0.2 List of Abbreviations

ANSI	American National Standards Institute, it is a non-profit organization that administers and coordinates the united stated voluntary standardization and conformity assessment system.
AVSQ	Association of Quality System Evaluators, constituted in 1994 by ANFIA, Italy's National Association of Car-Building Industries, used by Italy's Fiat S.p.A, Alfa Romeo, Innocenti, Lancia, Maserati and Ferrari as the basis for their quality process. It closely resembles QS-9000 (but differs in five ways). It also overlaps EAQF and VDA 6.1 and relies on ISO 9001:9002 registration. It concentrates on two areas of checking the manufacturing process's stability, and developing products from design through the completion stage.
BS/ BSI	British Standards/ British Standards Institution, is the National Standards Body of the United Kingdom, responsible for facilitating, drafting, publishing and marketing British Standards and other guidelines, and develops standards and standardization solutions to meet the needs of business and society.
BVQI	Most widely recognized certification body in the world of: Quality, Health and Safety, Environment and Social Responsibility. United Kingdom. Recognized by 30 accreditation bodies worldwide.
CACDC	Computer-Aided Collection Data Centre.
CIC	Coordination-Intersection-Combination Function.
DBMS	Database Management System.
DIN	*Deutsches Institut für Normung e.V.* (German Institute for Standardization).
DIS	Draft International Standard, is the key stage in the development of an ISO. Is the end result of the work produced by a Working Group and approved by a Technical Committee. DIS stage is more than 95% technically accurate, is sent to the voting as an FDIS (Final Draft International Standard) for final approval which automatically be instructed as a formal ISO standard within 60 days. DIS and FDIS documents may be used as trade references between buyers and sellers.
EAQF	Stands for Evaluation, Aptitude Quality and Supplier, is an ISO 9001-based French automotive requirement, published in 1994, used by Citroën, Peugeot S.A. and Renault. And administered by the Groupe *d'Etude Sur la Certification Automobile (GECA)*. With VDA 6.1 and AVSQ:1994 give similar results to their users, but each has a different grading method.

EFQM	European Foundation for Quality Management, is the primary source for organizations in Europe looking to excel in their market and in their business. Founded in 1989, EFQM is now globally-minded organizations of all sizes and sectors, and both private and public. The EFQM Excellence Model was introduced at the beginning of 1992 as the framework for assessing organizations for the European Quality Award. The EFQM Forum 2005 wishes to make European business more competitive.
EMS	Environmental Management System.
EMAS II	The Eco-Management and Audit Scheme- European Union/ The scheme was launched in April 1995 and revised in 2001.
EPA	U.S. Environmental Protection Agency.
FMS	Financial Management System.
Four Structures	Organizational Structures (Or.St.), Operational Structures (Op.St.), Products Structures (Pr.St.) and External Structures (Ex.St.).
GR	General Regulations contains regulations, guidance, rules, laws, codes, etc.
HMMS	Hazardous Material Management System.
HRMS	Human Resources Management System.
IATF	International Automotive Task Force- IATF members include the vehicle manufacturers as: BMW, Daimler Chrysler, Fiat, Ford Motor Company, General Motors (including Opel Vauxhall), PSA Peugeot-Citroen, Renault SA, Volkswagen and their respective trade associations: AIAG (U.S.), ANFIA (Italy), FIEV (France), SMMT (U.K.) and VDA (Germany).
IS	International Standards issued by ISO.
ISO	International Organization for Standardization or International Standards Organization.
"ITMS"	Integrated Technical Management Systems of Quality, Environment and OH&S, and it is "standardized" in accordance with International Standards.
JAMA	Japan Automobile Manufacturers Association Inc. is a nonprofit trade association representing 14 Japanese car, truck, bus and motorcycle manufacturers.
JISC	Japanese Industrial Standards Committee consists of many national committees and plays a central role in standardization activities in Japan. The task is the establishment and maintenance of Japanese Industrial standards, accreditation and certification, development of measurement standards, and technical infrastructure for standardization of industrial and mineral products.
LV 21	*Länderausschuss für Arbeitsschutz und Sicherheitstechnik (LASI): Arbeitsschutzmanagementsysteme- Spezifikation zur freiwilligen Einführung, Anwendung und Weiterentwicklung von Arbeitsschutzmanagementsystemen, LV 12, 2000.* (LASI 21:2000, OH&S-Management System- Specification, by German States).

LV 22	*Länderausschuss für Arbeitsschutz und Sicherheitstechnik (LASI): Arbeitsschutzmanagementsysteme- Handlungshilfe zur freiwilligen Einführung und Anwendung von Arbeitsschutzmanagementsystemen (AMS) für kleine und mittlere Unternehmen (KMU), LV 22, 2001*. (LASI 22:2001, OH&S-Management System- Handling Assistance, by German States).
MMS	Marketing Management System.
NS	National Standards issued by countries and associations.
NSO	National Standards Organization.
OHSAS	Occupational Health and Safety Assessment Series.
OH&S-MS	Occupational Health and Safety-Management System.
OSHA	Occupational Safety and Health Administration. The department of Labor of the U.S. government with the responsibility to ensure safety and healthful work environments.
PCT	Performance-Cost-Time Criteria.
QMS	Quality Management System.
QS-9000	Quality System Requirements. It is the common supplier quality standard for Daimler Chrysler Corporation, Ford Motor Company and General Motors Corporation. QS-9000 is based on the ISO 9001:1994, but it contains additional requirements that are particular to the automotive industry. It applies to suppliers of materials, production and service of parts, heat treating, painting, plating and other finishing services.
RMS	Risk Management System.
RTA	Related Technical Activities, as (auditing, inspection, testing, etc.), they are one face of TE.
TE	Technical Elements, as (RTA, Technology and Engineering).
Three Areas	Quality, Environment, Occupational Health and Safety or QMS, EMS, OH&S-MS.
TMS	Training Management System.
VDA 6.1	The German automotive industry's quality requirements, published by the Association of German Automobile Industry *(Verband der Automobilindustrie)*, VDA 6.1's fourth edition was released in 1998, becoming valid Jan. 1, 1999. it was constituted by 27 major stakeholders, including Daimler Chrysler, Audi, BMW and Volkswagen, to exceed ISO 9001:1994's requirements and integrate other supplier quality standards (including EAQF, AVSQ and QS-9000:1995). It consists of two essential parts: management responsibilities and business strategy, and product and process requirements, they encompass 23 elements.

0.3 List of Figures

0.4 List of Tables

Chapter 1- Introduction

1.1 Overview

Manufacturing businesses, as well as the service industries today, face stringent quality requirements than ever before and now find themselves confronted with the challenges of international needs such as increased life span of products, reduced production cycle time, total costs and an increased number of multinational markets. The increasing needs of producing high quality products, more concern for environmental protection and increasing requirements for occupational health and safety of workforce and public make it necessary to look for a new way of meeting these requirements together with the same efforts and costs. These factors also call for the establishment of a new philosophy, a system or practical solution in management systems of quality, environment and occupational health and safety inside a dynamically progressing world.

Due to expanding industries and service sectors all over the world, there is a permanent increase of operational manufacturing and energy consumption. Products and services must be on a high quality level, the environment needs to be preserved, and the occupational health and safety needs to be strengthened. All these are processed under new technical and technological development and must result in effective cost management and time.

Now most industries, manufacturers, distributors, vendors, suppliers, customers and consumers find it necessary to have a common understanding of management systems, namely quality, environmental protection, and occupational health and safety. The design of the above management systems depends on the national and international standards and regulations, rules, laws, codes and so on, and receives power from them as ISO 9000:2000 for quality management systems, ISO 14000:2003 for environmental management systems and OHSAS 18001:1999 & 18002:2000 for occupational health and safety management systems. In addition, it depends on other regional models such as the European Foundation for Quality Management EFQM-Model, specific standards for automotive manufacturing ISO/TS 16949:2002 and many other national standards as DIN in Germany, ANSI in USA, BSI in Britain and JISC in Japan and so on. These standards define the most critical elements in their management systems.

Each of these management systems plays a key role in the effectiveness of each other. They are technically and functionally interrelated, even though each of them exists individually. Today it is needed to develop a complete unified system in order to understand the area of quality, environment and OH&S and their interdependences in a better way and hence, increase the effectiveness of management systems, because there are interrelations between all achievements of a high level of product quality, more environmental preservation and higher occupational health and safety for workforce and public in order to minimize overall losses. “In Germany, the losses by OH&S are around $ 90 billion annually” [Pischon, 1999, page 41].

And as seen from their interrelation, the achievement of high level of product quality depends on other requirements and affects their levels as well. “The quality specifications are derived from customer requirements and orders, internal and external quality standards, environmental requirements, laws, regulations and technical developments” [Thierfelder, 2000, page 58-59]. Because of this strong interrelation all product requirements are connected with each other. “The requirements of products include quality, environment, health and safety, fabrication, cost performance ratio and functionality” [Umwelt-10, 2000, page 509].

There is also a strong interrelationship between manufacturing processes and the total unit of quality level, environmental pollution and its adverse impacts on people’s health. A lot of studies prove this mutual dependence between them. “In manufacturing of steel, the released compounds are CO_2, SO_2, NO_x, VOC_s and solid waste, and potential environmental impacts are air, soil and water contamination, ground ozone and acid rain” [UNEP, 1997, page 29].

Management systems of quality, environmental protection, and occupational health and safety consist of common technical elements such as auditing, controlling, inspection, etc. The other faces of technical elements are technology and engineering. They take a vital role in these management systems because they have a huge affect on their parameters. Also they play a significant function as a solution for any problem in these systems. “Five main areas require urgent engineering solutions, such as energy use, waste disposal, material recycling, damage repairing and design” [Duggan, 1999, page 34]. A good design and new technology will ensure more environmental protection and cost reduction. An example for that is the automotive part manufacturing. “The direct injection of gasoline offers significant potential for improving the fuel economy and CO_2 emissions” [Fry, 1999, page 103]. In addition, faces of technical elements will increase the competition basis in operational manufacturing and continual improvement. “Be-

cause customer needs and expectations are changing, and because of competitive pressure and technical advances, organizations are driven to improve continually their products and processes" [ISO 9000:2000, 2.1].
According to these mentioned needs and necessities of this situation, it is required to develop, maintain and implement a new integrated system for the management of quality, environment, and occupational health and safety (OH&S) through technical elements and then standardizing them according to national and international standards and other required regulations.

The Integrated Technical Management System "ITMS" is an advanced method to resolve this impasse. (definitions and meanings of the integration in chapter 6.1& 6.5). The technical elements need to be recognized, unified and their management systems are to be integrated in order to form an integrated technical management system. Such a system is to be implemented into all concerned departments and operated in an effective way.
Several procedures need to be done in order to perform an "ITMS" constitution process: portioning the organization, unifying technical elements, integration procedure, standardizing and implementing the integrated management systems. Each procedure has its vital role and benefits.

The role of the QMS is distinct and assists the new direction of the technical integration constitution. Being a part of the organization's management system, it gives additional possibilities for integration with EMS and OH&S-MS and other management systems like financing and marketing and focuses on the needs and requirements of customers, society and other external parties. Here, in sight of the technical integration process, there are interrelation between the definitions of customer, organization and product. They have common or similar identification because their goals are interrelated and depend on each other.

In order to support operation of the new integrated technical management systems, it must establish a unified documentation that must be standardized in accordance with international standards which contain all necessary documentation of QMS, EMS and OH&S-MS and their operations inside an organization, and establish a center of computer-aided collection data with data modelling. All these are required to support the new system.

The role of the organization's workforce is essential for the development and managing of the new system as it is involved in many production and service activities that affect their personal occupational health because most organizations staff is involved in the production processes. "A study on seven companies as Siemens, Toshiba, I.G.C, General Electric, etc. shows that all of the seven companies focused on human factors as a means of manufacturing improvement" [Gilgeous, 1999, page 25- 44].

1.2 Literature Review and Previous Work

In the field of integrated management systems for quality, environment and occupational health and safety there exist several studies and investigations of other researchers which were written before and also during this thesis work.
There are series of studies about quality management and occupational safety and health in Europe [Tb 70. 1996]. This publication of many authors contains several articles on the issue of unification and integration between quality and occupational health and safety with environmental protection. They observe investigations on possible consequences in working out the conditions of integration, discuss how to combine each of them and describe models of working conditions in operations and other activities within an organization. Another author questioned whether the QMS is sufficient to perform the product requirements. He tried to find ways of integration, whereas other authors discuss the planning of QMS and show how to plan integration process principles. They are demonstrated in models with individual phases of systematic occupational health and safety in QMS and EMS. These investigations deal with factors like: management system selection, lists of physical effects, working time, hazardous substances, objective priorities, activity implementation, monitoring and so on.
These investigations are still based on the old version of ISO 14000:1996 when less attention was paid to technical elements. In addition, the description of integration is small because the investigation volume was divided by some authors, and organizational and operational structures were yet not considered.

One book [Waite, 1998] talks about the issue of integrated performance assurance and how management systems of quality, environment, health and safety can be combined. This study is an approach for the first step of planning and implementing an integrated performance assurance programme. It meets one side of the integration of performance assurance and gives a detailed description of this approach. Additionally, it focuses on the sections of implementation, assessment and cost reduction. It takes little care of standardization according to the national and international standards and regulations.

Another book [Schnurr, 1998] discusses the relationship between quality, environment and OH&S related to the denotation of integration. This reference provides several investigations and shows a detailed way into integration and concentrates on the integration of policies for environmental, social and economic aspects. The investigation is more connected with the integration policy and mixtures with cultural and economic factors. In addition, it focuses on environmental issues.

In a doctoral thesis [Reinhardt, 1999] there are four different integration processes presented. The author adds the two areas of occupational health and environmental protection as 21st and 22nd elements of QMS by introducing occupational health OH and environmental protection procedures into the QMS handbook and presents most of the

OH&S specifications (page 90-99). He identifies 28 sections to be the framework of the integration structuring (page 140-160). The thesis contains many forms and checklists of the process preparation. However, it does not focus on technical elements.

In a publication [Pishon, 1999] a successful intent is presented that shows how to set up an integrated management systems. It describes steps on how to establish an integrated management system and shows clearly the basis of the process. It explains the terms of QMS, EMS and OH&S-MS in details, interprets the organizational concepts and its implementation. The investigation reveals many important concepts concerned with the subject. It does not state the technical aspects as a specific element in its investigation, and deals with the old version of international standards of ISO 9000:1994 and ISO 14000:1996.

In an investigation [Molitor, 1999] the main columns of an integrated management systems are described which are commonly used every time and everywhere. It pays more attention to the economical reasons of the integration, discusses the internal and external relations and the scopes of training and practices the subject of integration. The study specifies the integration for small and medium organizations.

Another investigation [Floß, 1999] describes effective regulations, laws and instructions of occupational health and safety followed by the process of integrated management systems. It concentrates on the understanding of regulations and laws, strengthens their definitions and depends on their actions taken and be followed in the integration process. The study concentrates on one area of occupational health and safety for the integration.

A further book [Bakker, 2000] researches in his publication the general methods, instruments and concepts of the integration of two businesses. On page 28-30 he describes twelve motivation factors and objectives for integration process at all stages. Page 45-52 show the matrixes between benefits as cost reduction, capability and synergies in relation with operations, products and markets. Page 53-58 specify the basic levels of integration (full, partial, minimal) and indicate what levels on integration are needed for new companies, between two units and functions, showing the role of operational, financial, geographical and cultural issues.
The rest of the book identifies the fundamentals of the integration. The book is describing vital concepts of the integration process and might be useful to integrate quality, environment and OH&S. The author only describes the integration between businesses in general details.

The publication [Smith, 2002] presents an integrated management system (IMS) by definition and states reasons for the process. The author describes six heading elements of policy, planning, implementation and operation, performance assessment, improvement and management review as a basis framework for establishing integrated management systems. He exhibits the continual improvement by PDCA cycle for these headings, and in his published work he adds examples of the IMS policy and basic documentation principles. The approach is profitable in many sides and may offer the right way in establishing other integrated management systems. The study deals with the old version of ISO 14001:1996, is small in size and does not include technical elements.

There is a huge handbook by twenty three different authors [Jahnes, 2003], who participate in issuing this large study. This investigation deals with integrated management systems of quality, environment, and occupational health and safety. Each chapter discusses one main aspect of the integration process. The first band talks about management systems function, concepts of building integrated management systems. The second band describes the principles of enterprises, the documentation establishment, data and information.
The study is huge in its explanation and presents all aspects of the integration building and implementing, since it presents all standards and regulations in the world, matrixes, quality tools, environmental protection ways, occupational health and safety rules and legislations and so on.
The study contains many forms and checklists for the designing and operation of integrated management systems. It describes the deepness of relations and makes a large effort in the world of integration. And it shows general information and methods and does not take the technical elements as a main issue, it deals with the old version of ISO 14001:1996.

The dissertation [Niemeyer, 2004] gives an overall review of integrated management systems, tries to introduce total quality management as a wide scale for the integration, describes the designing columns of the process and presents the concepts of documentation. Furthermore, it reviews the training on the basis of integration process and figures cases by firms, it draws the concepts of the costs and time in implementing an integrated management system.
This thesis uses the new version of national and international standards, and ISO 14000:1996 but does not enter to the technical elements as a specific subject.

The outcomes of the above publications can be summarized as follows:

- Most studies do not present the technical elements as a main subject.
- The publications and studies that were issued from 1996 to 2000 deal with the old version of ISO 9000:1994 because the new version had not been issued by that time.
- Most of the publications and studies that were issued from 2000 to 2005 deal also with the old version of ISO 9000:1994
- So far, there has been no intention to introduce ISO 16949:2002 (except for Jahnes, 2003 and Niemeyer)

- Many of the research studies are focussed on two areas instead of three. There were attempts to integrate the quality with occupational health or environment, and environment with occupational health and safety.
- Many of them did not provide steps of constitution process, did not try to determine a model, and did not consider to construct frameworks for building an integrated management system (except Smith, 2002), he made a framework for six main elements with their 24 headings, but he deals with the old version of ISO 14000:1996.
- There were no attempts to plan a computer-aided collection data centre to assist the implementation or operation of the integration process and they did not introduce data modelling. The same applies to standardized documentation.

1.3 Current Assertions

These assertions should be declared in relation to the subject and in order to understand the motivation and as introduction of constitution the integrated technical management systems process. As a general status, they are:

1. Each family of ISO 9000:2000, ISO 14000:2003 and OHSAS 18001:1999 with their series of standards does not state the specific performance criteria of quality, environmental protection, and occupational health and safety. There is no specific national or international standard which gives detailed description for designing or establishing a QMS, EMS or OH&S-MS. The standards only give assistance through requirements and guidance to design and establish such management systems.
2. There are no specific or specialized national or international standards for development of an integrated management system of quality, environment, and occupational health and safety.
   There are only separate standards for each one of them and they recommend that the integration must be done, and advice to endorse their assistance to the process of integrated management systems between quality, environment and OH&S. "These international standards enable an organization to align or integrate its own quality management system with related management system requirements" [ISO 9001:2000, 0.4]. About ISO/DIS 14001:2003 "The revision has been focused on clarification of the 1996 edition to assist in understanding and has been taken due consideration of the provisions of ISO 9001:2000 in order to enhance the compatibility of the two standards for the benefits of the user community" [ISO 14001:2003, Introduction]. And "OHSAS 18001:1999 has been developed to be compatible with the ISO 9001:1994 and ISO 14001:1996 management systems standards, in order to facilitate the integration of quality, environmental and occupational health and safety management systems by organizations" [OHSAS 18001:1999, Foreword].

1. 4 Technical Elements (TE)

1.4.1 What are Technical Elements?

The technical elements in this investigation study take the axial role and are referred to those tasks which are concerned with the faces of technical activities, without them no organization can exist. Technical elements, as a term, have many definitions relating to different attributes. It gives many meanings according to the practical technical skill and execution technique. It pertains to any science or business having appropriate experiences such as technical quality auditor, technical environmental inspector, technical biochemical coordinator and technical machine operator, technical solution executor and technical processing observer, etc.

1.4.2 Faces of Technical Elements

This thesis work shows three faces of technical elements that introduce the process of constitution of an “ITMS” as shown in **Figure 1.1**

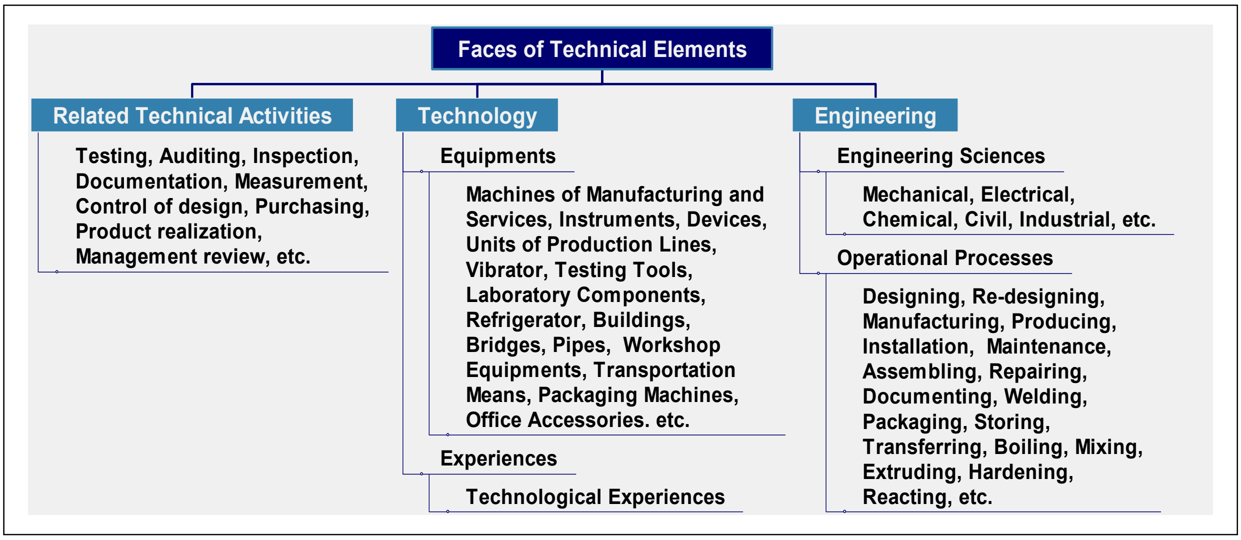


Figure 1.1 *Faces of Technical Elements*

Related Technical Activities

Those are concerned with quality, environment, and OH&S, which are mentioned as requirements in each one of ISO 9001:2000, ISO 14001:2003, and OHSAS 18001:1999 for establishing QMS, EMS and OH&S-MS. The functioning of these requirements is introduced into the process of “ITMS” constitution as one face of technical elements which are later unified. Examples are: auditing, testing, inspection, recording, documenting, correcting, reviewing, conforming, etc.

Technology

Technology is another face of technical elements. This includes equipments, machines, full production line, means of service industry, tools, facilities, instruments, devices, etc. Technology could be an occupational experience and the knowledge used for practice. “It is the total body of knowledge brought to the transformation process” [Noori, 1995, page 378, 279].
There are many ways how technology affects the environment. “The environmental technology grouped into several categories of pollution control technologies, waste management, recycling industry, remediation technologies and cleaning technology” [Kemp, 1997, page 11].

Engineering

Engineering is a discipline that transfers scientific solutions to practical problems. It is a practical application of science to the industry and to the needs of humanity. “Engineering is the methodical and disciplined application of scientific and technical skills in the social and economical benefits of mankind” [Marsh, 1999, page 148].
The engineering structures are natural resources in order to produce goods and services, achieve the goals of high quality, environmental protection, and occupational health and safety for workers and public. In connection with management systems, the engineering develops management and arrangement behaviour of an organization across engineering management.

In Appendix B, **Table B.2** shows the types of engineering sciences that the “ITMS” is applicable in their technical elements. And **Table B.1** shows the types and classification of organizations of manufacturing and production, services and public that can apply the “ITMS” in their tasks and operations.

1.4.3 The Vital Role of Technical Elements

The role of technical elements is vital because they have specific factors that improve the living state of an organization. They provide higher quality, reduce adverse envi-

ronmental impacts and hazards, and they enable an organization to economize production. No organization operates without technology and engineering principles and no manufacturing or service industries can be achieved effectively without related technical activities such as auditing, inspecting, controlling, documenting, etc. These activities can not be separated from their business.
Technical elements take a vital role in any operational manufacturing and play their effective actions in different industries and services, even though most factor reasons that seek for the certification process will depend on them. “There are 39 key departments of various industries, services and commercial organizations for certification, most of them are related to technical sides” [Becker, 2003, page 105]. The same importance applies to most methods of the project execution. “The reservation check-list of pipelines and pipe work in a project contains 21 steps, 100% of steps are technical” [Horsley, 1998, page 89]. In the industry sectors, the technical elements take a large role in gaining high quality systems and help to achieve their goals. “The appropriate quality systems and quality goals in food chain industry are achieved from technical requirements” [Meyer, 2003, page 14].
When designing new systems, they are in front of the process and may be incorporated with other aspects and will enter into the overall business in order to perform the business targets of the organization. One example for this is the Toyota company: “Toyota has taken up the new system, incorporated socio-technical principles” [Muffatto, 1999, page 20] and “it was already pursuing another strategy by adopting new technology to be integrated with the overall business in the company” [Ettlie, 2000, page 240].

The efficient requirements of operations are obtained through quality techniques that are used for technical elements activities. “Most important tools for cause-to-effects-analysis of FMEA/FMECA, FTA, Ishikawa diagram, Pareto diagram are used for technical elements and unification” [Birolini, 1999, page 78]. The requirements of customer service also could be performed and affirmed under prioritising technical requirements which researched extensively by quality tools as QDF. “Prioritising technical requirements are important in meeting customer requirements in quality function deployment (QFD)” [Swift, 1995, page 265- 271].

The level of efficiency varies under any use of technology, many studies could prove this. “The efficiency can vary by technology” [Salecker, 2003, page 229]. In view of using technology methods and tools, technical elements are sufficient to produce higher efficiency and reliability for the manufactured elements. “In smart ignition drivers, the resin-mould technologies of power semiconductors have provided and reduced cost and size, and improved reliability” [Fujihira, 2000, page 38]. Moreover it gives more accuracy in any activity as measurement, the technology can assure that. “The accuracy of equipment of measurement is raised due to technological performance“ [Wisweh, 2000, page 1].

Likewise technical elements in view of new technology performance and their developed processes will reduce the operation costs and minimize the product price. “The technology performance improvement will greatly reduce price entry barriers for all companies worldwide” [Browne, 1996, page 82]. They lead also operations to reduced material employment. “The developed process in heat treatment of steel sections in metallurgy by enabling technology has advantages of saving materials by 30%” [UNEP, 1997, page 87]. And the saving of materials is also apparent in the manufacturing of automotive technology parts. “In automotive industry, the stratified charge of direct injection spark ignition (DISI) improves fuel economy up to 18% over the drive cycle” [Shayler, 1999, page 149- 158].

Because of these roles, nowadays many manufacturing organizations and service industries are more concerned with technical elements which are affirmed by many cases. “In a study case on six companies, it indicates that technical success, new technological knowledge and reduced production cost will take large scoring” [Hillebrand, 2001, table page 222].

Related to the environment, technical elements are critical because their operations cause environmental changes. Most pollution originates from technology use as production lines, machine operations, chemical plants, energy stations, heating instruments and so on. Like pollutant gases have adverse affects on human’s health and safety. For example the harmful gas of carbon monoxide CO is caused by stoichiometric combustion of fuel from motor vehicles.

In relation with occupational health and safety, technology as a tool and instrument application can assure more occupational health and safety for workforce and public. “A research group survey analysis indicated that appropriate use of Personal Protective Equipment (PPE) could have prevented as much as 37% of occupational injuries and illnesses” [CoVan, 1995, page 122-123]. Moreover the application of them can also reduce the overall risks. “The risk will be reduced by applying technology” [Beroggi, 1995, page 10].

Nowadays technical elements in manufacturing organizations and service industries are mostly introduced and integrated into management systems. Therefore it is absolutely required to build a specific team for more effective managing and integration of the technical elements into the overall organization’s task. Here is one example: “General Motors Corporation employs a centralized team of experts in technical areas to accomplish the task of corporate technology integration” [Ettlie, 2000, page 366].

The vital roles of technical elements are:

- No organization works without technology and engineering principles.

- Related technical activities are referred as requirements in ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 which can not be separated from any organization.
- Customer requirements could be performed through application of technical elements.
- Technical elements take a vital role in operational manufacturing and any other processes and play their effective actions in different industries and services.
- The certification procedure demands requirements that are mostly related to technical elements.
- They take a huge role in gaining high quality products and help to achieve their purposes.
- They are critical because their operations are connected strongly with the environmental aspects protection.
- Technical elements in face of technology will reduce the operation costs and minimize the price of products. Many investigations have proved this fact.
- The technology as a tool and instrument application brings more assurance of occupational health and safety for workforce and public.
- Technical elements are today objectives and goals of most manufacturing and service organizations. They try already to integrate new technology and applied sciences in their business.

1.5 Problem Presentation

As described in the later sections of this chapter, the problems could be found here in **Figure 1.2** and could be classified into three main features of:

- *Standards*
- *Integration process*
- *Management systems*

The problems in feature of standards are those related to: ISO 9000:2000, ISO 14000:2003 and OHSAS 18001:1999 and 18002:2000. There exists no (unified) national or international standard for quality, environment and OH&S. There are only separate standards but they have common elements and each of them can be aligned with the other standards towards integration.

The problems in feature of integration process are: Until now there are no specific national or international standards for integration. And while reviewing previous studies (the results in chapter 1.2) several issues have been obtained. They will remain to be problems.

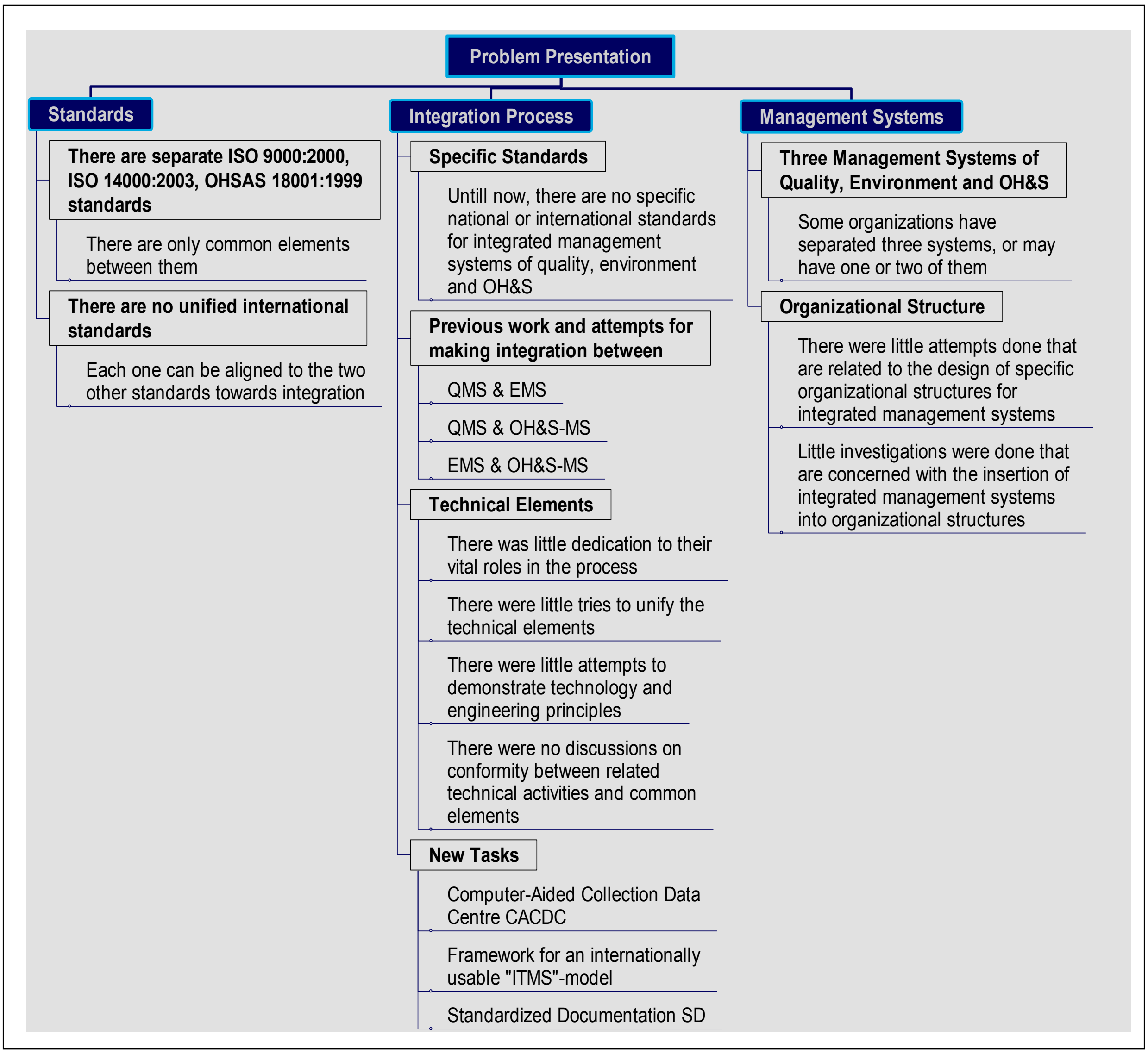


Figure 1.2 *Problem Presentation*

About technical elements, there was little dedication for their vital roles in the process of the integration. Up to now, there were only a few intents to unify them and there were a little demonstration of engineering principles towards integration.

This thesis tries to design a network taking use of a computer-aided collection data centre in order to handle all data and information about the integration process and establish a standardized documentation that contains all three areas.

The third feature of the problem presentation is about management system. Nowadays, organizations have separated management systems and wish to integrate them. Some of them have one or two and wish to design the third and then realize integration between them. Some did only little integration investigation and wish to gain more experiences about this matter. This applies also if new organizations are set up and wish to improve quality of a partial operation by integration process.

In separated management systems some problems may be produced by processes, operations and responsibilities. “The possible problems demonstrated by separated management systems are: non-coherent policies, strategy and objectives, duplication in similar operations and activities, wide scale documentation, uncontrolled state, more bureaucracy for innovating processes and losses in data and information, audit duplication for the same or similar subjects and the continual improvement be in partial condition, not as a unified process” [Pischon, 1999, page 276- 277].

1.6 Motivations for an Integrated Technical Management System (“ITMS”)

It should be observed that the integration means more than just combining different management systems and directing them together. Integration is the process of combining some or all internal management systems into one combined system and implementing it as a whole into a department, structure or entire organization. The motives could be referred by two ways.

1.6.1 Motivation One

Important issues have been declared in the previous sections of this chapter. They could be assessed as motivation for the constitution of integrated technical management systems of quality, environment and occupational health and safety. They are referred as:

- The permanent necessity to develop products and services in parallel conforming to certain objectives such as improving quality, environmental protection and occupational health and safety performance.
- The non-existence of a specific or specialized national and international standard as discussed in chapter 1.3 “current assertions”.
- The vital roles of technical elements.
- The presented problems in chapter 1.5 are assessed as motives for the integration process.
- There are interrelated definitions between customer, organization and product which give more motivation to integrate and fulfill their requirements together, as explained in chapter 2.1.4.
- In order to make more development in the subject and find new ways of how to constitute integration process with efficient manner and effective operation because as indicated in review of previous works, it is still necessary to make more investigation now and in the future.

1.6.2 Motivation Two

Motivation two is related to the following reasons:
There are similar benefits when implementing international standards. This facilitates the integration process and is considered to be a motivation for its constitution. “The generic benefits of ISO 9000 and 14000 are very similar, and the major benefits of implementing ISO 14000 are to enhance company’s ability to systematize and integrate quality and environmental management into the overall management to achieve requirements” [Waite, 1998, page 10].
There are common benefits between QMS, EMS and OH&S-MS and they provide similar benefits during their implementation. This state is assessed as motivation for designing an integrated management system because they give interrelated goals and similar requirements during their accomplishment. The comparable benefits between QMS, EMS and OH&S-MS are shown in Chapter 2.5.

All over the world one can find extensive campaigns of organizations with the goal to improve the quality level, minimize adverse environmental impacts and improve the occupational health and safety conditions. This is due to the fact that massive changes have been occurred within the last two decades within all kinds of industries. Organizations are compelled to fulfil stringent quality requirements, environmental standards and OH&S regulations. Many types of requirements have changed and organizations face a higher number of demands and parts of products to be achieved or manufactured. As example: “the telecommunication components have been growing in numbers from 6 in year 1970 to 52 in year 2000” [Oodan, 2003, page 110]. With the same line the consumption of goods and energy has been increased worldwide: “In Germany, the electricity consumption has been increased since year 1993 to 2000 by 8%, and this trend will increase by 14% until 2020” [Energie, 2003, page 4].
But on the opposite side there is also resistance to the new challenges by planning and campaigning to preserve the environment by waste reduction and increased environmental protection standards. For example “in Germany, the recycling of the papers increased from 7.4 million tones in 1990 to 8.7 million tones in 1999” [Umwelt, 10, 2000, page 527]. In another campaign the authorities plan to “reduce emissions of CO_2 by 25% from year 1990 to 2005” [Umwelt, 4. 2000, page 173].

The quality, environment and OH&S standards define each other and have interrelations in their operations. Each of them needs to consider the other. A good quality management system tends to integrate the other two management systems of environment and OH&S because dealing with quality means to deal with safety as well. “A quality process in terms of production is generally also a safe process” [CCCP, 1995, page 18]. And as a series of definition, the same safety could be defined to other types of accidents, pollution and exposure to hazardous substances. “The safety can be defined in terms of population exposure to environmentally sensitive areas” [Beroggi, 1995, page 124]. This defining between them can be seen in the design of engines of vehicles. “The studies showed that the best environmental achievement depends on vehicle engine and fuel type, and the emissions of CO and NOx depend on the vehicle type” [Farnlund, 1999, page 41- 44].

The integration reduces failures if it is effectively implemented. The combination and intersection between the management systems produce more benefits than if they stay individually in their application. “In United Kingdom health and safety executive reports that the failures in 100 years are 100 for single system, 50 for single systems with self-monitoring, and 10 for dual system” [Kletz, 1995, page 5-6]. In addition, the integration brings more success and gives higher advantages in realizing their results. “For more successful systems, it must be integrated accurately with the functional forms in an appropriate system models” [Weber, 2001, page ix].
The integration enhances organizational functions through coordination between technical elements, saves costs and improves productivity. “The integration facilitates the coordination of technical and managerial efforts to enhance organization functions, reduce costs, save energy, improve productivity, and increase the utilization of resources” [Badiru, 1995, page 34]. And it produces a more efficient organizational structure. “Advantage of the integration is more efficient structure, decreasing organizational expenditure, more efficient monitoring and higher acceptance of only one system frame” [Schneider, 1999, page 138-139].
Additionally, the effective and modern management methods can be performed by the integration and the volume of management could be reduced. “The experiences show that an integrated management system is about 25% smaller than producing separated QMS and EMS, and the time will be reduced from 12 to 8 months” [Menzel, 2000, page 44].

There are more benefits of integration process related to minimizing technical activities, cost reduction and others. “It remains as a goal of the integration process to minimizing inspection expenditure, combining of certification and auditing, cost saving, offering more flexibility and establishing an information basis unit” [Pischon, 1999, page 295-296]. And the integration will optimize the performance-cost-time criteria that make the organization more effective. “System integration ensures that all performance goals are satisfied with a minimum expenditure of time and resources” [Badiru, 1995, page 34].

According to the above description, the second motivation of constituting an integrated technical management system can be summarized as following:

- There are calls by national and international standards for integration and unification. It is referred in details in chapter 3. This facilitates the process and gives more motivations to do this.
- The synergies between QMS, EMS and OH&S-MS result in common benefits. Therefore their compound integration fixes their overall goals, as described in chapter 2.5.

- The quality, environment and OH&S define each other and they have interrelation in their operations. This fact highly motivates to integrate them.
- Internationally, there are intensive campaigns by organizations to improve their quality level, minimize adverse environmental impacts and improve the occupational health and safety conditions for workforce and public.
- The integration reduces failures if effectively implemented, enhances organizational functions, organizational structure, and improves productivity by coordinating technical elements. Furthermore, it produces effective and modern management methods.
- The integration optimizes performance-cost-time criteria. It improves their interrelation more effectively. At the same time it reduces the number of uncontrollable operational processes.

1.7 The Structure of this Thesis

The main structure of this thesis work consists of five main sections and is shown in **Figure 1.3**.

Section one (five chapters):

The first chapter starts with the introduction and gives an overview of the overall theme of integrated technical management systems of quality, environment, and occupational health and safety. This is followed by a review of previous literature and work. Afterwards the technical elements are described and their faces determined. A presentation of current problems, the motivation for constitution process of an integrated technical management system and the specific goals for this thesis end up with chapter one. Chapter two describes the main aspects for organizations, customers, products, systems, QMS, EMS, OH&S-MS, determines common benefits of the three management systems and the role of the four management functions. Additionally this chapter states the four conditions of designing a technical integration.
Chapter three gives an overview of national and international standards, general regulations and its divisions with their definitions and describes the ISO 9000:2000, ISO 14000:2003, OHSAS 18001:1999 & OHSAS 18002:2000, ISO/TS 16949:2002, and EFQM-Model. Additionally, it discusses the requirements and calls by these standards towards unification and integration process and finally determines the faces of common elements. Chapter four presents the framework of "ITMS" constitution process, finding kinds of integration and gives general columns of technical integration constitution. Chapter five draws some considerations about the constitution and operation of integrated technical management systems and gives essential concepts that should be achieved.

Section two (one chapter):

Chapter six is the main chapter. It tries to find new steps for the constitution process of standardized integrated technical management systems of quality, environment and occupational health and safety. It describes the five procedures that are necessary to design this new system such as portioning the organization into four structures that represent the overall tasks and activities of any organization. These structures are described in details with their portions. Their benefits are demonstrated as well. Other procedures are presented through describing the ways of unification between technical elements, integration and coordination-intersection-combination between QMS, EMS and OH&S-MS and standardizing them according to national and international standards that are finally implemented into the four structures and overall departments. This chapter describes also a suitable framework for an internationally usable “ITMS” model that explains the constitution principles for all kinds of organizations.

Section three (two chapters):

This section describes two specific goals of the “ITMS” constitution process and how they can be realized. Chapter seven discusses data and information, how to establish a computer-aided collection data centre CACDC into the organization for management and distribute data between all departments. It describes the types of network and suitable ways of connection, the data modeling and how it could be modelled, presented. Chapter nine is about the “ITMS” documentation and gives details about levels of standardized documentation. It begins with the description of documents and documentation and explains the various conditions and needs to perform a standardized documentation.

Section four (one chapter):

Chapter eight discusses the success and evaluation methods of a constituted “ITMS.” It begins with success concepts for the constitution process and presents some concepts as technical compliance and balancing, equilibrium among technical related activities and criteria of performance-cost-time. It explains the important processes of auditing, continual improvement and evaluation.

Section five (two chapters):

Chapter ten presents the overall benefits of an integrated management system and the individual benefits of the technical integration process. Chapter eleven contains the conclusions which summarize the content of this thesis work and methods of its investigation and present an outlook of the results related to this new system.

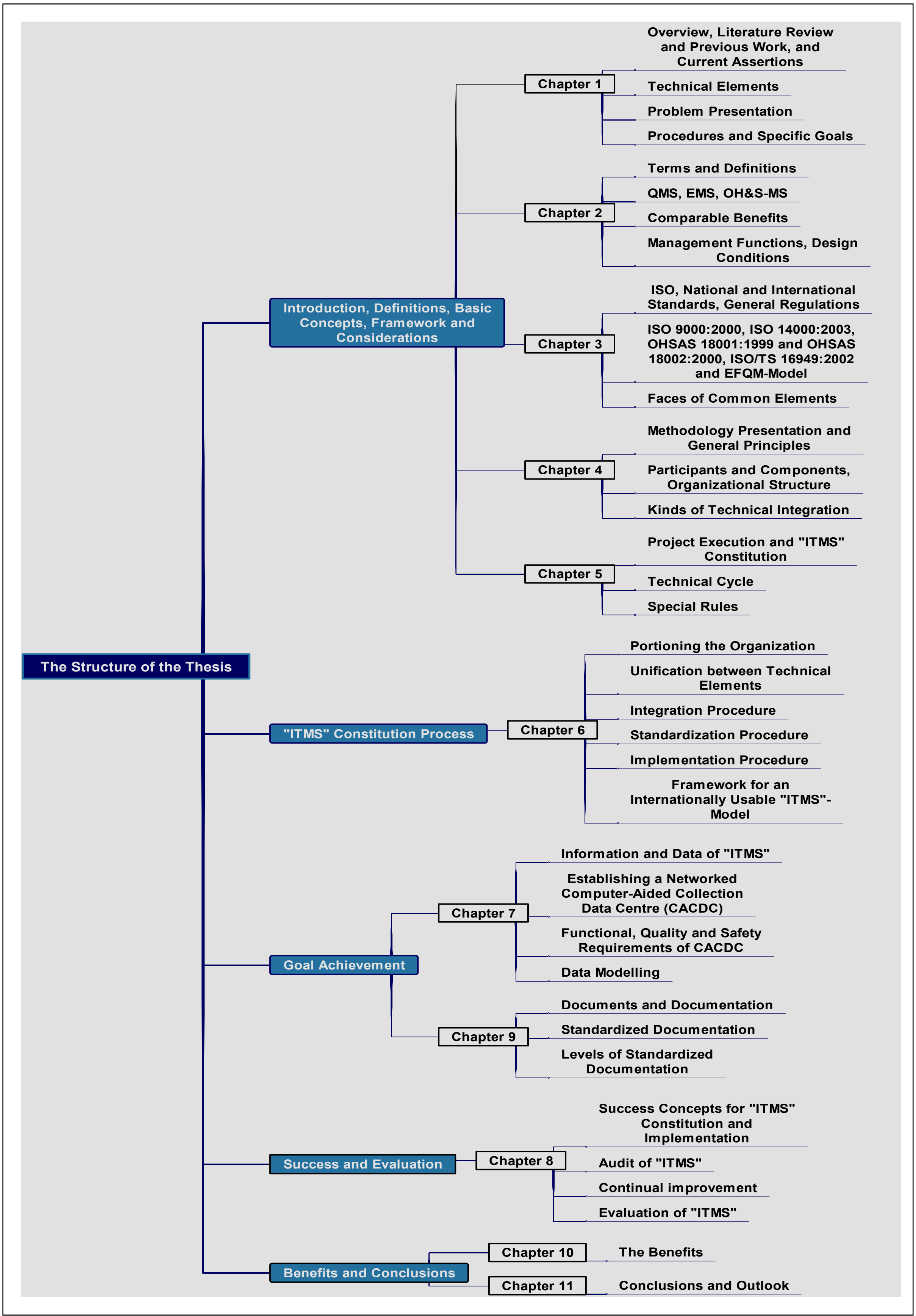


Figure 1.3 *The Structure of this Thesis*

1.8 Methodology Presentation

This investigation study follows a certain methodology that is applied to all chapters, sections and sub-sections. This is done by using interrogatives: ‘What, Where, When, Why, Who, How and Examples’ as depicted in **Figure 1.4**. There are the seven interrogative factors that are repeated in each subject (sections and subsections addressed in chapters) to offer definitions, tools, explanations etc. “What” explains the nature of the subject, “Where” indicates the location where the subject is active, “When” depicts the time when the subject appears or should appear to set the goals and limits of the time period, “Why” demonstrates the reasons of appearance of the subject, the motives why the subject is important, and for which reasons the subject is processed, “Who” asks for persons, authorities, departments or teams who execute the subject and achieve duties, “How” gives ways and steps in order to make the subject be in functions, “Examples” are offered in order to make subject more understandable and enforce it to be used in practice, the examples only deal with quality, environment and OH&S, and other related components.

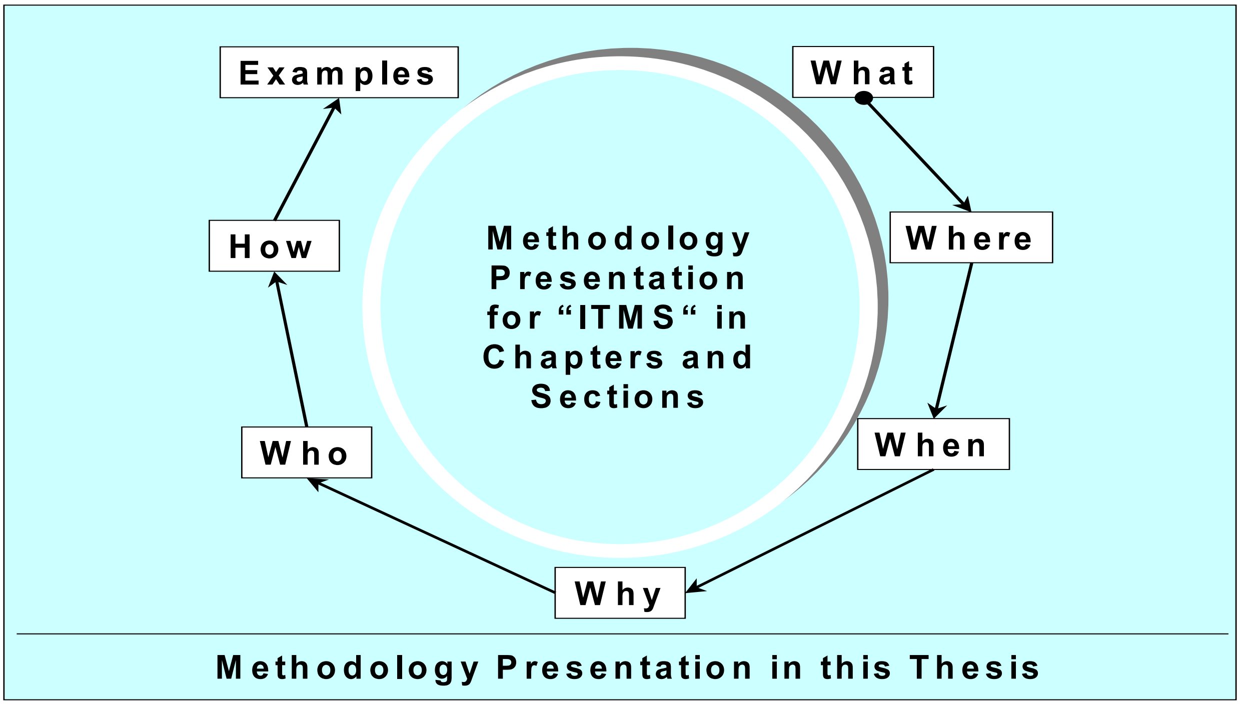


Figure 1.4 *Methodology Presentation*

1.9 Procedures and Specific Goals

The “ITMS” constitution passes on some series of consequential steps which form the main processing functions of the technical integration process. These steps are defined

here as procedures which need to be followed in order to achieve the goals. At first, the technical elements which are intended to be unified must be chosen and then to be unified in parallel with the integration of three management systems and standardized according to national and international standards. Then, these integrated systems have to be implemented into the departments and each of the structures and portions.
These steps enable the technical integration process to achieve the research objectives. They are: Identifying and gathering of technical elements, determining the faces of common elements, determining the clauses from the standards which call for integration, determining the principles for "ITMS" constitution, defining the kinds of possible integration, defining the framework for an internationally usable "ITMS" model, establishing computer-aided collection data centre (CACDC) and describing levels of standardized documentation (SD).
Every research or investigation study aims to verify something and has objectives or purposes. **Figure 1.5** shows procedures and specific goals of this thesis work.

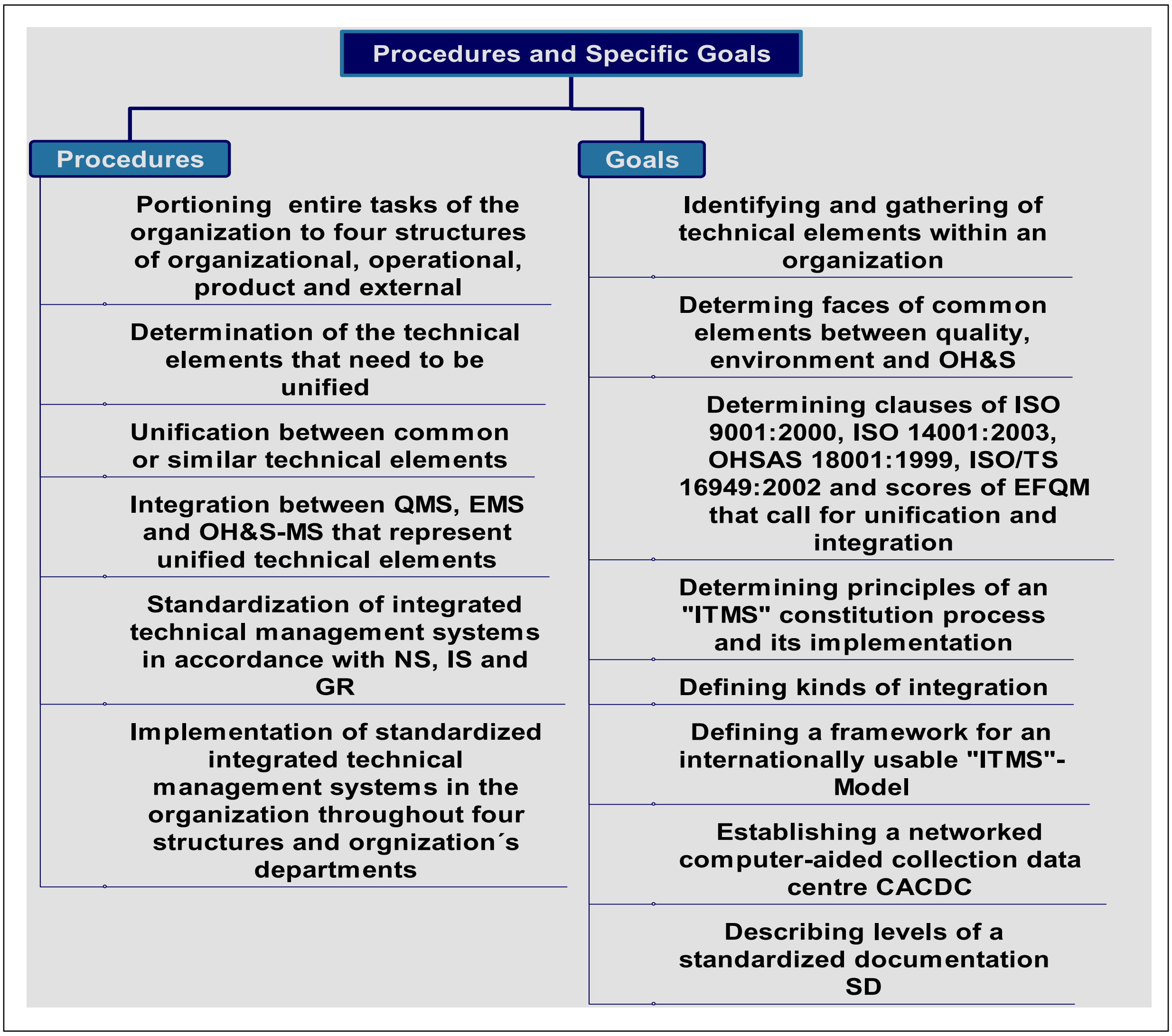


Figure 1.5 *Procedures and Specific Goals*

Chapter 2- Definitions and Basic Concepts

2.1 Terms and Definitions

2.1.1 Organization

An Organization is the act of realising a business or an activity, creating a team or a group and results from distributing persons or materials properly or methodically such as the work force in a firm. “The organization is a group of people and facilities with an arrangement of responsibilities, authorities and relationship. Examples are companies, corporations, institutions, charities or parts or a combination thereof, the arrangement is generally orderly, and an organization can be public or private” [ISO 9000:2000, 3.3.1, & Note 1& 2]. Every operating unit may be considered as an organization. “For organizations with more than one operating unit, a single operating unit may be defined as an organization” [ISO 14001:2003, 3.14, & Note] and [OHSAS 18001:1999, 3.12 & Note].

An organization could be socio-technical system consisting of people, sites, plants, machinery, technology and a specified work system and is designed to link everyone who takes part in management to achieve the objectives such as standards requirements, society requirements, customers’ opinions, designs, operations, environmental protection and occupational health and safety.

The organizations are varied in their objectives, cultures, types and circumstances. Therefore it will be necessary to select a structural organization that will be suitable for these characteristics. **Figure 2.1** shows the structure of an organization and defines several aspects of its existence.
The department is a part of the function in the organization’s main tasks of production, manufacturing, assembly, storing, service etc. When department is mentioned in this thesis, it refers to the units that achieve an operation within overall organization’s task and it will be considered as an individual organization. Divisions are other units such as human resource, legal, marketing, etc, those which assist to achieve the main task of the organization.

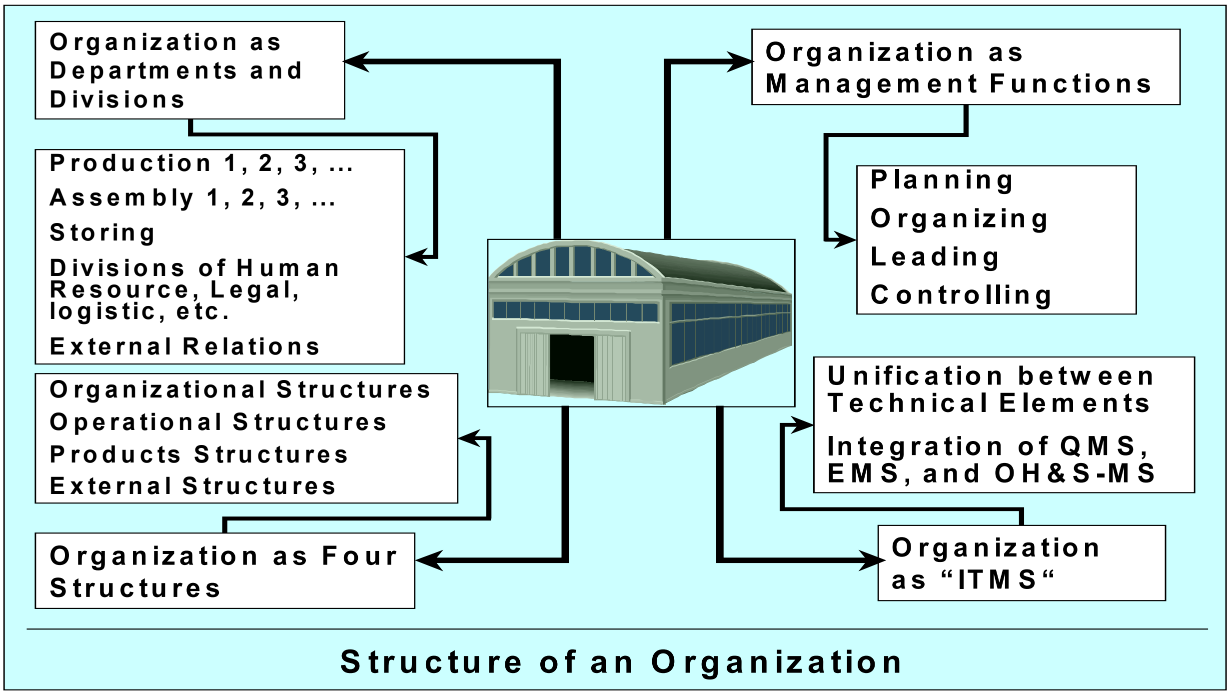


Figure 2.1 *Structure of an Organization*

2.1.2 Customers

Customer, in context of the integrated technical management systems has many definitions. **Figure 2.2** shows more expanded meanings; it has to include all of them due to their obligatory interrelation. Customers are those organizations and persons who receive products and services. The customer has been defined in international standards. "Customer: organization or a person that receives a product. Example: consumer, end-user, retailer, beneficiary. Each customer can stand internal or external to the organization" [ISO 9000:2000, 3.3.5].

The customer has a vital role because he has strong interrelations between human, work and production. "There are triple cases between human, work and production, that the human as user affecting on the structure of operations" [Quaas, 2000, page 351]. The vital role of customer is also shown more clearly in the certification process. "The Baldridge Award is based on seven examination criteria with different scoring, the largest scoring being for customer focus and satisfaction (30%)" [Wheaton, 1999, page 96-97].

It is the customer who decides, uses, receives, evaluates and assesses the quality, environmental elements and occupational health and safety.

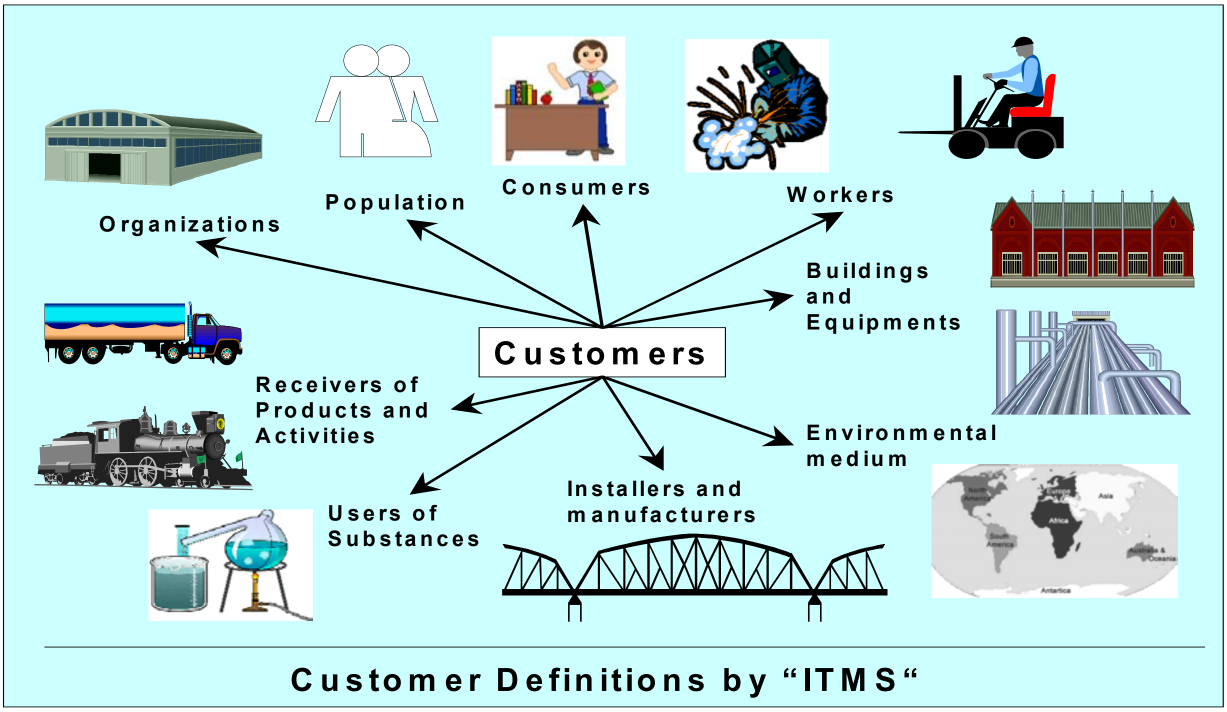


Figure 2.2 *Customer Definitions by "ITMS"*

A customer can be embodied in different forms:

- An organization that receives a product.
- A consumer of goods.
- Receiver and user of products and services (passengers, patients in hospitals, etc.).
- Receiver of adverse environmental impacts and pollutant elements (air, water, soil, etc.).
- Workforce, for example workers on production lines in firms, operators of machines and devices, traders of chemical and biological substances, manufacturers, etc.
- Population like pedestrians on the street and those who live in buildings.
- The natural and capital elements existing inside and outside an organization (equipment, devices, instruments, etc.).

2.1.3 Products and Services

Products are consumer goods, services or other activities and could also be an operation. The product is defined as "result of process and they relate to hardware, software or any produced part" [ISO 9000:2000, 3].

At the same state any impact on environmental elements that is a result of a process will be calculated as a product. “Environmental impact: any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspects” [ISO 14001:2003, 3.6].

About the occupational health and safety, the products are the conditions and factors that affect the health of workers, employees and other groups. “Occupational health and safety: conditions and factors that influence the well-being of employees, temporary workers, contractors, visitors and any other person in the workplace” [OHSAS 18001:1999, 3.10].

In the International Standards, the product simultaneously means service. “Throughout the text of this International standard, wherever the term (product) occurs, it can also mean (service)” [ISO 9001:2000, 3]. In this declaration, the product takes an entirely new definition; therefore the products may be results of:

- Processes (products, goods, semi-products)
- Environmental work conditions
- Occupational work conditions

2.1.4 Interrelation of Definitions by “ITMS”

Here, as shown in **Figure 2.3**, in the context of the integrated technical management systems, an interrelation of definitions can be found in case of customer-organization-product. Each one has an individual definition, but all of them are interrelated.
The meaning of customer as a receiver is related with the meaning of organization that manufactures products which are represented by many other definitions.
The organization produces products, at the same time it acts also as a customer of raw materials and semi-products. The customer is the consumer, receiver and user of goods (in sight of quality), at the same time (in sight of environment) he is considered as environmental elements such as water, air and soil that could be polluted and damaged due to the organization’s activities and other humans activity, but the customer (in sight of OH&S) is a worker on production lines in firms, operator of equipments, machines and instruments, or he can be a dealer with chemical and biological substances etc, who can get affected by accidents or psychological stresses under working conditions. Also the same customer as a human being receives the polluted surrounding elements from inside the country or from neighbouring countries that receive the same environmental impacts that are transmitted by means of air, rivers and commercial goods.

And for products, they are results of operational manufacturing, activities or any other business (this is in sight of quality management), the same product are described as environmental conditions in working places (insight of environmental management), and can be computed as performance measurement of occupational health and safety (in sight of OH&S management). Thus, the definitions of those three main aspects are taking other dimensions and their meanings are expanded and are more interrelated which each other.

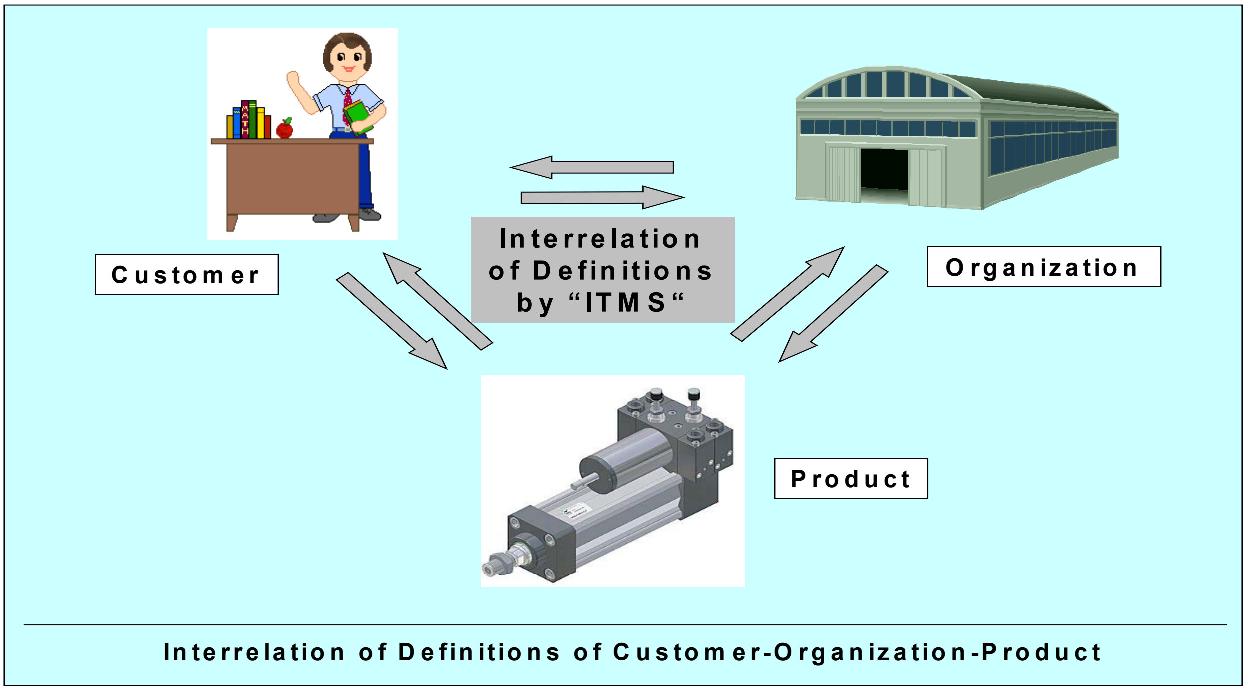


Figure 2.3 *Interrelation of Definitions by "ITMS"*

2.1.5 The Systems

The system is a set of connected things or parts, organized body of materials, resources and procedures regulated by interaction to accomplish a set of functions. The Oxford English Dictionary [Oxford, 2003] defines system as "a whole composed of parts in an orderly arrangement according to some scheme or plan"

The system is defined by international standards as the "set of interrelated or interacting elements, establishing policies and objectives" [ISO 9000:2000, 3.2.1]. Management system has some requirements. "Management system: set of interrelated requirements used to establish policy and objectives and to achieve those objectives" [ISO 14001:2003, 3.7, Note 1]. Also the management system of an organization can include different management systems, such as a QMS, a FMS or an EMS. The management system itself is composed of an organizational structure, planning activities, responsibilities, practices, procedures, processes and resources.

For the successful technical integration constitution process, it is necessary to understand the role of each of the three types of the systems (quality, environment and OH&S systems) as a part of the total organization's work and hence a part of the technical integration. They are calculated as sub-systems in comparison with the band for integrated systems and arranged in some orderly way according to a structural and functional form in the integrated technical management systems to be implemented effectively. Here, any sub-system could be treated and worked as a system when dealing with technical integration process. **Figure 2.4** shows the three areas of the integrated technical management systems.

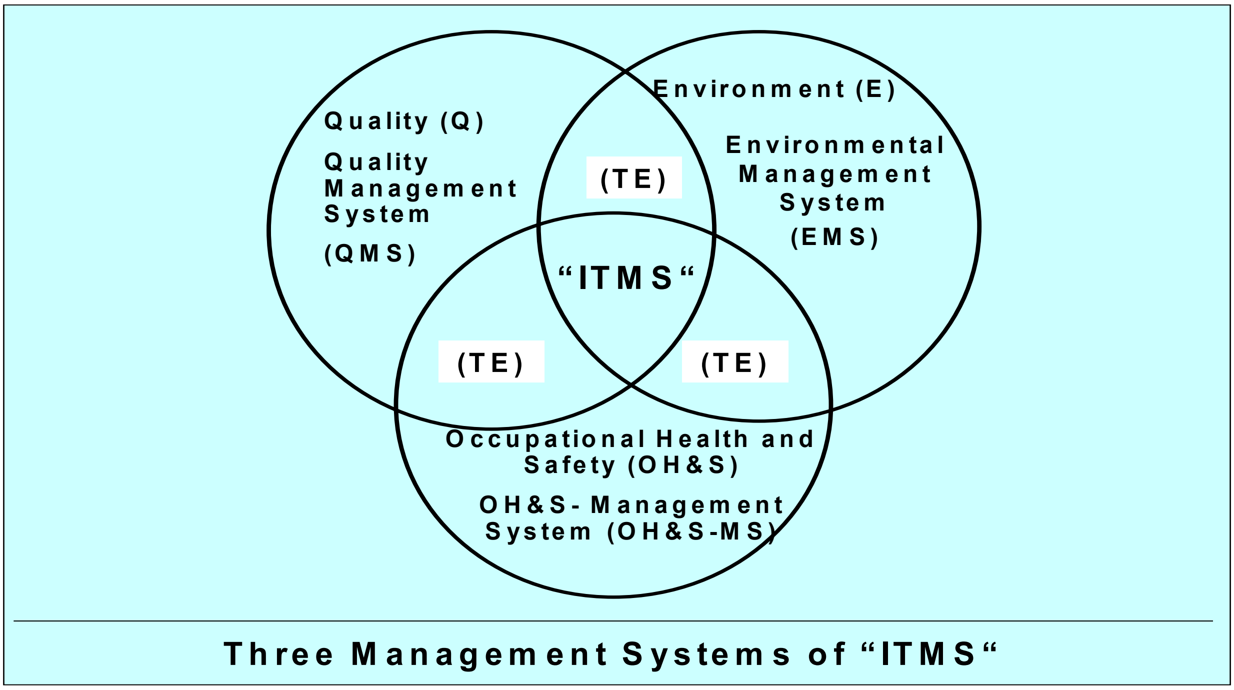


Figure 2.4 *Three Areas as Elements and Management Systems*

2.2 The Quality

2.2.1 Definitions of Quality

The definition of quality varies and depends on the actual situation. Many experts and organizations have been defining quality as their opinion and experiences, but all their identifications tend to the main aim of highlighting quality of every aspect of an organization. A simple definition of quality taken from the Oxford Dictionary [Oxford, 2003] defines quality as the "degree of excellence" and it is the "totality of features and characteristics of a product or service that satisfy stated or implied needs" [Lawson, 1999, page 4-5].

Furthermore, the quality is "the degree to which a set of inherent characteristics fulfils requirements and the term 'quality' can be used with adjectives such as poor, good or excellent" [ISO 9000:2000, 3.1.1 & Note 1]. There are even more definitions but all suggest that the main purpose is to manufacture products and services at an effective cost and in limited effective time.
Quality is based on the level of conformance to agreed national, international standards and general regulations. It is defined as a measure of customer satisfaction and determined by his good will.
Figure 2.5 outlines how experts define quality and how they:

- outline the importance of the technology as the basic orientation toward quality.
- define the interrelation with management.
- prescribe goals of quality according to customer's need, satisfaction and continual improvement.

Here, it could be discovered that scientist's opinions concentrate on meeting customer needs and requirements, continual improvement, management role, engineers and technical orientation which are the main input components for "ITMS". (More details of input and output components in chapter 4.4).

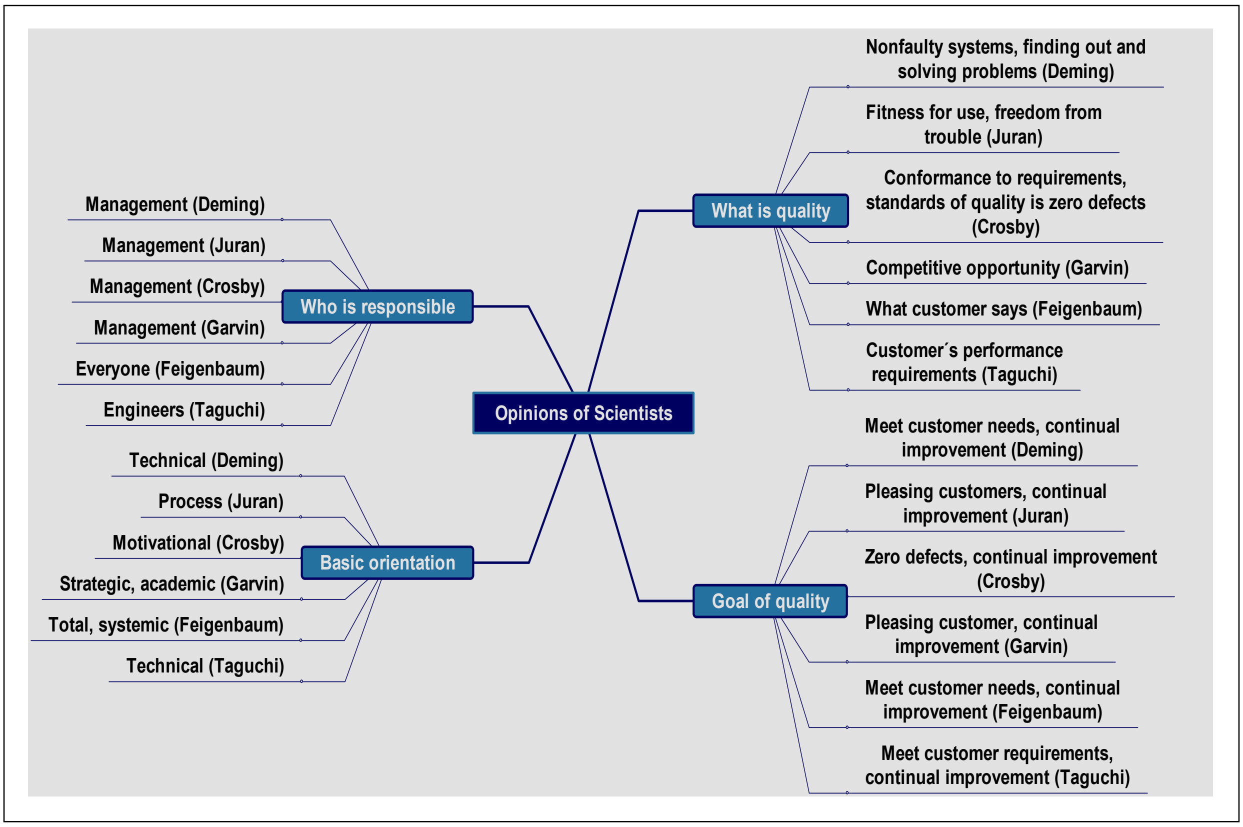


Figure 2.5 *Comparison of Scientists' Opinions about Quality, Technical, Management and Responsibilities*

2.2.2 Quality Management (QM)

Quality as management encompasses all activities of the overall management functions that determine the quality policy, objectives and responsibilities, and implements them by means such as quality planning, quality control, quality assurance and quality improvement within a quality system. “The quality control, quality assurance, quality improvement are as parts of quality management focused on fulfilling, providing confidence and increasing the ability to fulfill quality requirements” [ISO 9000:2000, 3.2.10, 3.2.11 and 3.2.12].
Quality management has been defined by international standards. “Quality management: systems to establish policies and objectives and to achieve those objectives. Note: A management system of an organization can include different management systems, such as a QMS, a FMS or an EMS” [ISO 9000:2000, 3.2.2 & Note].
For a better understanding of standardized integrated technical management systems, some aspects related to quality and QM need to be understood, because they are concerned with technical elements, such as:

Methodology: A convenient method that studies and identifies the quality specifications of functional components, by which the quality is described and represented. Most of these components are referred to the technical elements. For example, the functional components of automotive engine could be flexibility, economic driving, actual fuel consumption rate, emission rate, material composition and so on.

Characteristic: It is the prominent aspect of the quality, a feature that helps to describe recognizably quality, such as characteristics of mechanical, electrical, physical, chemical and biological operations needed for quality attributes.

Attributes: A bundle of some characteristics, which an operator would need while using the product. For example, in transportation of goods (service industry) the quality attribute of the container have characteristics of container size, humidity, freezing temperature, distance, time of duration, etc.

Parameters: These are quality characteristics that could be measured and expressed by one or more measurement units, such as the boiling point of aluminium.

Excellence: It is used as indicator to evaluate a product or service, necessary to quality characteristics and parameters and show the performance value. For example, the quality of a production line, car, machine, etc.

2.2.3 Quality Management System (QMS)

The quality management system (QMS) is a systematic process approach defined by an organization to establish its core quality principles in the form of quality policy, objectives and goals and to implement feasible methods to achieve them. The QMS is a "management system to direct and control an organization in regard to quality" [ISO 9000:2000, 3.2.3].
The QMS recognizes and implements changes that realize improvements in products and services as determined appropriately by system criteria and management decisions while simultaneously minimizing variation in product and service quality.
The optimal QMS balances organizational needs in a way that it maintains flexibility in products and services while providing an appropriate level of discipline and control over the processes and ensuring that quality consistently meets or exceeds customer expectations.

The QMS is a tool that enables every organization to achieve better and better quality of their products and services through continual improvement of methods of performance. It is a part of the organization's management system focused on the achievement of results of quality objectives and requirements and satisfies the needs and expectations of the interested parties.
In relation with other management systems, the quality objectives complete other objectives. "The quality objectives complement other objectives of the organization such as those related to growth, funding, profitability, the environment and occupational health and safety. The various parts of an organization's management systems might be integrated" [ISO 9000:2000, 2.11]. Management systems applied by various organizations with quality objectives include:

- EMS
- OH&S-MS
- FMS
- RMS

2.3 The Environment

2.3.1 Definitions of Environment

The environment is the totality of the surrounding atmosphere and area in which everything exists such as the landscape and the flat agricultural or all things that make up a place and everything around us such as weather or climate, water, plants, oceans, air and so on. Environment is the "surrounding in which an organization operates, including air, water, land, flora, fauna, humans and their interrelation, and surroundings in this context extend from within an organization to the global system" [ISO 14001:2003, 3.4, &Note] [ISO 14050.2002 Environmental management- Vocabulary].

In relationship with occupational health and safety, "environment" can be divided into the elements of:

- *Work environment*
- *Pollution prevention*
- *Health preservation*

The international standards describe work environment as "a set of conditions under which work is performed, and conditions include physical, social, psychological and environmental factors, such as temperature, recognition schemes, ergonomics and atmospheric composition" [ISO 9000:2000, 3.3.4]. Pollution prevention is "the use of processes, practices, techniques, materials, to avoid, reduce or control the emissions, separately or in combination, and can include source reduction, process and product changes, energy substitution, recovery, recycling and treatment" [ISO 14001:2003, 3.15, Note]. The environment as health combines "the aspects of human health and disease that are determined by factors in the environment, and practice of assessing and controlling factors in the environment that can potentially affect health" [WHO, 2004].

For a better understanding of the technical integration, there should be more clear definitions and meanings because they are introduced into the integration process. In this context, the definitions consider environment as:

<u>Elements:</u>
The most favourable environment for plants and animals. Those things are places like water, soil or air.

<u>Medium:</u>
The totality of surrounding in which something exists or lives, such as surrounding conditions for the chemical reactions, surrounding climate for production or conditions for food preservation.

<u>Ecology and bionomics:</u>
The science of the relationship between organisms and their environment. It means everything that may directly affect the metabolism or behaviour of a living organism or species, including light, air, water, soil and other living beings.

<u>Engineering:</u>
The application of science and engineering principles to prevent environmental damages and to correct existing problems. The engineering identifies designs, builds and operates systems to find solutions that are aware of environmental matters in a social

and economic context, such as architecture and building construction. This includes ventilation, humidity ratio, air conditioning, building material reflection, etc. Here is one example: Metallurgy manufacturing includes the oxidation and reductive character of the gases and flames during high-temperature processes.

2.3.2 Environmental Management (EM)

The environmental management is the management of roles, responsibilities, policies and procedures of environmental matters. And as applied, the term refers to the identification, assessment and management of potential health problems associated with chemical, physical and biological environmental hazards and the use of natural, economic and human resources in a way that preserves the natural environment and workplace. It is also concerned with the managing of economic activities for the benefits of our environment.

The environmental management needs to preserve resources and protect the environment, health and safety of workers and the community. It focuses on finding solutions to environmental problems. It has to understand and manage the effects of human activities on the environment or assess health, legal, and economic impacts of the problems and their alternative solutions. Also it needs to develop and apply effective policies for environmental regulations.
Possible applications for EM are:

- Risk management and pollution prevention
- Waste reduction, recycling and control
- Reduce resources consumption and elements conservation
- Minimising of hazards
- Selection of environmental materials
- Training and awareness raising
- Monitoring and measurement
- Auditing and communications

2.3.3 Environmental Management System (EMS)

An environmental management system by an organization is able to control the activities, products and processes that cause or can cause impacts on the environment, and through it, the environmental adverse impacts of the operations can be minimized. The EMS is the “part of an organization’s management system used to develop and implement its environmental policy and manage its interactions with the environment. A management system includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources” [ISO 14001:2003, 3.7 & Note].

The EMS is a systematic approach to prevent pollution and reduction of contamination with continual improvement of the overall system in an organization.
It is an organization's overall management system that may compliment the international standards and other national environmental agencies. It is an approach intended to ensure that all necessary actions are taken to integrate environmental protection standard levels and agencies decisions, and its requirements depend on the task and nature of the organization. "The environmental management requirements of an organization depend on its activities and their impact on the environment" [Schnurr, 1998, page 73].
The EMS is a specific tool and measurement that may be applicable for an adaptive management approach to certain actions that are related to the organization. The integration of EMS will make it more effective to prevent environmental degradation (pollution, disturbance, resource depletion, lost biodiversity, and other kinds of environmental damage), promote sustainability and implementation of actions and mitigation of overall losses during production and services. The overall framework of EMS elements consists of policies, programmes, trainings, documentation and records, monitoring, auditing, and management review and so on.

2.4 Occupational Health and Safety (OH&S)

2.4.1 Definitions of Occupational Health

The Occupational Health is the science of designing, implementing and evaluating comprehensive health and safety programmes that maintain and enhance workforce's health, improve safety and increase productivity in the workplace.
Occupational Health is a service programme designed to help businesses keep their employees healthy in safe and productive environment. The purpose of an occupational health service is "to promote and maintain the physical, mental and social well being of all staff" [WHO, 2004].

In relation with work of people, the occupational health is "the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations by preventing departures from health, controlling risks and the adaptation of work to people and people to their jobs" [ILO, 2004].

2.4.2 Definitions of Safety

The safety is any state of being saved or preserved from harm and being free from danger or injury. Safety is the “freedom from unacceptable risk of harm” [OHSAS 18001:1999, 3.16]. It is the “State or quality of being safe, freedom from danger” [Craighead, 1996, page 3].

There are many definitions of safety, the word safety is very often used in the every day life and it is the “quality or condition of being safe and free from danger, injury or damage” [Agnes, 1998]. In relation with the situation that is to be implemented, is to avoid or reduce the accidents probability. “The definitions of the industrial safety in the sense of the law are measures for accidents prevention during working and the work-caused health dangers including suitable measures for humans organization at the work” [Quaas, 1999, page 103].

The safety can be defined by many different terms such as risk, danger, salvation, impregnability, security, injury and as an instrument that is designed to prevent injury.
In condition of occupational activities and industrial safety, the Personal Protective Equipment (PPE), is designed to protect workforce from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards, and PPE includes a variety of devices and garments such as goggles, hard hats, gloves, vests, safety shoes, earplugs and respirators.

Safety engineering is another attribute of OH&S, that the primary goal is to produce safety for every organizations of all types and nature, introducing how the work be projected safely and how systems be designed and analyzed, how the engineering systems behave under man-made demands, and to know what are the potential failures and internal and external hazards on workers and society.

2.4.3 Occupational Health and Safety

Occupational health and safety are assessed as factors of well-being internal and external related persons. “Occupational health and safety: conditions and factors that affect the well-being of employees, temporary workers, contractors, visitors and any other person in the workplace” [OHSAS 18001:1999, 3.10].
The topic industrial safety and health protection contains words like safety, industrial safety and accident prevention which are partially synonymously used [Pischon, 1999, page 40].

The risk is one element that enters to the OH&S with larger importance and is also concerned with the environmental material preservation. "The risk is the probability or likelihood of injury, damage, or loss in specific environment and over some stated period of time" [Beroggi, 1995, page 3].

2.4.4 OH&S Management System (OH&S-MS)

Occupational health and safety is dealing with management style structure that binds with any business, and it declares how an organization can support the effective control of hazards and risks through the management process. "OH&S management system: part of the overall management system that facilitates the management of the OH&S risks associated with the business of the organization. This includes the organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the organization's OH&S policy" [OHSAS 18001:1999, 3.11].

According to OHSAS 18001:1999. 1 scope, the Occupational Health and Safety Assessment Series (OHSAS) specification gives requirements for an occupational health and safety (OH&S) management system, to enable an organization to control its OH&S risks and improve its performance. It neither state specific OH&S performance criteria, nor does it give detailed specifications for the design of a management system. The OHSAS specification is applicable to any organization that wishes to:

- Establish an OH&S- MS to eliminate or minimize risks.
- Implement, maintain and continually improve an OH&S.
- Assure itself of its conformance with its stated OH&S policy.
- Seek certification of its OH&S- MS.
- Make self-determination of conformance with OHSAS specification.

2.5 Comparable Benefits between QMS, EMS and OH&S-MS

Demonstrating comparable benefits between QMS, EMS and OH&S-MS show the common objectives for implementing them in an organization, and result the advantage in using them.
As benefits of QMS, the purposes are to enable the organization to accomplish its mission, its goal and its objectives effectively and successfully. This consists of customer satisfying, minimizing failures and time and risk reducing. “The motives of QMS are customer satisfying, competitive ability improvement, workers motivation, minimizing the failures, liability risk reducing, minimizing of times, international competitive participation, satisfaction by market requirements, and certifying” [Pischon, 1999, page 129].
For EMS, there is a strong commitment from the management, allocation of appropriate resources, and development of a strategy to be implemented within a specified period of time and implementation using a combination of internal and external resources that

would lead to certain benefits of the EMS. An EMS can facilitate its constitution and combine with quality, health and safety practices for workforce and the public by a way of its management system.
As for the benefits of OH&S-MS, the organizations are required by law and regulations to identify and control significant and substantial risk factors that can contribute to ill health at work, and try to ensure high standards of OH&S. The establishment of a management system of OH&S is essential, the benefits can help organizations to meet their obligations, national and international legislations and regulations. As comparable between benefits of QMS, EMS and OH&S-MS. **Figure 2.6** shows their common benefits tending to more common objectives and targets of the three areas of quality, environment and OH&S.

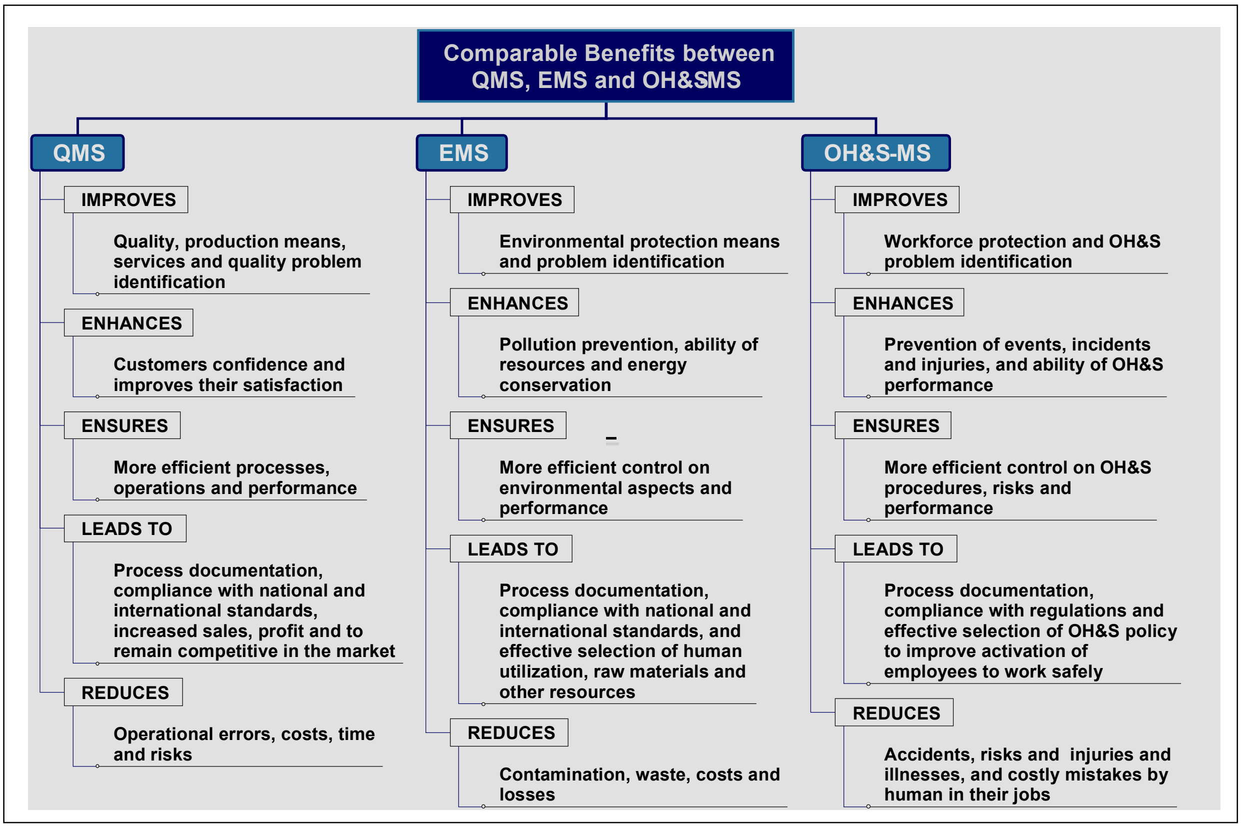


Figure 2.6 *Comparable Benefits between QMS, EMS and OH&S-MS*

2.6 Management Functions and Technical Integration Process

Management is the art of conducting and directing an activity, it is the process of planning, organizing, leading and controlling all parts of an organization's activity as operations, production, services, marketing, quality, environment, occupational health and safety, etc. through the deployment and manipulation of resources such as human, material, technology, engineering, financial ability, and others. “Management: coordinated activity to direct and control an organization, sometimes refers to people or group of people with authority and responsibility for the conduct and control of an organization” [ISO 9000:2000, 3.2.6].

It is figured as a set of requirements towards objectives. “The management system is a set of interrelated requirements used to establish policies and objectives and it includes organizational structure, planning activities, responsibilities, procedures, processes and resources” [ISO 14001:2003, 3.7, Note 1 & 2].

In an organization, the management could be consisting of several systems each one concerned with one activity supervision. “A management system of an organization can include different management systems, such as a quality management system, a financial management system or an environmental management system” [ISO 9000:2000, 3.2.2 & Note].

The management has four functions of planning, organizing, leading and controlling. **Figure 2.7** shows the duties of these four functions, and relates those functions to the integrated technical management systems.

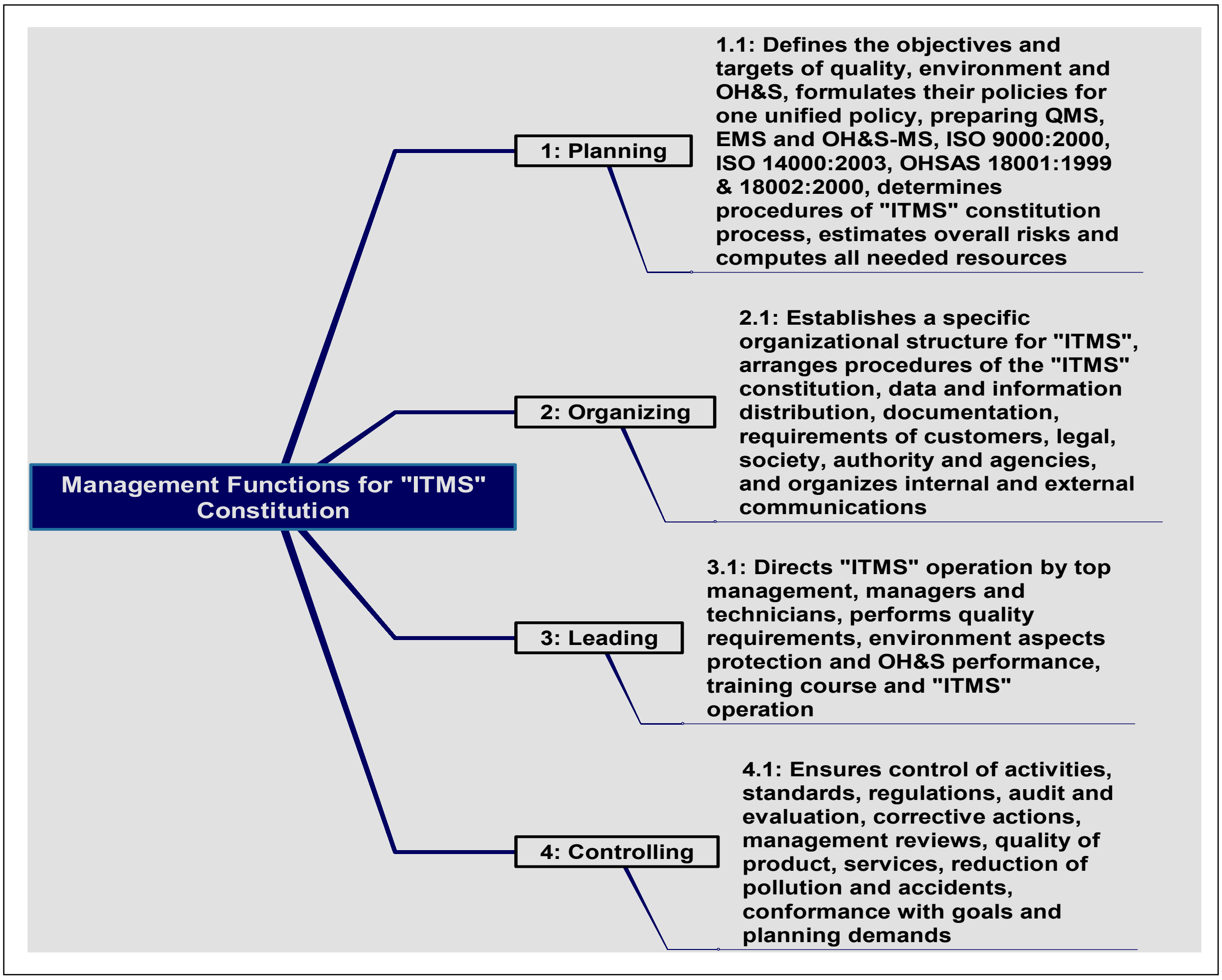


Figure 2.7 *Management Functions for “ITMS” Constitution*

2.7 Four Design Conditions

At every organization there are only four conditions in which an "ITMS" could be instituted, and become the beginning point for its planning, designing and constitution of an "ITMS." The contents of this research are applicable for those four conditions. In designing integrated technical management systems, the size, type, nature or the volume will have no effect on the process of constitution, because it could be performed without any affect of these aspects, they only affect the volume of the integration. "The size of the firm should not be a consideration when deciding about whether to integrate programmes" [Waite, 1998, page 22].

On the other hand, the constitution could be adopted by all organizations under international standards requirements because the existing management system by an organization gives the capability to form special management systems for each of quality, environment, and occupational health and safety, and the same possibility to form an integrated technical management system, but this occurs by complying with International standards. "It is possible for an organization to adopt its existing management systems in order to establish a quality management system that complies with the requirements of this International Standards" [ISO 9001:2000, 0.4].

The research will show four conditions in which an "ITMS" could be designed and implemented as shown in **Figure 2.8**. The conditions are:

1. Nothing: starting in that condition that an organization has no management system of quality, environment or O&HS.
2. One or two management systems: starting from a point that an organization has one or two management systems and uses them. It needs to constitute other management system and then integrate them.
3. Separated management systems: starting from the condition that an organization has all three management systems but each system functions separately. It wishes to make integrated systems between them.
4. One technical function: starting from the condition that an organization wishes to develop a limited technical function operation for quality, environment and OH&S especially in small or medium organization (e.g. technical integration for welding, medical test, machining a tool in the workshop, etc.).

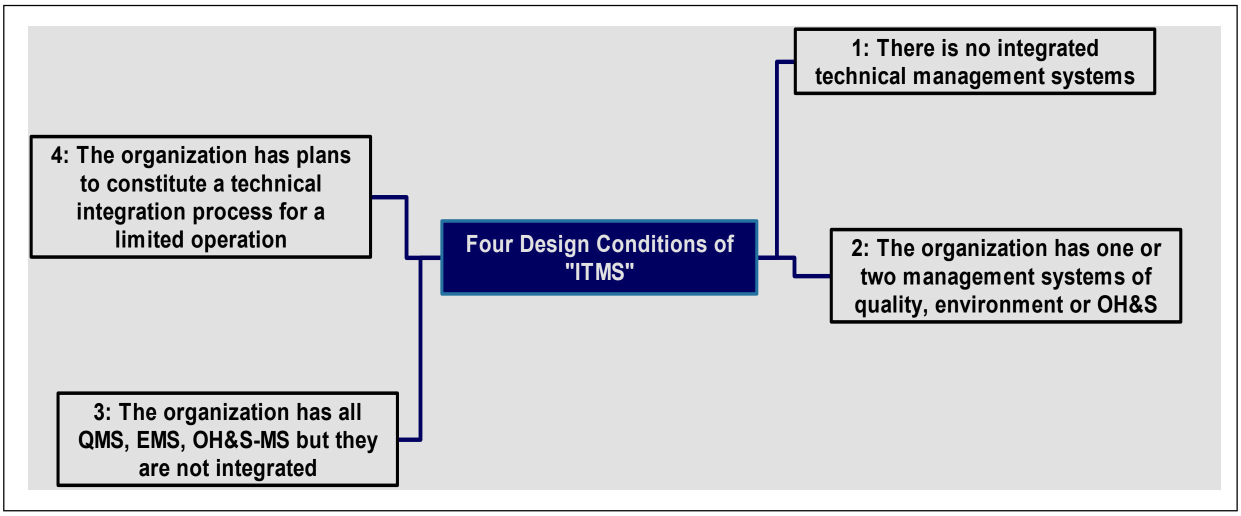


Figure 2.8 *Four Design Conditions*

Chapter 3- Standards, Standardization and Analyzing

3.1 International Organization for Standardization

The International Organization for Standardization (ISO) is a worldwide network and federation of 146 countries and each country is represented by one member. The ISO works in partnership with national and international organizations, associations, agencies, governments, industries, businesses and consumer representatives. The ISO and its members are non-governmental. It was established in 1947, with a central secretariat in Geneva, Switzerland.

According to ISO it can be represented by different abbreviations in different languages (IOS in English, OIN in French (*Organisation international de normalisation*), however, the founders decided to give the organization the name “ISO” stemming from the Greek *isos*, meaning "equal". Therefore, regardless of the nation or language, the organization is always referred as ISO.

The mission of ISO is to promote the development of standardization and related activities in the world with the aim of facilitating the international exchange of goods and services. ISO is able to act as a bridging organization, meeting the requirements of business and needs of stakeholders, with the desires of society, consumers and users. There are national standard organizations NSO for countries, who issue standards in their regions.

3.2 National and International Standards

A standard is a reference point for the evaluation of other things, a set of measurements for all subsequent works and a basis for comparison against standardized reference model.

The standard as a term means standard process in engineering sciences, standard product in industrial manufacturing, and it could be understood as standard symbols, standard traffic movement and standard documentation form as examples, or it can be a model. “The standard is a model used to verify commonly levels of quality, quantity and performance” [Craighead, 1996, page 386].

ISO and NSO prescribe national and international standards (NS, IS), which specify requirements for QMS, EMS, and OH&S-MS for organizations of all types and sizes. These standards describe fundamentals for designing these three management systems by issuing and publishing standards of ISO 9000:2000, ISO 14000:2003, OHSAS 18001:1999 & 18002:2000.

There are thousands of standards and technical regulations in the world that contain special requirements for all countries or regions developed by national delegations, representatives and experts who are members of ISO and technical committee. They reach consensus on a drafted agreement, then circulated it as a Draft International Standard (DIS). After being approved by a vote, the document with eventual modification is circulated to the ISO members as a Final Draft International Standard (FDIS). Then it is subsequently issued and published as an International Standard.
The standard is a worldwide responsibility because it affects the world on global level, as seen in environmental standards. “Major environmental issues from local, national, regional and international points, should be examined according to geographical areas” [Saad, 1999, page 110].

On the other hand, many nongovernmental organizations such as trade associations, professional societies, engineering associations, occupational unions, private laboratories and others issue standards and make investigations and issue certifications. Most international standards are implemented as national standards in most European countries and others. Many other national standards harmonize with the international standards.

3.3 General Regulations

The general regulations (GR) in this thesis represent regional, national and international regulations that contain issued and approved regulations by regional and national associations, agencies, federations, societies, unions and institutes, and are often made laws by governments.
These regulations include rules, laws, codes, guidelines, orders and instructions. “The components of the industrial safety management systems are: laws, regulations, rules of prevention of accidents, instructions of executions, general administrative regulations” [Floß, 1999, page 87-88].
The regulations are usually provided with understandable phrases and statements as demands. “Codes, standards and statutes generally demand action with the term shall” [Pyatt, 1995, page 11].

There are several regional, national and international specifications and regulations about occupational health and safety, which pertain to all aspects of human, equipment and material protection. They are internationally accepted and they are different in some dealing principles, but in original task they have the same goals and objectives. “The following are some examples of standards and regulations of occupational health and safety:

- Occupational health and risk management system, OHRIS (Bavarian model draft for development, organization, introduction and integration a management systems for industrial safety and plant safety: 1997)
- BS 8800:1996, occupational health and safety management system (British standards)” [Reinhardt, 2001, page-99].

The following are parts of general regulations:

3.3.1 Regulations

Regulations are the act of ruling, administrating law and control on specified arrangements in order to control the actions and exercises of authority. There are procedures, which contain the most exact rules of the government. They can be management rules for any operation and activity. It governs behaviour and control procedures. All the regulations lead to occupational health and safety in organizations, for example in building construction. “The main purpose of the building regulations is to ensure the health and safety of people in or about the building, and they are concerned with energy conservation” [Seeley, 1995, page 7].
They aim to bring conformity and work in a systematic manner, and provide ordinary procedures, directions and orders for achievement and improvement.
The regulations are introduced into most parts of our life through our environmental surroundings. As examples, Environmental Protection Agency EPA states; “62 FR 38652. July 18, 1997, National ambient quality standards regulations, 63 FR 69390 December 16, 1998 National primary drinking water regulations, and 61 FR 52602. October 7, 1996 Medical services regulations” [Sunstein, 2002, page 220].

3.3.2 Guidance

Guidance is the method of instruction, technical direction for implementation and application. It gives non-ordered instructions to achieve a goal by powered exercise from organizations and agencies. It also plays an important role in the forming of laws and regulations. “The sources of European laws and regulations are: decree, orders, regulations, ordinance, prescriptions, guidance, instructions, principles and directives” [Kamiske, 1999, page 5].

They are named in many cases by the guidelines as regarding to the type of technical specification, as examples, “Guidelines are issued by American Institute of Chemical Engineers, as the guideline for: preventive human error in process safety, engineering design for process safety, vapour release mitigation, safe storage and handling of high toxic hazard materials, etc.” [CCPS, 1995, page 1].

3.3.3 Rules

Rules are a systematic body of regulations defining the way of life of members of a society. They include the way of life and movement of workers of an organization, and they are generally accepted to be right. The rules are prescribed guide for actions within a society and inside an organization as well.
They are important because they define the proper way of movement, function and activity, and by consulting with the authorities they make a declaration about processes with comparison according to the specified rules.

3.3.4 Laws

Laws are established rules defined under the conditions of existence of a state. They are verdicts, orders, ordinance, statutes, resolutions and judicial usages which are enforced by controlling authority. “By Black’s Law Dictionary, the law is a body of rules or action or conduct prescribed by the controlling authority, and having binding legal force, which must be obeyed and followed by citizens” [Craighead, 1996, page 386].
The laws in practice exist about every matter such as preservation of environmental elements, occupational health and safety, traffic regulations, standards and rules of service, buildings and goods, etc. These rules must be established, controlled and imposed by authority.

The legislation or laws in the context of integrated management systems take totality as laws of the environmental protection so as they encompass all local, national and regional laws and should be implemented together. “The command structure or hierarchy of the environmental legislations are city law, federal law, and European law” [Kamiske, 1999, page 49].

In connection with this thesis subject, some examples of laws are: municipal law, law of noises, marine law, laws in relation with environment and safety, laws of x –ray and so on. **Table 3.1** provides examples of typical standards and regulations used in products and operations that should be followed in order to fulfil objectives and targets of high quality, reducing adverse impacts on environmental aspects and raising of occupational health and safety performance.

Examples of Typical Standards and General Regulations		
Products and Operations	**Typical Standards (NS & IS)**	**Typical General Regulations (GR)**
Equipment and Machinery	High Voltage Station	Protection Regulations
	Water tank structure	Occupational safety (cloth specifications)
	Truck vehicles	Operating codes
	Painting equipment	Handling instructions
	Pipe welding	Body protection (eyes, head, hands…)
	Medical x-ray devices	Radiation limit orders
	Purification instrument	Safety contents of drinking water
Building and Construction	Buildings or halls	Building codes
	Crude oil stations	Alarm system
	Hospitals	Electrical codes
	Schools	Emergency rules
	Street	Traffic regulations
	House spaces	Ventilation rules

Table 3.1 *Examples of Typical Standards and General Regulations*

3.3.5 Codes

Codes are an official compilation of laws and classified on subject basis and to be followed in order to produce more safety and avoid accidents or hazards. "The code is a systematic collection, a private or official compilation, of all permanent laws and classified according to subject matter" [Craighead, 1996, page 386].

3.4 Benefits of the NS, IS and GR

Standards make positive effect on manufacturing and services industry. Without standards, product compatibility, customer satisfaction, environmental protection, public safety, production efficiency could not be achieved. They are very useful to meet requirements of industrial operation, service, customers, suppliers and other regulatory bodies. The standards define critical elements that should be considered to produce high quality products, preserve environmental aspects and OH&S performance. Regarding the great losses in the world, the use of standards is urgently required, at the same time they are necessary for preserving human health. **Figure 3.1** shows the aspects of national and international standards and general regulations.

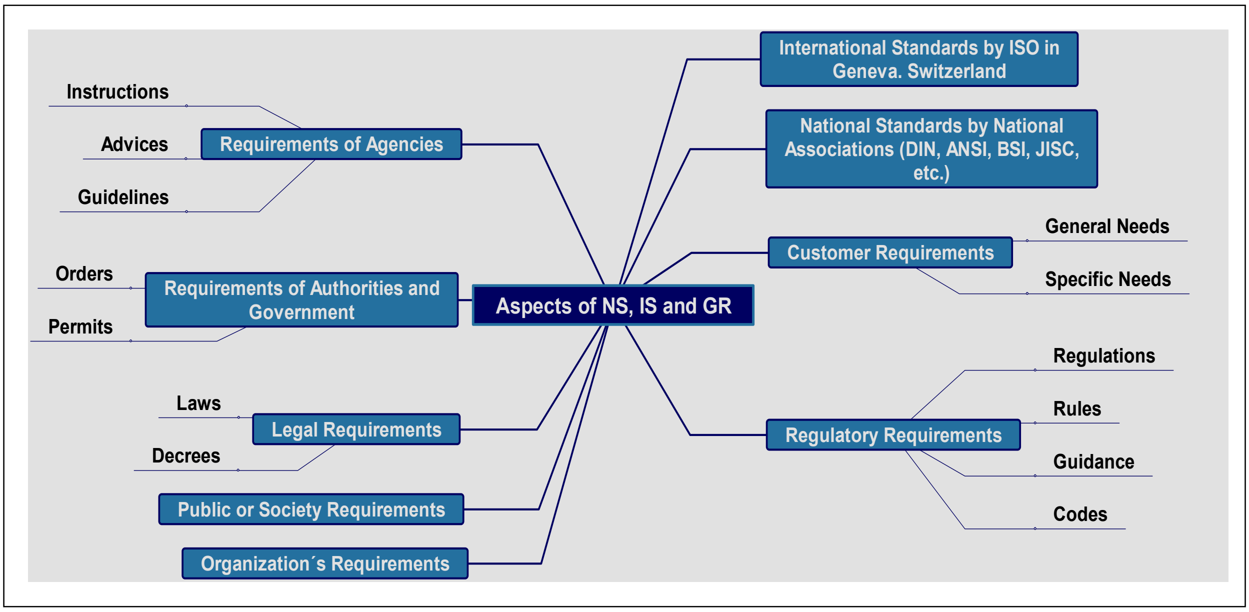


Figure 3.1 *Aspects of NS, IS and GR*

One of their useful applications is in safety and environmental preservation as in the case of constructing buildings, as mentioned before in chapter 3.3.1; "The application of the building regulations means ensure health and safety of people in building and energy conservation" [Seeley, 1995, page 7]. On the side of economical benefits, they take a great role in saving costs of production and design. "A study conducted by Shell confirmed that the oil and gas industry would save an equivalent of 1% of its annual expenditure by implementing International Standards" [ISO Focus, 2004, page 25].
The standards will lead organizations to a successful state. "The success potentials in the organizations are standards, workers motivation and guidance" [Molitor, 2000, page 4]. They are major factors for organization's improvement. "One recommendation for needed improvements is technical standards" [GAO, 1999, page 4].
The importance of the standards and regulations also enters in to the design of products that should confirm safety requirements not only the quality and cost benefits. "The designers and manufacturers are not allowed to make works that hurt people even if benefits are to be obtained" [Pyatt, 1995, page 11].
The best benefit of standards and general regulations is the standardization, which could be done by the imposition of standards and general regulations into operations and products (more details in chapter 6.6). In relation with integrated technical management systems, their benefits are:

- *Standardization of integrated technical management system of QMS, EMS, and OH&S, which results in "ITMS"*
- *Standardized "ITMS" documentation which is referred as SD*

Figure 3.2 shows the resources of the standardization that are represented by NS, IS and GR.

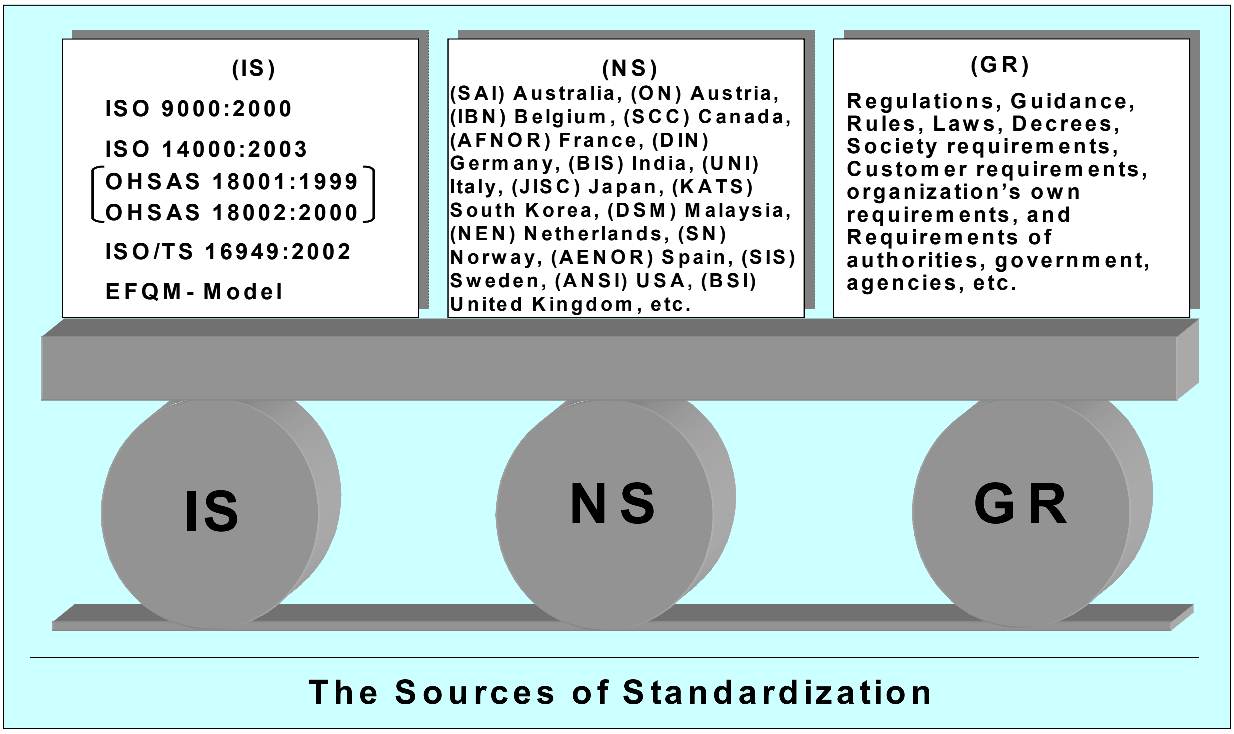


Figure 3.2 *The Sources of the Standardization Procedure*

3.5 ISO 9000:2000

ISO 9000:2000 standards represent an international consent for good management with aims of ensuring that the organization can deliver the product or services that can meet the customer's quality requirements. It was developed to assist organizations of all types, sizes and natures. "It has been prepared by Technical Committee ISO/TC 176" [ISO 9000:2000, foreword].

ISO 9000:2000 standards are not a series of product standards and requirements, but they are series of generic standards for QM systems, and it helps to implement and operate an effective QMS, and enables organizations to provide an assurance to fulfil agreed customer requirements and satisfaction. It could be an effective marketing tool.

The ISO 9000:2000 family includes three main standards plus many other associated quality standards, technical records and guides which can be described as supporting tools that give guidance on a specific aspect, the following shows some of their examples:

- ISO 10015:1999 Quality management guidelines for training.
- ISO/TR 10013:2001 Guidelines for quality management system documentation.
- ISO 10006:2003 QMS- Guidelines for quality management in projects.

The main standards together form a coherent set of QMS standards, facilitating mutual understanding in national and international trade, following are their brief description:

- ISO 9000:2000 Quality Management Systems- Fundamentals and Vocabulary, describes the fundamentals of a QMS and specifies the terminology for a QMS. It was developed on the basis of previous standards ISO 8402:1994 Vocabulary and ISO 9000-1:1994 Selection and Use.

- ISO 9001:2000 Quality Management Systems- Requirements, specifies the requirements of an organization in order to constitute an effective QMS, where an organization needs to demonstrate its ability to provide products that meet customer requirements and applicable regulatory requirements and aims to enhance customer's satisfaction.
  The ISO 9001:2000 has five main requirements of: Quality Management System, Management Responsibility, Resource Management, Product Realization, Measurement Analysis and Improvement.

- ISO 9004:2000 Quality Management Systems- Guidelines for Performance Improvements, which replaces ISO 9004-1:1994, provides guidelines for both effectiveness and efficiency of the QMS. The aim of this standard is the performance improvement of an organization and satisfaction of customers and other interested parties.

3.6 ISO 14000:2003

This international standard consists of two main standards issued and published by international organization for standardization (ISO):

1. ISO 14001:2003 Environmental Management Systems- Requirements with guidance for use.
2. ISO 14004:2003 Environmental Management Systems- General guidelines on principles, systems and supporting techniques.

According to (ISO 14001:2003, foreword); “the ISO 14001 was prepared by Technical Committee ISO/TC 207, Environmental management, Subcommittee SC 1, Environmental management systems”.

In the new version of the ISO 14000:2003 there is a note about it as follows:

“The two standards are draft international standards (ISO/DIS 14001) and (ISO/DIS 14004), issued by ISO/TC 207/SC 1, and voting began on 28.08.2003 and finished on 28.01.2004.They are revision of first edition (ISO 14001:1996, ISO 14004:1996).This

ISO document is a draft circulation for comment and approval, in addition to their evaluation as being acceptable for industrial, technological, commercial and user purposes" [ISO 14001:2003 Environmental management systems- Requirements with guidance for use].

As mentioned in the (ISO/DIS 14001:2003, Scope) it specifies requirements for an environmental management system, to enable an organization to formulate a policy and objectives taking into account legal requirements and information about significant environmental aspects.
The ISO 14000: 2003 is applicable to any organization that wishes to:

a) implement, maintain and improve an environmental management system;
b) assure itself of its conformity with its stated environmental policy;
c) demonstrate such conformity with this international standards by:
    - Making a self-determination and self-declaration;
    - Seeking confirmation of its self-declaration by a party external to the organization; or
    - Seeking certification/registration of its environmental management system by an external organization.

The ISO 14000:2003 family consists of the two main standards and may include other standards, which can be described as supporting tools that give guidance on specific aspects. The following are some of their examples:

- ISO 14042:2000 Environmental management- Life cycle impact assessment.
- ISO 14020:2000 Environmental labels and declaration- General principles.
- ISO 14050:2002 Environmental management- Vocabulary.

3.7 OHSAS 18001:1999 and OHSAS 18002:2000

Occupational Health and Safety Assessment Series OHSAS is an international standard giving requirements related to health and safety management systems in order to enable an organization to control its risks and improve its performance.
There are two issues of occupational health and safety:

1. OHSAS 18001:1999 Occupational health and safety management systems- Specification.
2. OHSAS 18002:2000 Occupational health and safety management systems- Guidelines for the implementation of OHSAS 18001:1999.

According to OHSAS 18001:1999, Foreword and Scope, this series has been developed in response to urgent customer demands for a recognizable occupational health and safety management system standards against which their management systems can be assessed and certified, and it gives requirements for an OH&S-MS, enabling an organization to control its OH&S risks and improve its performance.

Today, the organizations of all kinds are increasingly concerned about achieving and demonstrating sound occupational health and safety performance to their workforce, clients and other stakeholders by managing the risks and improving the beneficial effects of their activities, products and services. Also according to OHSAS 18001:1999, foreword, and OHSAS 18002:2000, foreword, there are some documents that were referenced during the development of the OHSAS specification, as:

- BS 8800:1996: Guide to Occupational Health and Safety Management Systems.
- SGS & ISMOL ISA 2000:1997: Requirements for Safety and Health Management Systems.
- BVQI Safety Cert Occupational Safety and Health Management Standards.
- UNE 81900 Series of Pre-standards on the Prevention of Occupational Risks.

As mentioned in (OHSAS 18001:1999, Scope) the OHSAS series gives requirements and guidelines for an occupational health and safety management system OH&S-MS. And (as in similar to ISO 14001:2003, chapter 3.6), the OHSAS specification is applicable to any organization that wishes to:

a) establish an OH&S management system to eliminate or minimize risk to employees and other interested parties who may be expressed to OH&S risks associated with its activities;
b) Implement, maintain and continually improve an OH&S-MS;
c) Assure itself of its conformance with its stated OH&S policy;
d) Demonstrate such conformance to others;
e) Seek certification/registration of its OH&S-MS by an external organization; or
f) Make a self-determination and declaration of conformance with this OHSAS specification.

There are thousands of standards for occupational health and safety, and a large numbers of agencies and associations involved in OH&S. Following are some of the examples:

- ISO 14121:1999 Safety of machinery- Principles of risk assessment.
- ISO 9355-1:1999 Ergonomic requirements for the design of display and control actuators- Part 1: Human interactions with displays and control actuators.
- LV 21:2000 & LV 22:2001 OH&S specification and guidelines by German states.

3.8 ISO/TS 16949:2002

The ISO/TS16949: 2002 Quality management system's particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organization and technical specifications, which is a worldwide common automotive quality standards, was released in March 2002, and it based on the ISO 9001:2000.
The 1st edition of the ISO/TS 16949 was released in 1999, it was based on ISO 9001:1994 to emphasize continual improvement in the supplier base, but the IATF revised its requirement in order to align with the ISO 9001:2000 framework that was rolled out in April 2002.

The International Automotive Task Force (IATF), a group of automotive manufacturers in collaboration with the ISO, developed and published ISO/TS 16949:1999 Quality system requirements for automotive suppliers, this issue was the particular requirements for the application of ISO 9001:1994. Their specifications were developed with input from the four established automotive standards: QS-9000 (USA), VDA6.1 (Germany), EAQF (France) and AVSQ (Italy), and they are originally based on them.
Also the Japan Automobile manufactures association Inc. (JAMA) has made efforts in coordination with the ISO and supports from ISO/TC 176 quality management and quality assurance, they introduced the:

ISO/TS 16949:2002, Quality management systems- Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organizations.

The new version of ISO/TS 16949:2002 includes ISO 9001:2000 and along with customer-specific requirements defines quality system requirements for using in the automotive supply chain around the world. It successfully harmonizes the quality system requirements of the automakers of Germany, US, Italy, France, Japan, Korea and Malaysia.
The new version has other benefits such as:

- Provide additional confidence for better resources utilization and reduced waste.
- Increase the efficiency on product and process design.
- Focus on every duty of top management, clearly defined measurable quality objectives, human resource management by training and effective analysis of data.

3.9 International Standards call for Integration

The new version of ISO 9001:2000 has many differences with the last version of ISO 9001, 2, 3:1994 and is based on more advantages for an organization.

The new ISO 9001:2000 not only focuses on the clauses of ISO's series standards, but extends them to view the organization as a series of interacting and more connected or unified processes and more intersection between elements than the former issue in 1994. Such that leads to more degree of integration process with other management systems (such as EMS, OH&S-MS), which is one of the most important characteristics of this new issue. And in comparison with the original standard, the revised standard applies to all product categories, sectors and organizations, and passed in little elements (5 instead of 20) that give more flexibility.
These advantages are in favour of the integration constitution process.
As a total quality management, it tends to technical integration as well. "One pillar of total quality management is the integration" [Ho. 1995, page 50- 51].

The ISO 9001:2000 could be helpful and is beneficial for the technical integration constitution process. The benefits are shortly described as:

- The standard is now used globally and universally (not just in manufacturing).
- The "5" broad headings is a better structure than "20" elements.
- More compatibility with other standards (ISO 14001:2003) and requirements (OHSAS 18001.1999).

The ISO 14001:2003 tends to integration process constitution with others such as quality, OH&S and financing. "The ISO 14001 includes principles for full integration of the environmental program with health and safety, quality, finance, business, planning, and other essential management processes" [Waite, 1998, page 20].

The OHSAS 18001.1999 complies with relevant OH&S legislation, standards and codes. It could be effectively implemented with the requirements of ISO 9001:2000 and ISO 14001:2003. "The OHSAS has been developed to be compatible with the international standards of quality and environment" [OHSAS18001:1999, Foreword]. Therefore it will be assistance to the integration process between the three management systems.

The ISO/TS 16949:2002 is closer to the integration constitution process and there is more realization of technical elements. "This international standard does not include requirements specific to other management systems, such as those particular to environmental management, occupational health and safety, financial management or risk management. However, this International Standards enables an organization to align or integrate its own quality management system with related management system's requirements" [ISO/TS 16949:2002, 0.4]. It affirms the combination between safety of products and minimization of risks in its requirements stated in clauses (ISO/TS 16949:2002, 6.4.1 & 7.2.1 & Note 3). **Figure 3.3** shows the numbers of clauses of three main international standards that call for integration and unification.

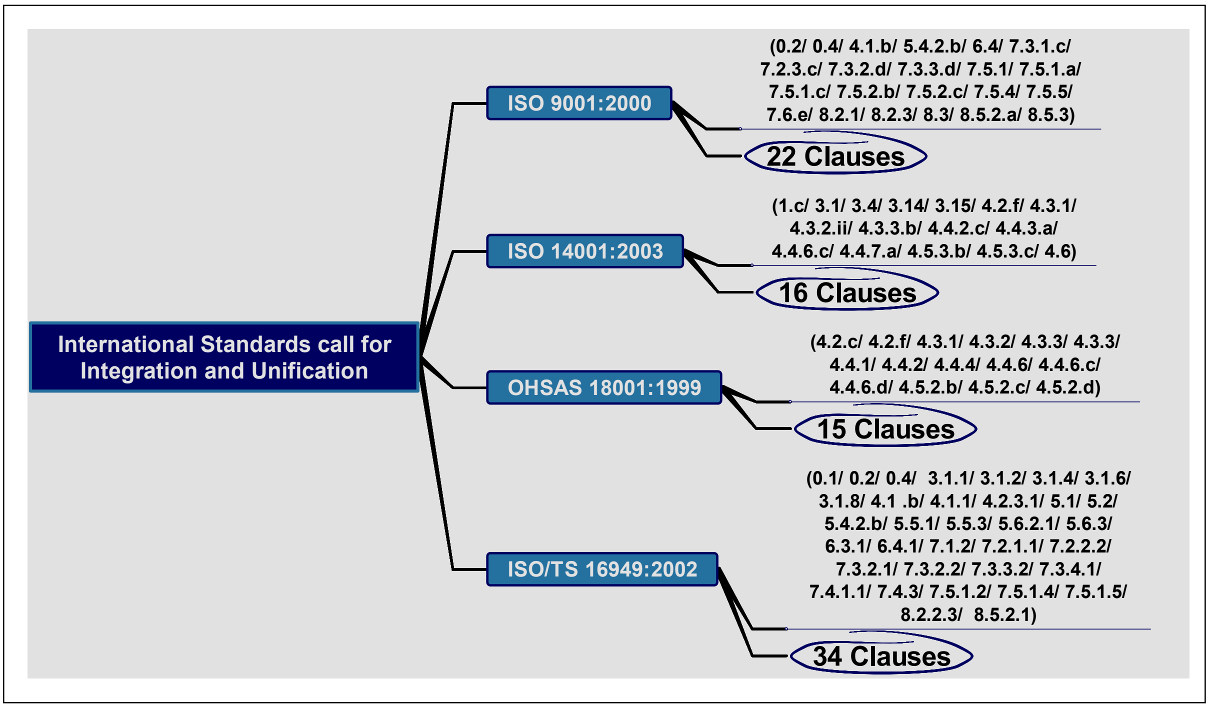


Figure 3.3 *Call for Unification and Integration by International Standards*

3.10 EFQM-Model

The European Foundation for Quality Management (EFQM) is a non-profit and a primary source organization in Europe, looking to excel their market and their business. Founded in 1989, EFQM is now assessed as the excellent and global minded by organization of all sizes and sectors (private and public).

The EFQM is the establisher of the EFQM Excellence Model and the European Quality Award. There are permanent efforts to promote learning and practice of quality management, and every year leading organizations are sponsors for the EFQM Forum.

The EFQM-excellence model as illustrated in **Figure 3.4** consists of a framework based on nine criteria. Five of these are called enablers and four called results.
The enabler's criteria cover what an organisation will do and the results cover what an organization will achieve, and the results are those caused by enablers.

The definitions of the indicated criteria are as follows:

- *Leadership: The leadership or leaders make it more easy to reach the mission and vision.*
- *People: The organization manages, directs and develops its people.*
- *Policy and strategy: The organization implements its mission and vision by focused strategy, policies, planning, objectives, targets and processes.*

- *Partnerships and resources: The organization plans and manages its external partnerships resources.*
- *Processes: The organization designs, manages and improves its processes.*
- *People results: The organization achieves what is useful for its people.*
- *Customer results: The organization achieves what is useful for its external customers.*
- *Society results: The organization achieves what is useful for the society and public.*
- *Key performance results: The organization achieves performance as what was planned.*

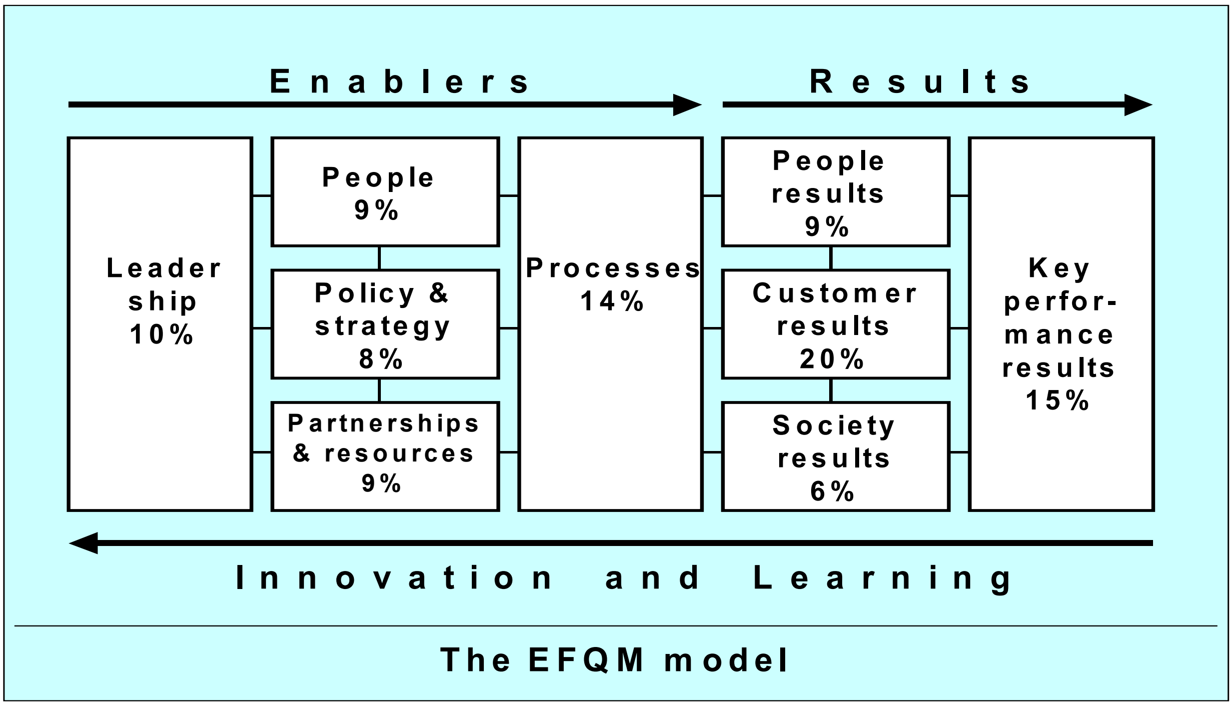


Figure 3.4 *The EFQM-Model*

3.10.1 EFQM-Model calls for Integration

In relation with the "ITMS", the scoring process has been described by the EFQM-model for an organization under 100% for two enablers and results. The enablers are all inputs of the "ITMS" constitution, and results are outputs of achieved "ITMS" objectives and targets. During transformation of EFQM-Model, it can be noted that the above three boxes of results (people, customer and society) represent the organizational and external structures in the portioning procedure (portioning is one of five procedures of "ITMS" constitution, (More details can be found in chapter 6). They occupy a 35 (*9+ 20+ 6)* degree ratio in the EFQM-model, which means by filling requirements of workforce and customers, it will take average of 35% from 50% of the total results ratios. It demonstrates the importance of filling requirements and regulations of the workforce and customers in quality and safety as shown in **Figure 3.5**.

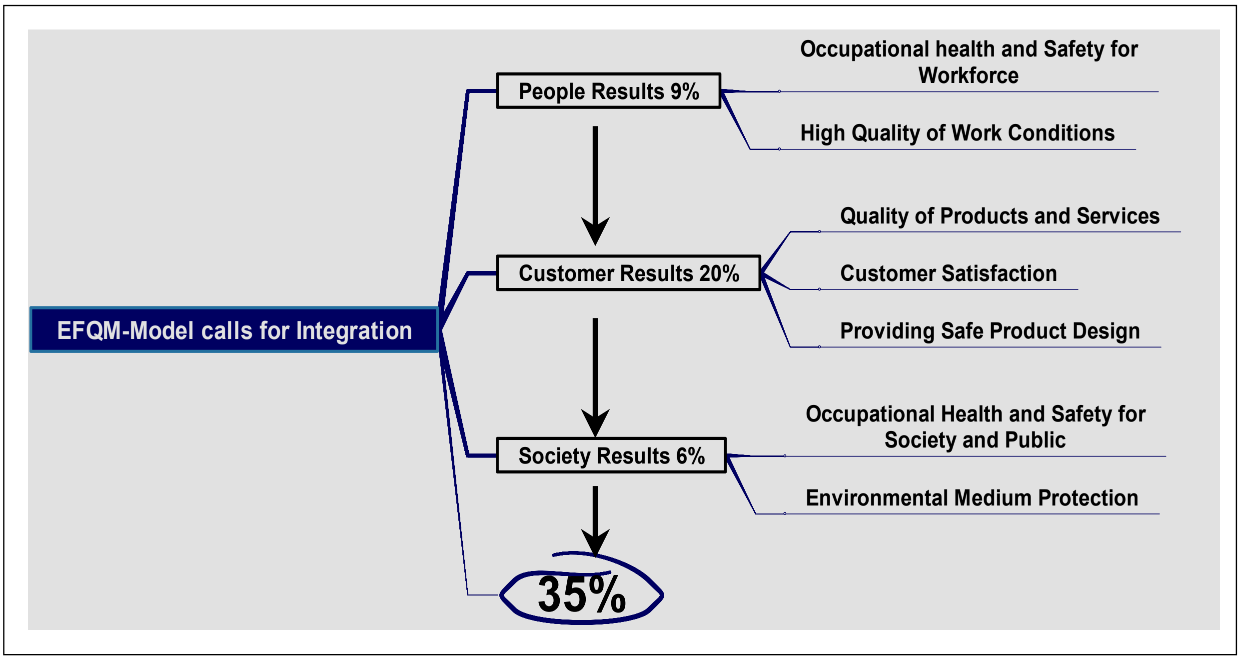


Figure 3.5 *EFQM- Model Calls for Integration*

3.11 Faces of Common Elements

The common elements are those which have the same characteristics and bear comparable functions and activities, or they have almost common processes, operations and works, or intend to have the almost same results.

There are common elements among international standards and management systems which are shown in **Figure 3.6**. Those elements are similar in their activities and functionality. The results are similar or nearly similar when they are active and operating. The demonstrating of common elements is useful because any of their designation will facilitate the designing of other elements. In addition, it is an important factor for the success of standardized technical integrated management systems for quality, environment and OH&S, and its continual improvement and implementation as shown in the sections:

- *Section 1.4.2 (Faces of technical elements)*
- *Sections 2.2, 2.3 and 2.4 (QMS, EMS and OH&S-MS)*
- *Section 2.6 (Management functions)*
- *Section 3.5, 3.6 and 3.7 (ISO 9000:2000, ISO 14000:2003 and OHSAS 18001:1999)*
- *Sections 3.8 and 3.10 (ISO/TS 16949:2002 & EFQM-Model)*

It was determined that four types of common elements can serve the integrated technical management systems and its overall objectives and targets of high quality, environmental protection and OH&S performance. The common elements are:

Faces of technical elements: These include the related technical activities, technology and engineering. The related technical activities RTA are considered as the main elements of integrated technical management systems. Most of them are mentioned in the requirements of international standards. They define the way to achieve other operational processes in order to execute their requirements and specifications, such as auditing, testing, inspecting, recording, documenting, correcting, conforming, etc.
At the same time this research figures out them as technical elements that would be unified in their actions. Its detailed description will be found in chapter 6, as an initial step for integrating their management systems.

Operational processes: These are concerned with business and any operations or activities which are to be carried out. They are any technical efforts to be taken in manufacturing organizations or service industries, such as operational processes in a workshop of welding, grinding, cutting, pressing, etc and in other service firms such as repairing, maintenance, modification, fabricating, mixing, circulating, compounding, transporting, storing, packaging, etc. These operational processes have similarity in dealing with three areas of quality, environment and OH&S that could be unified as element and integrate their management systems with a suitable degree of acceptance.

Four management functions: As described in chapter 2.6, there are four management functions of planning, organizing, leading and controlling which are interlinked with each one of QMS, EMS and OH&S-MS. There is an overlap between most management functions and sub-functions, therefore it is necessary to view and return to an integrated process which defines a set of interrelated requirements used for procedures and purposes achievements.
These can be applied in any project, department or in entire organization. The four functions must exist internally in any technical activities when achieved. The production units, whether small or large, can be implicated significantly within four management functions.

Requirements of international standards: There are common elements between three of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 and some will participate in the common elements from ISO/TS 16949:2002. The common elements here mean those requirements issued in clauses which are intended to the same goal and are required in the same manner. These requirements are referred in the EFQM-Model as well.

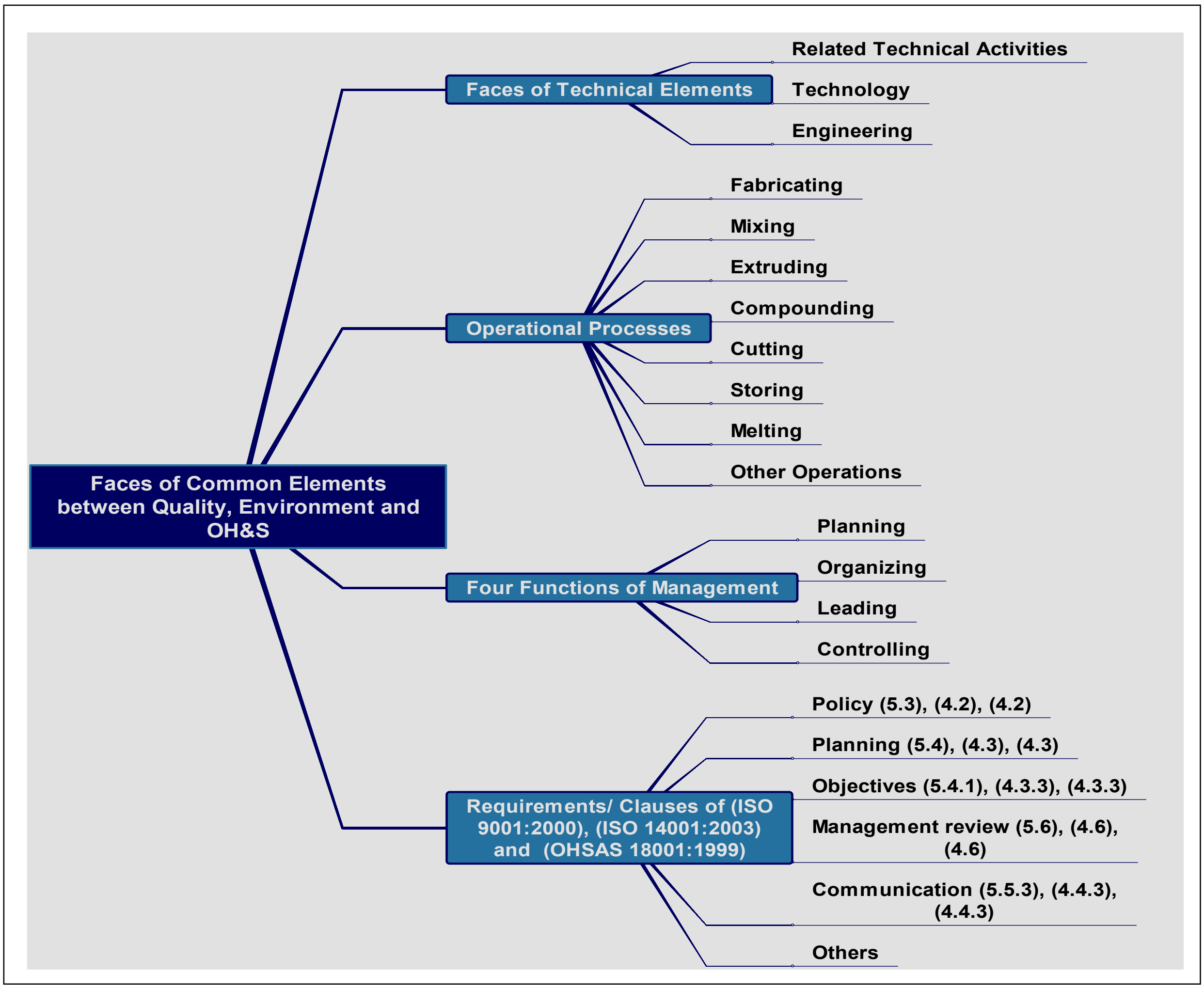


Figure 3.6 *Faces of Common Elements between Quality, Environment and OH&S*

This similarity could be seen in the same ISO´s publications, where their tables show the correspondence between them. These tables facilitate the planning and constitution of the "ITMS" and are as follows:

<u>From ISO 9001:2000:</u>
Table A.1- Correspondence between ISO 9001:2000 and ISO 14001:1996
Table B.2- Correspondence between ISO 9001:1994 and ISO 9001:2000

<u>From ISO 14001:2003:</u>
Table B.1- Correspondence between ISO 14001:200x (DIS) and ISO 9001:2000
Table B.2- Correspondence between ISO 9000:2000 and ISO 14001:200x (DIS)

<u>From OHSAS 18001:1999:</u>
Annex A (informative) Correspondence between OHSAS 18001:1999, ISO 14001:1996 and ISO 9001:1994

Chapter 4- Framework of “ITMS” Constitution

4.1 Introduction

A framework is the simplified description of a complex entity or process. It can be addressed logically and systematically to a particular issue or system. “A framework is defined as a conceptual structure that encapsulates the fundamental knowledge and the set of relationship of a discipline” [Ghosh, 2002, page 27].

It could also be a set of assumptions, concepts and practices that establishes a specific way or method. The framework expresses a set of specific functionality with an effective control.

The framework of the “ITMS” is a way to customize a structure through a set of components that provide specific behaviour application and interfaces between them so that an effective “ITMS” can be built. Hence, this framework will also show its limitations during the constitution process. This chapter provides framework of “ITMS” constitution as described in followed sections.

4.2 General Principles in this Thesis

There are some general principles in this thesis work which form the basic principles for the constitution of “ITMS”. They are assumed as a circle where the principles are put inside. Whenever they are repeated in this research, they have the same meaning in all chapters and sections. Following are the principles:

- Three areas: represent quality, environment and OH&S, and also (QMS, EMS and OH&S-MS)
- Technical elements: represent all elements of the three faces (chapter 1.4)
- Common elements: represent four faces of common or similar elements (chapter 3.11).

- NS, IS and GR: they represent national standards, international standards and general regulations (chapters 3.2, 3.3, and Figure 3.2 show sources)
- “ITMS”: abbreviation for “integrated technical management systems for three areas.” It is standardized in accordance with national and international standards and general regulations (NS, IS, GR).
- “ITMS” Constitution process: means the process of designing or building the “ITMS” that contains all five procedures.
- Five procedures: This is a series of consecutive and interrelated procedures of the constitution process shows how an “ITMS” can be constituted, they are: portioning, unification, integration, standardization and implementation (chapter 6).

4.3 Participants of Constitution Process

Several internal and external participants are involved in the “ITMS” constitution process that makes the process successful. **Figure 4.1**. The internal factors are within an organization whereas external factors originate from the exterior.

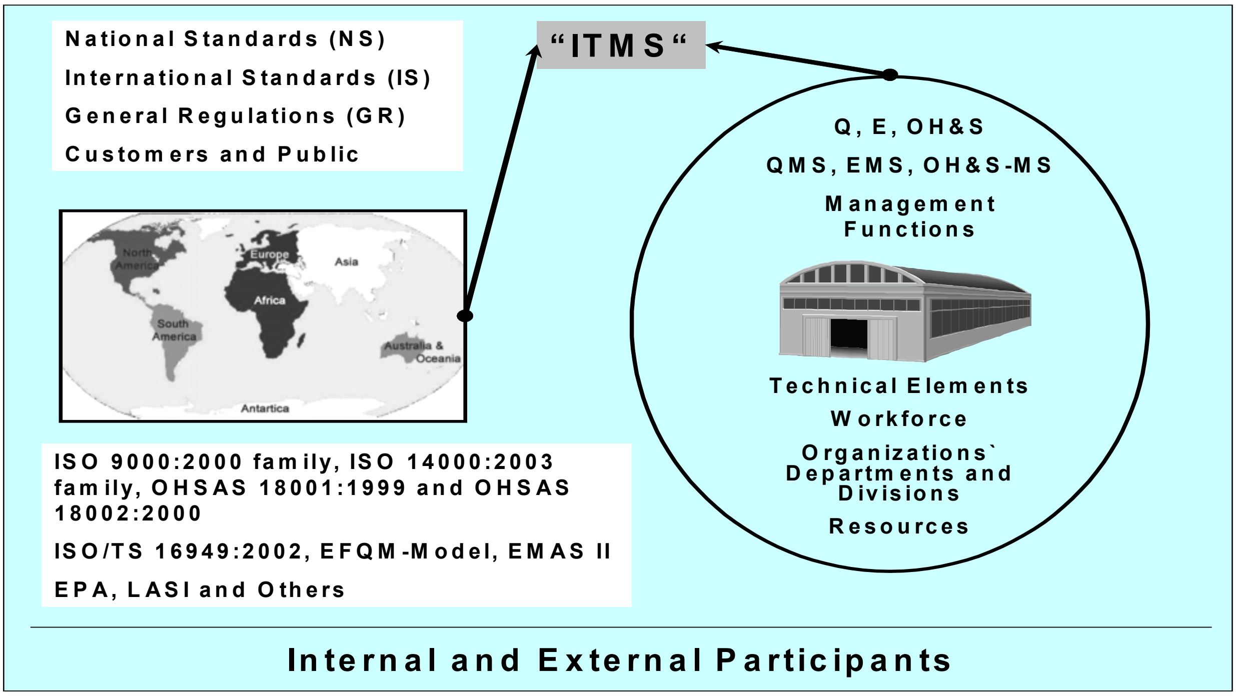


Figure 4.1 *Internal and External Participants of “ITMS”*

The internal factors are determined by the given structure of a company such as the quality, environment and OH&S and their respective management systems, the technical elements, departments, the workforce and resources. They are to be considered as participants that exist inside the organization which actively involve in the constituting and functioning of the “ITMS”. External participants influence the organization originating from the outside. They are factors to be considered which specify the various requirements and demands expected from the constitution and functions of the “ITMS”. The customers, society, national and international standards, general regulations and others comprise of the external participants.

4.4 Input and Output Components

Input is defined as something that is put into a system or an organization in order to achieve a planned purpose (such as electric current that is supplied to electrical equipment for mechanical work, raw materials for manufacturing certain products and so on) and the output is the amount or quantity of an activity or product that is an outcome of that system (such as the finished product is an outcome of a production line).

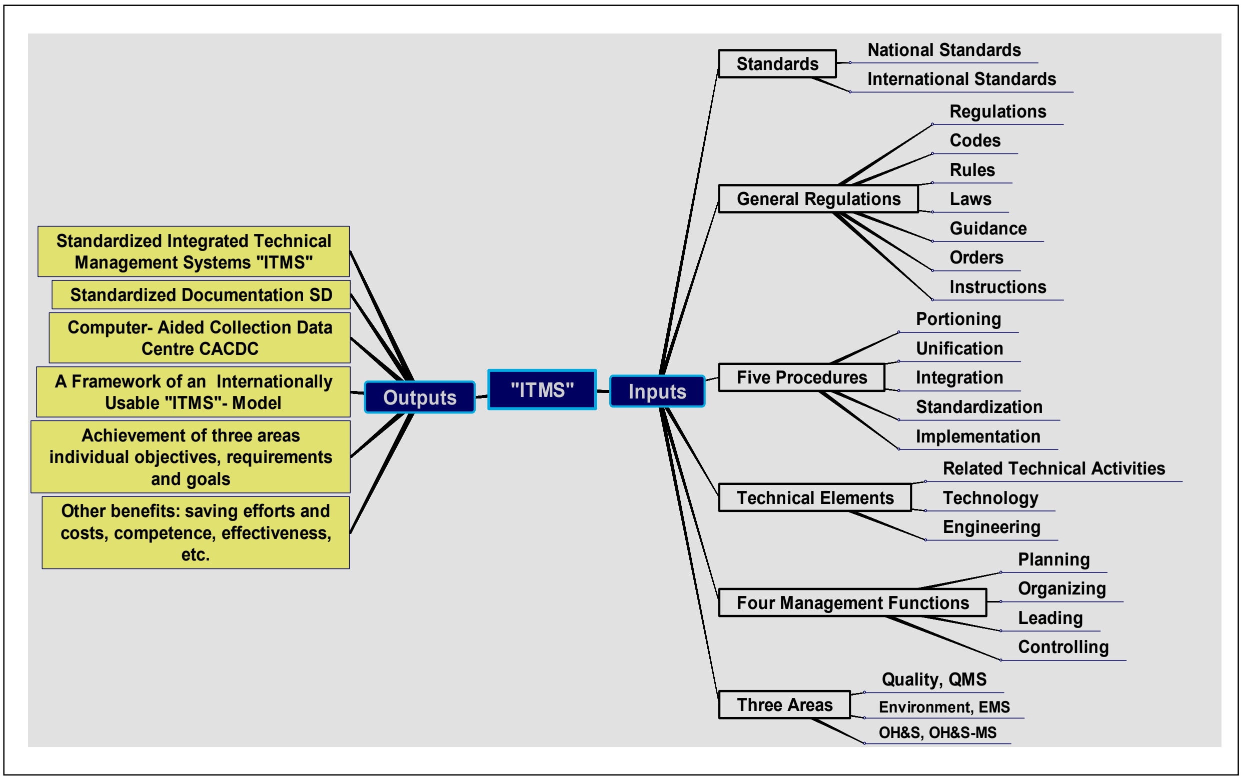


Figure 4.2 *Input and Output Components*

In the “ITMS” constitution there are inputs and outputs that take part in the process as it achieves the purpose. In a general overview the constitution process has six groups that enter to the process resulting in an output of six main objectives, as shown in **Figure 4.2**. In the context of “ITMS”, inputs are all the important components like the stan-

dards, general regulations, five procedures, technical elements, four management functions and three areas which determine its constitution.
Here output component are the standardized integrated technical management system, standardized documentation, computer-aided collection data centre, framework of an internationally usable "ITMS" model, achievements of the three areas' objectives and targets and other benefits such as cost savings, competence, effectiveness, etc.

4.5 Selecting an Organizational Structure for "ITMS"

The organizational structure of the "ITMS" illustrates the relationship among the members that are involved in their various levels of responsibility for the ITMS" performance. The structure illustrates who directs whom and how the shape of accountability, lines of authority and responsibility are to be figured and disciplinary procedures are to be reflected. It also means organizing relations between different functions and positions of the staff and shows who supervises whom in such a way that enables them to perform their functions and report to the persons who are just above them. The main aspects of the organizational structure building consist of determining what activities need to be accomplished, grouping of identified activities in term of functional orientation in departments and design staffing with the appropriate personnel skills to perform the designated objectives and targets of the "ITMS" in a coordinated manner. "Organizational structures: arrangement of responsibilities, authorities and relationships between people. The arrangement is generally orderly" [ISO 9000:2000, 3.3.2].
The selection of an organizational structure and designing a member group of the "ITMS" task needs to determine which structure will support the best achievements of its objectives and targets, and how many members will join the team, and who will operate.
The tasks of the "ITMS" team members are various. The following are main duties of the team that must be performed:

- Constitute "ITMS" (executing and controlling all five procedures (chapter 6)).
- Implement the constituted "ITMS" (chapter 6).
- Continual improvement, evaluation and auditing of the implemented "ITMS" (chapter 8).
- Manage, record, control and document "ITMS" (chapter 9).
- Coordination with departments, divisions and technicians.
- Cooperate and communicate with internal and external parties, departments, workforce and other work groups (chapter 4.3).

There are certain factors which enhance the team performance such as the job situation, identification of their tasks and positions, and the training programmes must be prepared for more workforce performance and awareness. "The process of the introduction of an integrated management system should be accompanied by training courses, innovative plans and effective and profitable structures" [Molitor, 1999, page

6]. Every team member should be involved in “ITMS” related trainings to gain more experiences, improve his skills and get more motivated. Training is the process of providing knowledge and must define some stages. “Training: process to provide and develop knowledge, skills and behaviours to meet requirements. For selecting and implementing training, management should monitor the following stages: a) defining training needs; b) designing and planning training; c) providing for the training; d) evaluating the outcome of training” [ISO 10015:1999, 3.2 & 4.1].

Figure 4.3 shows the detailed organizational structure which mainly consist of the organizational departments, external communication office and managing directors.
Every team has an essential role within the organization in order to complete “ITMS” This complex activity is solved by job experiences. When the subjects of quality, environment and OH&S are adapted to the experience of team members, it will lead to more success, and this lead to another benefits such as certification. “One way to the certification is to design a responsible team for the system development” [Szyminski, 1999, page 17].

It should be emphasized that the specific function and professional directions to team members are responsible for the establishment of procedures and actions and remain dependent for accurate integrated technical management systems. An ideal composition of the team may consist of four main parts: the constitutor, manager, implementer and technical staff. Those might be enforced by inspectors and auditors as well. Their duties description can be found on the following:

<u>Constitutor:</u> The person (one or more) or an external organisation who is experienced in the three areas, NS, IS, GR, structures, systems, management and constitution strategy. He works as planner and designer for the “ITMS” and is responsible for the success of the constitution process and review. It may be one person or more, depending on the size and type of the organization. The tasks of the constitutor are to:

- plan functional steps towards an “ITMS”.
- design and execute the five procedures.
- provide management supports, supervision and oversight for the “ITMS” functions.
- participate in the development of a specified team and calculate necessary resources.
- collect information and data, and do documentation, resolution of problems and development for other members.
- review and audit constitution process.

<u>Manager:</u> An experienced person (one or more according to the size and type of the organization) that has knowledge of NS, IS, GR and the management systems. He is leader of the “ITMS” and directs and manages the “ITMS” which has been constituted and prepared by the constitutor. The overall duties of the manager are to:

- manage the constituted "ITMS".
- communicate with external sides.
- supervise the CACDC and SD.
- lead team members.
- receive, analyse, evaluate and decide about "ITMS".
- supervise "ITMS" operation in departments.
- ensure overall "ITMS" performance, issuing of programmes and continual improvement.
- supervise "ITMS" evaluation and auditing.
- review "ITMS" implementation results.

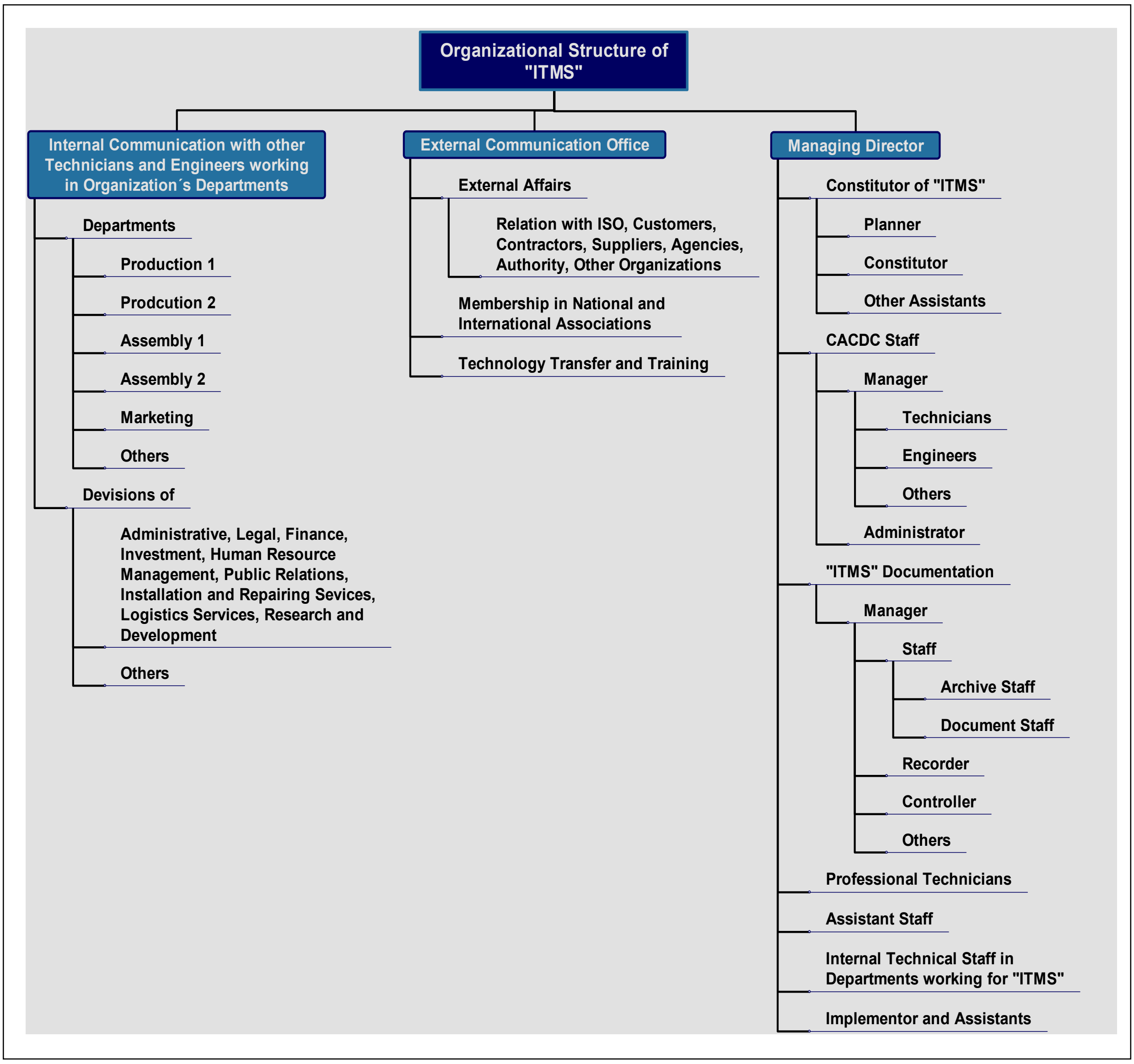


Figure 4.3 *Organizational Structure of "ITMS"*

Implementer: The person (one or more according to the size and type of the organization and departments) who has experience in NS, IS, GR, management systems and works under the supervision of the manager. He receives, communicates, distributes and inserts the new constituted “ITMS” into the organization through its departments and four structures. The duties are to:

- assist “ITMS” manager and help constitutor in restructuring and improvement.
- work on implementation and application of “ITMS”.
- coordinate with external sides.
- document and record implemented project.
- ensure success concepts and continual improvement.
- ensure that work adheres to the appropriate standards.
- ensure accurate audit and evaluation activities.
- receive and give data and information to CACDC.
- ensure that “ITMS” activities are identified and understood by various members.
- recommend changes in procedures to improve constitution process.

Technical staff: These are workers and professionals, who have experiences in the three areas, NS, IS, GR and are concerned with technical activities. They work as members or groups in all departments along with those from CACDC, documentation, internal and external relations and cooperate with all other technicians and workers inside the organization and have work connections at all levels. They perform an important role to make "ITMS" successful. "One column of integrated management system is the workers motivation" [Molitor, 1999, page 3].
Their duties are to:

- participate in implementing, auditing, reviewing, evaluating, measuring and controlling for the “ITMS.”
- connect and coordinate with departments and other workers. Cooperate and deal with operators and other technicians.
- work as technicians on the three areas (3A).
- work in departments, CACDC and SD.
- perform corrections wherever and whenever needed.

4.5.1 Location of “ITMS” in an Organizational Structure

What is the “ITMS” status inside structure or architecture of an organization? Generally, an organizational structure is the way in which the interrelated groups of an organization are connected, the hierarchy of an organization to work together to achieve common goals of production or services, and it illustrates the relationships among various levels. It is the formal system of working relationships within an organization, showing the relationships between all departments and their functions under the main concerns of effective communication and coordination.

The design of such an organizational structure should be achieved in such a way that all members of the organization are involved. Any quality level improvement along with environmental preservation and OH&S performance can be achieved by the effort of every member because they take a huge role. “A study of 600 enterprises showed that nearly all enterprises consider that the environmental protection is the matter for all workforces” [Müller, 1999, page 59].

Figure 4.4 shows the organizational departments like production, research and development. In this demonstration “ITMS” has an independent department, even though it is one part of the total organizational structure. Priority should be given to the location of the “ITMS” as one of the departments of the organizational structures. The constituted “ITMS” should be calculated as an important and valuable part in an organization and should have a suitable position, and be highly appraised by top management and entire managers.

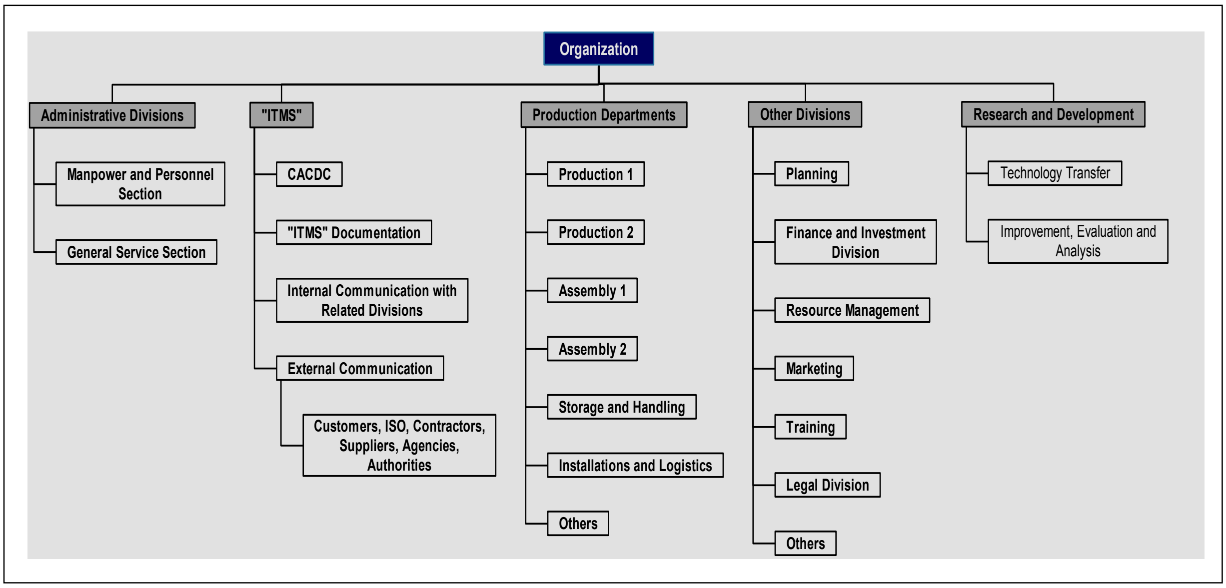


Figure 4.4 *Structure of an Organization and “ITMS”*

4.6 Kinds of Technical Integration

In the technical integration process, ten kinds of the integration can be recognized, each of them being an individual type. The kinds are divided by several groups so that each group is concerned with one main input component such as departments, four structures, and three management systems and so on, and any of them may include more than a kind of technical integration. In general state, there are ten kinds of integration that could be achieved as shown in **Figure 4.5.**

They are based on two factors: how the integration form is constituted or developed, and show the elements’ composition and the depth of the integration. These two factors are concepts of the technical integration process.
In relationship with the three areas of QMS, EMS, and OH&S-MS, one can distinguish between triple and double integration. The triple integration occurs when all three management systems of quality, environment, and occupational health and safety (QMS, EMS, OH&S-MS) are in place to be integrated together as one unit. The double integration occurs when two of the three QMS, EMS and OH&S-MS are integrated together as one unit.

Horizontal kind is the integration of all related technical elements from the same area, whereas vertical kind is the integration of that involves particular related technical elements from different areas (more description in chapter 6, Figure 6.7, Figure 6.8, Table 6.2, Figure 6.9). Here examples could be given for vertical kind as integration for audit between quality, environment and OH&S. Horizontal kind as integration for audit, testing and inspection of quality. But it must be known also, that horizontal and vertical kinds can take place in concurrence with triple or double integration.

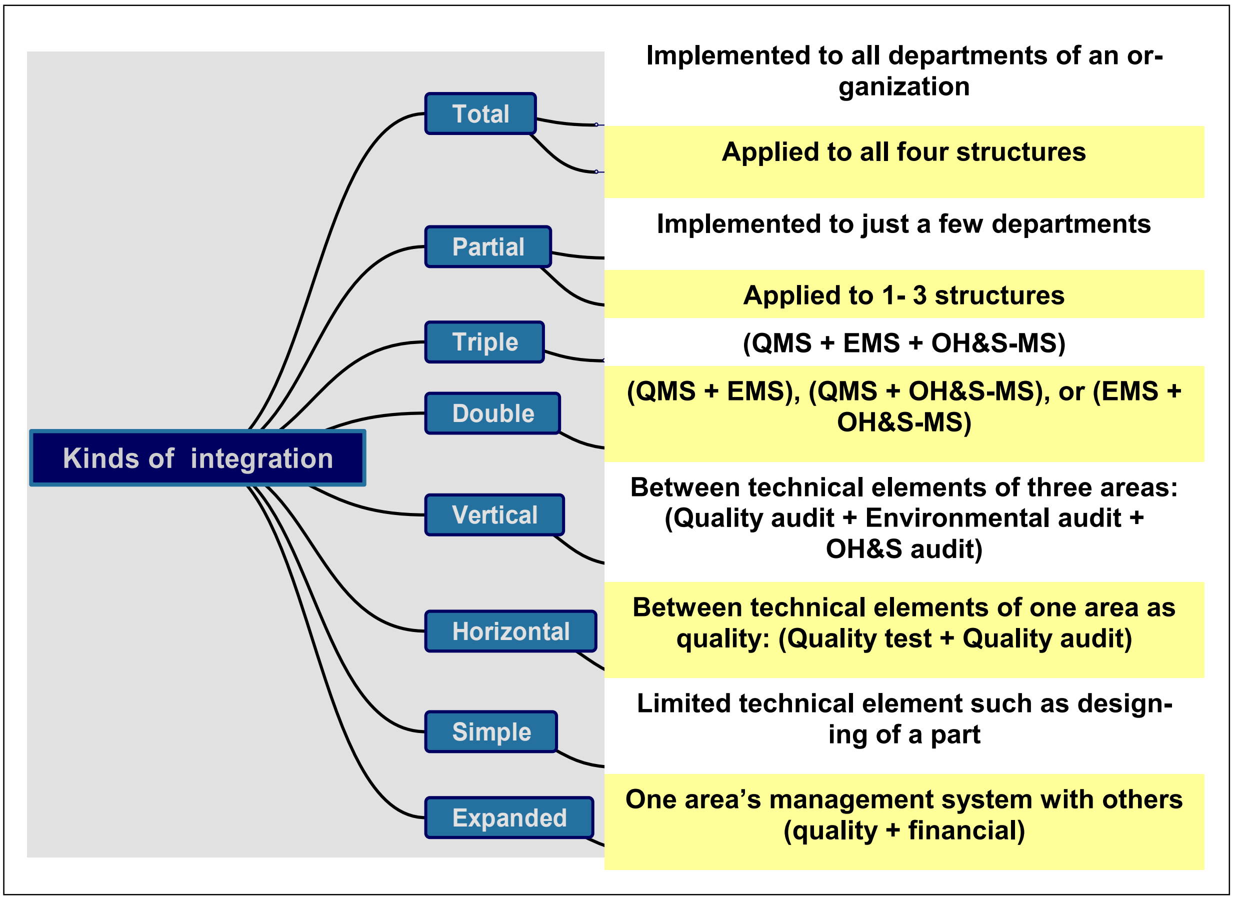


Figure 4.5 *Kinds of Integration*

The organization can have total integration if all departments and structures have been included in the process. This means that integration implemented into all organization’s department and entire organization tasks will be enriched by the process. If not, partial integration is just implemented into a few departments of an organization. “The full integration implies integrating all aspects of the companies or units involved, the partial integration involves the coming together of some but not all, and the minimal integration forms two separate companies or units continue to exist as separate entities" Bakker, 2000, page 53- 55].The same description is true about structures; they can have kinds of total, partial, vertical and horizontal integration.

In the large space of the technical integration process, there are other two kinds of simple and expanded integration. The simple one is concerned to those technical elements that have limited activities, when organization’s leadership wishes to improve them, as example designing and executing a project of bridge in construction engineering on a limited time, or providing one service in a limited time and cost.

Another integration system is expanded integration which can be executed between two management systems such as quality with the finance sector, environmental protection with the resource management and so on. All these sectors are interchangeable. “An expanded view of the integrated management systems could include financial management, information management system and personnel management system” [Szyminski, 1999, page 30].

4.7 General Columns of “ITMS” Constitution

In this thesis work, the constitution process is based on four groups of general columns. The columns are the three areas 3A, technical elements TE, five procedures of “ITMS” constitution, and four structures by portioning procedure. They are depicted in **Figure 4.6** and show their respective elements.
The three areas of quality, environment and OH&S are the main issues for the integration process. They are the main consideration of this “ITMS” work and influence almost every action that is undertaken here.

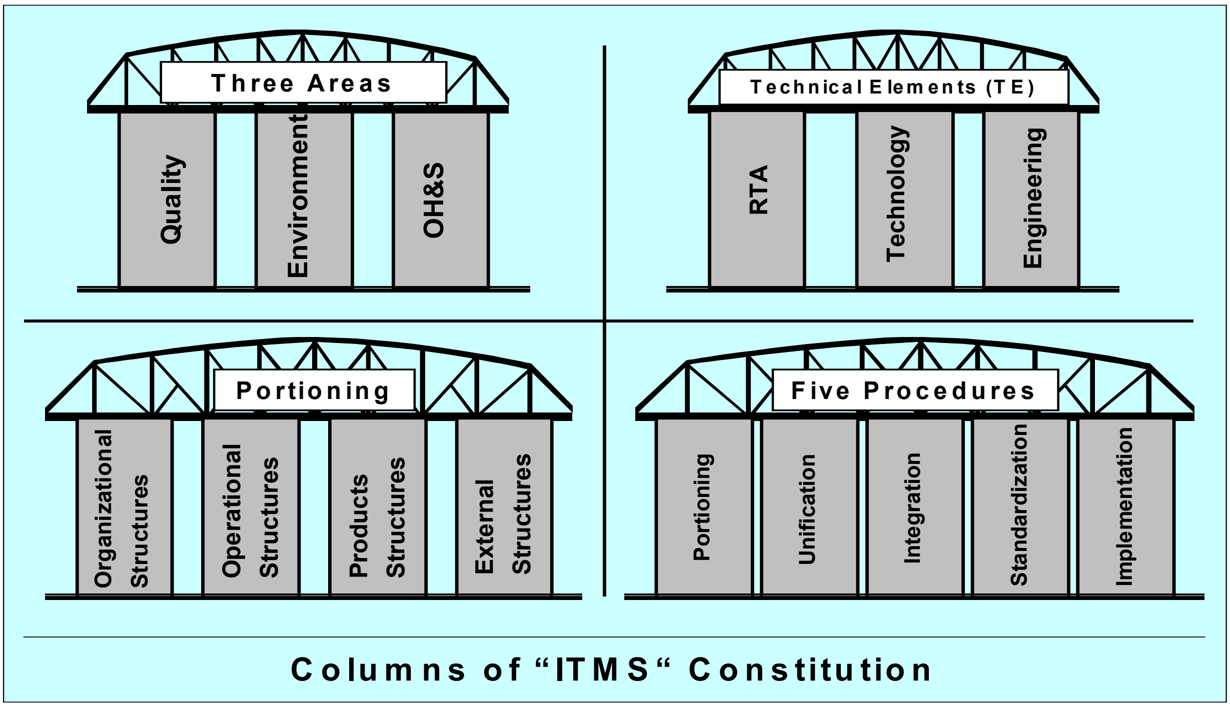


Figure 4.6 *General Columns of “ITMS” Constitution*

The technical elements are the core criteria in this thesis and they are further distinguished under the respective faces of related technical activities, technology and engineering. Their detailed description has been given in chapter 1.4.
The five procedures, as the name suggests, are the five main procedures which need to be precisely executed in order to achieve the final goal of “ITMS”. Portioning, unification, integration, standardization and implementation are the comprising five pillars and are described in details in chapter 6.

The last group of columns is portioning which is quite an important aspect of “ITMS” and divides the whole organization into four structures namely organizational structures, operational structures, products structures and external structures. Chapter 6.3 explains the in-depth procedure of portioning.

Chapter 5- Some Considerations about “ITMS”

5.1 Project Execution and “ITMS” Constitution Process

Project is any work or a piece of work that needs to be undertaken. Although there are many different ways of defining a project by international standards and other references, they all have similar meanings. “Project: a unique process, consisting of a set of coordinated and controlled activities with a start and a finish date, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources” [ISO 9000:2000, 3.4.3 & Note 1, ISO 10006:2003, 3.5 & Note 1]. Several activities compound a project. “Activity is the smallest identified item of work in a project” [ISO 10006: 2003, 3.1].

Projects in an organization have similar styles of execution, which depend on the same well-known management functions of planning (problem identification, project definition), organizing (arranging, resources preparation), leading (directing, scheduling, checking) and controlling (monitoring, reporting, termination).

“The project management encompasses many different aspects such as people, technologies, budgets, planning, and analyzing results. It also takes into consideration the psychological and motivational aspects” [Howes, 2001, page 1-2].
Successful project execution can only be attained through the composite work of engineering, procurement, construction and commissioning based on customer requirements and should be in accordance with NS, IS and GR.

The comparison between project execution stages and “ITMS” constitution processes are shown in **Table 5.1**.

Comparison between Project Execution Stages and "ITMS" Constitution Process		
Project Execution Stages	**Functions of the Project Execution**	**"ITMS" Constitution Process**
Problem Identification	identification of project execution problems	identification of "ITMS" constitution problems and design conditions
Project Definition	definition of project purposes, inputs, outputs and management style	definition of objectives and targets, common technical elements, QMS, EMS, OH&S-MS, NS, IS, GR, and current management style
Project Planning	planning the sequence of actions, stages and goals	planning the constitution procedures, operation, CACDC and SD
Project Organization	organization and arrangement of people, interrelationships, responsibilities and duties	arranging an "ITMS" team, specific organizational structure and level of communication, determining duties and responsibilities, education, awareness and skills
Resources Preparation	preparation of resources, workforce, tools, buildings, equipments, technologies, financial abilities, facilities, skills, etc.	preparing human resources and others, e.g. equipments, places and facilities
Scheduling	scheduling of specific tasks of the execution stages and time table	timing of the constitution process
Checking	checking of results, conformance with planned objectives and specifications	special rules, degrees of the procedures, technical compliance and balancing, equilibrium among RTA and PCT criteria
Reporting	affirming the executed planning, and the necessary data and information	assuring the constituted procedures, establishing the standardized documentation, transferring data and information
Control	auditing and ensuring the appropriate actions which are taken to correct unacceptable deviations	control procedures of the constitution process, implementation of "ITMS" in departments and structures, filling gaps and auditing
Repairing	reducing time and cost between actual and planned performance by minimizing overall losses due to planning	corrective actions, preventive actions, failures, quality defects, and continual improvement
Termination	declaring the time of delivery to client after the project execution and preparing for production and service	implementing and activating "ITMS" into all structures and departments, management review and evaluation

Table 5.1 *Comparison between Project Execution Stages and "ITMS" Constitution Process*

5.2 Technical Cycle among the Three Areas

The technical cycle is a series of transferring negative or positive influences on quality level, environment protection and OH&S performance which is shown in **Figure 5.1**. These influences alter the condition on all three areas and the operational ability of each area exchanges its effects with the operational abilities of the other two areas. Also two of the areas influence just each other and form a kind of sub-cycle and have similar influences.

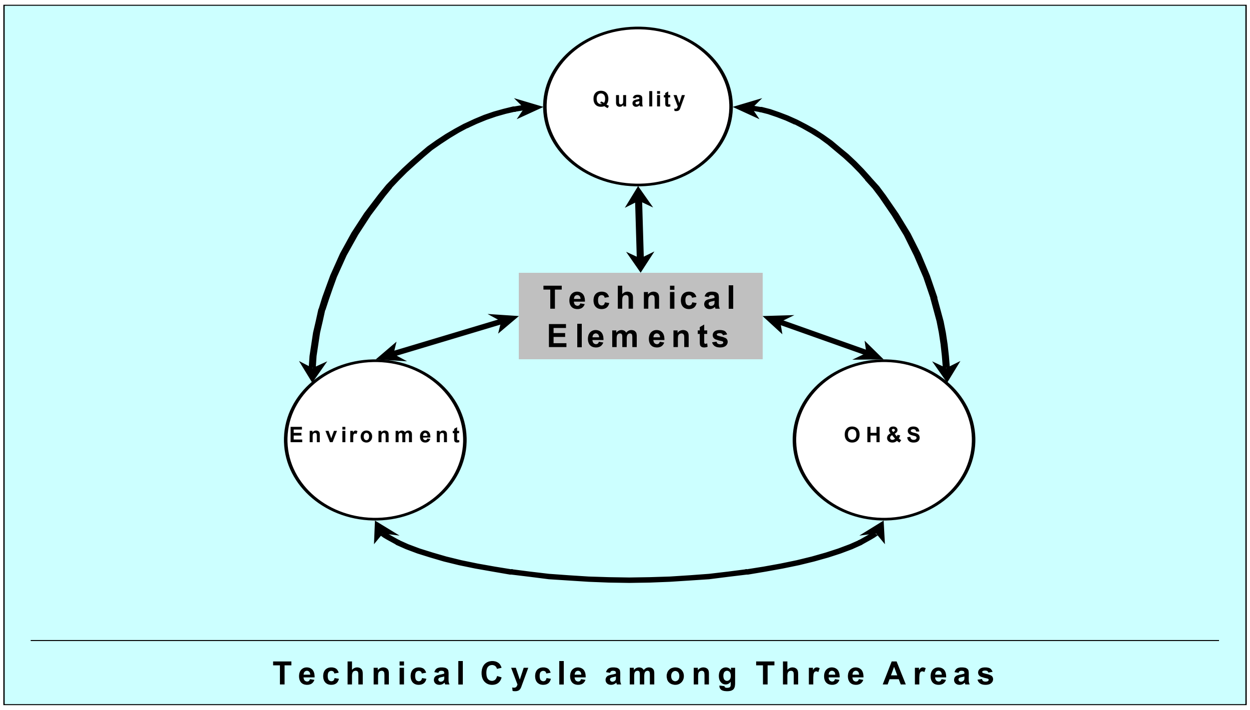


Figure 5.1 *Technical Cycle among Quality, Environment and OH&S*

The relation between these three areas is so strong that when one area of the cycle suffers, the other areas of the cycle suffer in a similar way. Such interdependencies are exhibited in many fields. For instance, in industrial sector, “In electronic components packages, moisture can cause drift and activate various failure mechanisms such as corrosion and electrolysis” [Birolini, 1997, page 138]. The interdependencies exist between emissions by a product and quality of its composed components. “The rate of emissions is related to the characteristics of the vehicle weight, engine, the road’s surface, the vehicle usage“[OECD, 1997, page 30].

It claims each one of them is connected technically with the other two, as all investigations have been proved. “Technical processes are deep overlapping aspects of quality, environment and OH&S” [Zwestloot, 1996, page 19].The interconnections of these areas apply for both positive and negative factors. For example: “The metal toxicity is also modified by various environmental factors, such as light, temperature and humidity” [Meyers, 1998, page 2750]. When the quality level improves, the OH&S and environmental protection levels also improves.

Similarly the technical cycle in recycling of waste materials holds up between the three areas. “By recycling nearly 300 million tons of scrap, energy is saved which is equivalent to 160 million tons of hard coal and avoids the emission of 470 million tons of carbon dioxide” [UNEP, 1997, page 90].

For better understanding of technical cycle between quality, environment and OH&S, we can see in the manufacturing of automotive engine that the high quality of the engine has a direct relation with the reduction in CO_2 emissions which imparts less adverse impacts on the environment and provides more safety to people by avoiding risks to health. As we see that better quality of the engine increases life saving by avoiding and minimizing emissions which occur due to low quality of enigine parts manufacturing during its working. Therefore the principle of technical cycle should not be neglected but recognized by the “ITMS” team during constitution process and it should be computed also by operational managers and designers in every planning, designing and manufacturing stage.

5.3 Special Rules of “ITMS”

There are some special rules which must be considered during the constitution of the “ITMS”. These special rules serve as factors for the correct completion of the “ITMS” constitution and accurate implementation and continual improvement. This thesis work professes:

1. Every aspect has a vital role and is non-removable.
2. Equality of the total Integration process.
3. Removing gaps by full “ITMS” implementation.
4. Mutual dependence between parts and the total.

5.3.1 Every Aspect has a Vital Role and is Non-removable

In the integrated technical management systems, every aspect has a vital role and is non-removable in the overall operational manufacturing and services in the organization and, it achieves the same importance level in relation with technical integration process and its operation inside the departments or within the four structures. The aspects which are participating in the process of “ITMS” constitutions are national and international standards, general regulations, requirements of customers, other instructions and orders by agencies and government. These aspects also include workforce activities and other resources. The integration is meaningless if any of them is not implemented in technical integration process or if there is no attention by constitutor or managers about their roles. The integration looses its effectiveness if one or more of these aspects have not been activated and then the objectives and targets of three areas can not be properly achieved. This explains that these aspects have connection in their actions as the nature of an organization which depends on many factors and these factors are part of integration. "The organization is shaped by factors of size, technology, nature, activity, external environment, product market, people and leader" [Cartwright, 2000, page 59]. There are other aspects which are also vital in role, such as costs and time. They are computed as internal resources and are considered in overall effectiveness of quality level, environmental protection and OH&S performance.

In any process, operation, product or service, the small or large tasks should not be forgotten or removed from the entire constitution process because they take a vital role in total results. And because any activity within organization's task comprises of a number of small tasks, they all operate to achieve the main task and these small parts must be contained in the whole size of any operation. For example, in hospital organization such as healthcare service sector, "1,600 processes must be managed to achieve excellent care in a hospital" [Lee, 1999, 130].

In manufacturing or construction sectors this significance is clearly demonstrated by figuring all separated designs into one final achievement because they participate in reaching a larger performance level. "All elements of mix design and structural design must be considered as one activity, and construction must be inextricably linked to ensure the overall process results in high-performance pavements" [Decker, 1996, page 1].

5.3.2 Equality of the Total Integration Process

This thesis work also professes that an integration process has total and partial types. The total integration process is the one which can be carried out in all structures and departments, and all of them come together to form the whole integration process of the entire organization. The total integration process is equal to the following:

- *The sum of every department's integrations*
- *The sum of the integrations of the four structures*
- *The sum of all of the portions' integrations*

The operations and every other engineering activities consist of their portions and applicable attributes, and they make up their characteristics.

In the manufacturing process, the work is divided into several categories and this gives the best way to product and operation realization. Therefore all categories are basis for the final result.

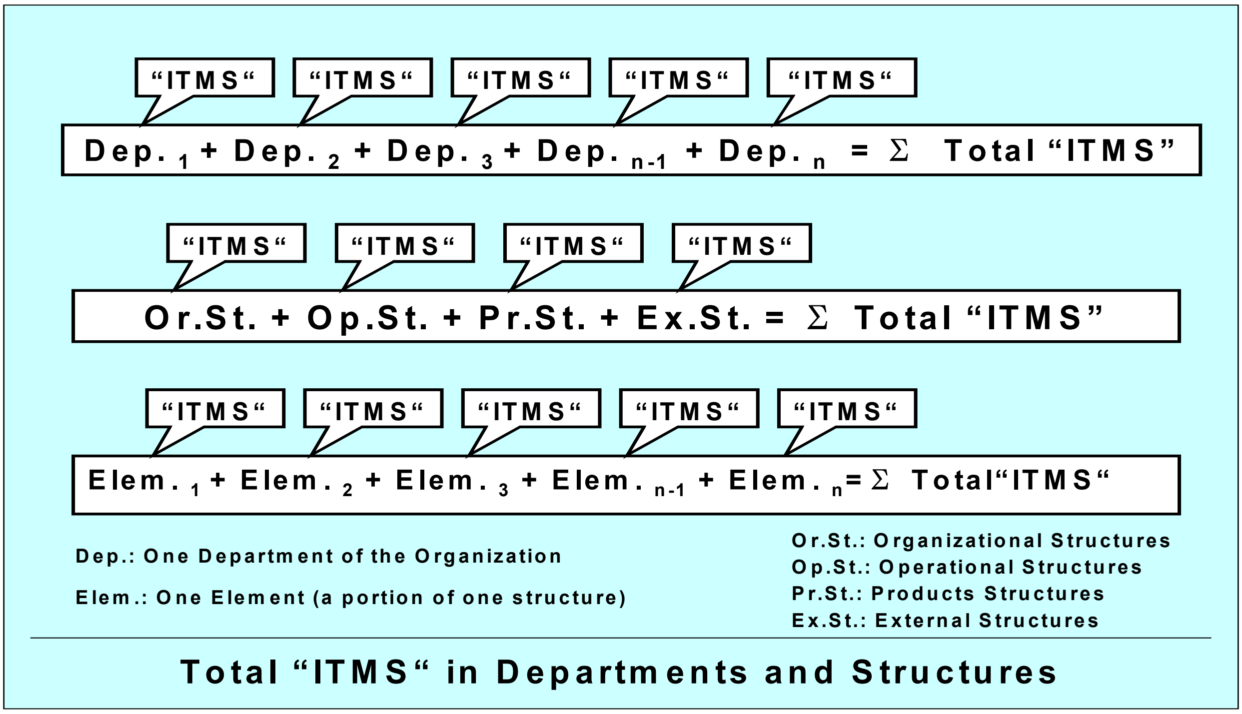


Figure 5.2 *Total “ITMS” in Departments and Structures*

Figure 5.2 shows the total “ITMS” in all departments and structures of an organization. The “ITMS” is applied in each department to get a partially integrated process. In the similar way the “ITMS” is applied on every organizational structures and operational structures to get partially integrated process, the same thing about products and external, and the “ITMS” should be applied on each element to make it partially integrated. And when we combine all these three partially integrated systems we will get a totally integrated process.

This is shown by larger automotive industry organization. **Figure 5.3** shows the implementation of “ITMS” on the different parts of engine manufacturing in an automotive industry. So when we apply total “ITMS” on one group of parts (e.g. pistons, camshaft, crankshaft, cylinder head, etc...) we must consider that the partial “ITMS” is implemented on every single piece. It means that the organization should try to achieve a high quality level (it is compliance with customer’s and other interested parties’ requirements) of product, and for the same product we consider the environmental protection (such as minimal energy consumption, rate of toxicity, noise, vibration, etc) and occupational health and safety for workforce and public (avoidance of injuries, harm, accident and hazards, etc) during its designing and production. All these three areas must be considered at one time during manufacturing and must be assessed in their technical specifications. This status gives the full meaning of the integration process as described in chapters 1 and 6, so that three areas have interrelations and each one is influenced by others and they cannot be separated during production and operation. This way leads to get partially integrated parts of one group, but when we implement total “ITMS” on every type of group used in engine manufacturing assembly, the system then becomes totally integrated. This rule should be applied to all industrial engineering such as operations of mechanical products, chemical substances, construction materials and electrical goods. “In the new assembly system at Toyota, the assembly was defined by 108 categories of parts, each category corresponding to a work group” [Muffatto, 1999, page 18].

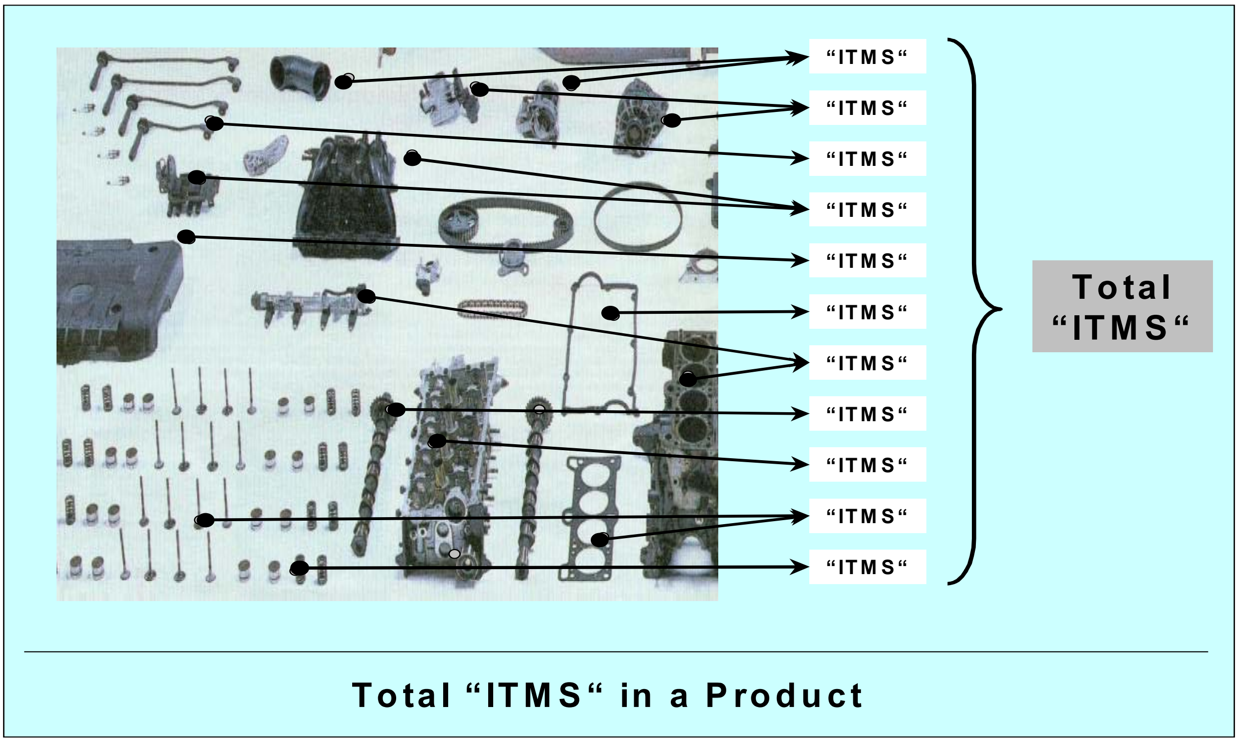


Figure 5.3 *Total “ITMS” in a Product*

5.3.3 Removing Gaps by full “ITMS” Implementation

For full “ITMS” implementation, an integration process should be activated into all departments and four structures into the smallest portions, in order to make it complete and effective so that the result would be even more beneficial. “The integration process appears to be involved at all organizational levels, components and processes” [Waite, 1998, page 21]. But if the “ITMS” is not properly implemented, it produces gaps in the processes. These gaps are referred to places which are not technically integrated. When gaps are referred to in a structure, that means the structure has no dealing with the process of integration and has no implementation, or that the technical integration has not been considered in that structure, portion or department. The gaps should be filled anywhere inside the organization as shown in **Figure 5.4**. As depicted in (a) and (b) the absence of gaps between organization's departments, structures or portions lead to a strong organization, whereas the existence of a gap is assessed as a weak situation in any composite part of any product or at any stage of any operation, and filling their gaps generates a strong level of quality. In (c) the portions are presented with gap filling by implementing "ITMS" into all portions. Any gap leads to the system weakness and lacks, whereas removing gaps leads to a strong state and enriches the place with high quality, more environmental aspects protection and higher occupational health and safety performance. The gap filling should be affirmed by top management and accurately executed by managers and technicians, the filling of gaps will then assure a strong organization through a stronger "ITMS".

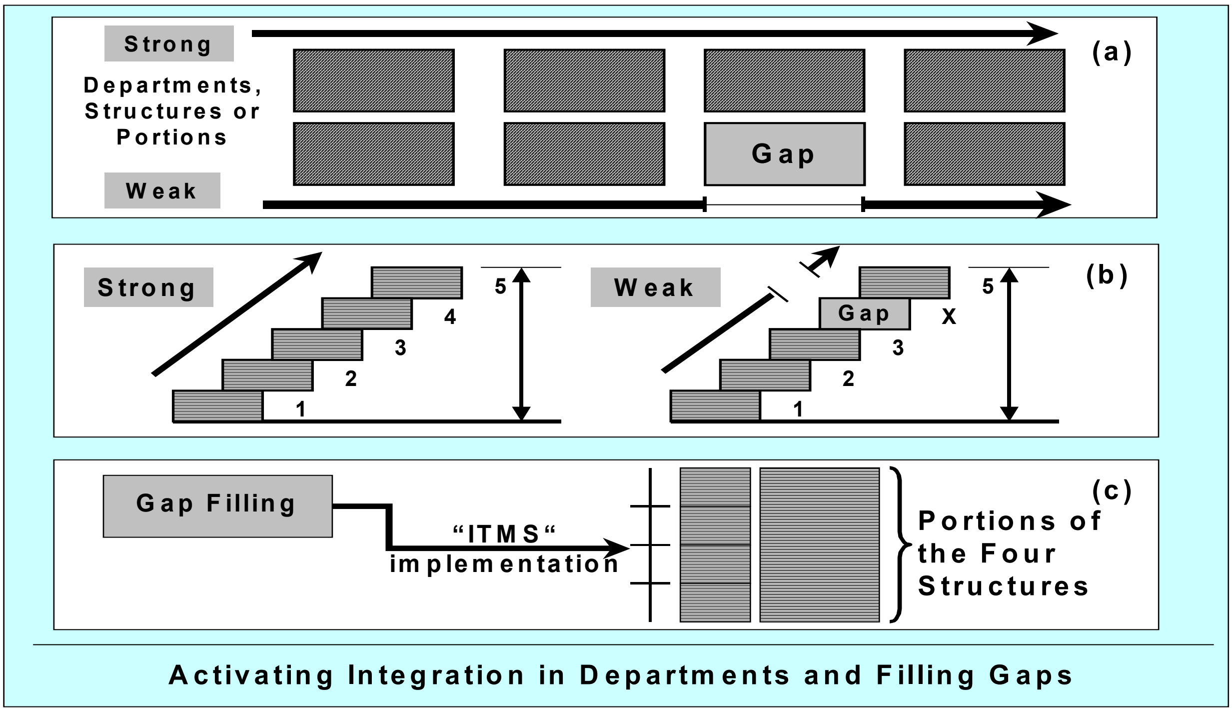


Figure 5.4 *Activating Integration and Filling Gaps*

There are basic regulations which act as assistance factors in the integration process and help to achieve the objectives and targets. As referred before, the total integration is equal to integration in all departments and in all structures and their portions. For this purpose, our plan should fill gaps in all operations, products and services, and any other internal or external activities. **Figure 5.5** shows the principle of gap filling in products structures (equipment and electronic industry), during manufacturing or assembling product. For this purpose, in every stage of product’s designing and its manufacturing operation, checklists should be formed and referred to all places (parts of a product) that are having no implemented integration in order to make correction and reach a stronger level. This means every part during their designing and manufacturing should include all attributes of the three areas and should be computed in the design calculation. For example, in designing process the quality should be considered besides estimating environmental aspects protection and estimating of OH&S for the design.

By this way, we deal with objectives and targets of the three areas, and link their components more effectively and form an effective integrated technical management system. “The integration involves the linking of components to form subsystems and the linking of subsystems to form composite systems” [Badiru, 1995, page 34].

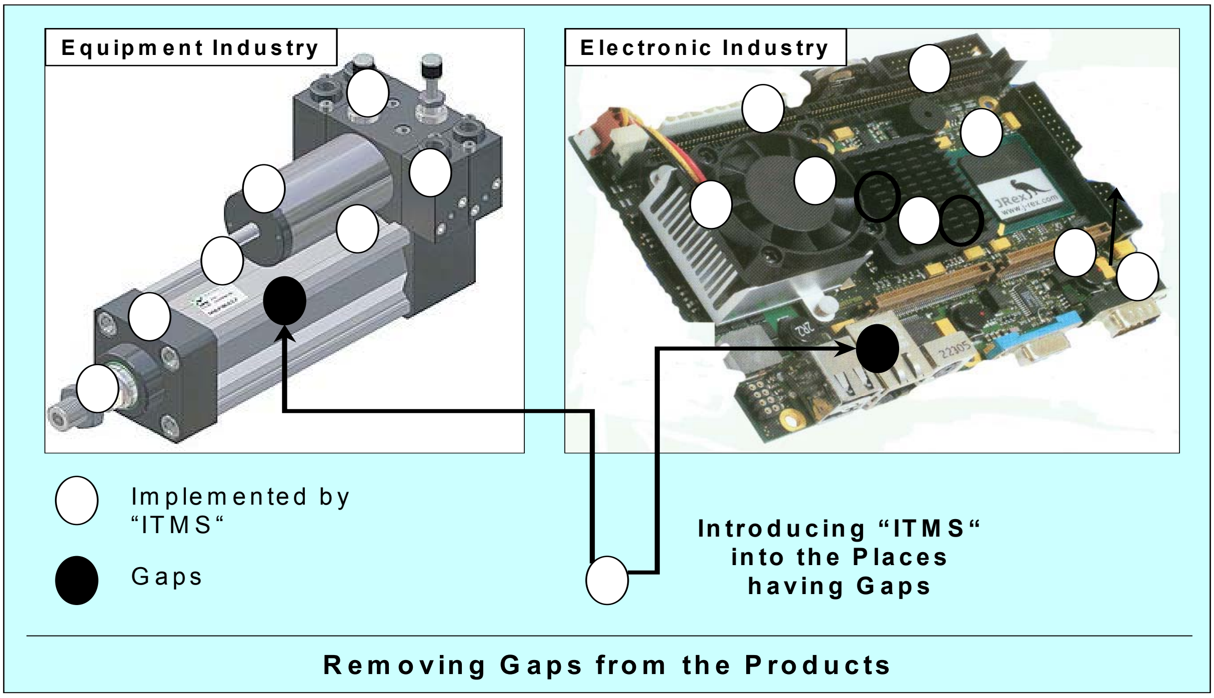


Figure 5.5 *Removing Gaps from the Products*

5.3.4 Mutual Dependence between Parts and the Total

Finally we also consider that the whole dependence is on the parts, relation between them and their total dependency. The application of these rules is a prerequisite to assist the constitution process and to gain more benefits. This application will be carried out by the “ITMS” team by analyzing all the departments and locations and the four structures. The understanding of the practical execution of these rules should be performed in a series, beginning with the first rule and moving subsequently down the list.

According to this rule, some concepts could be derived:

Total “ITMS” is dependent on the parts *A defective area causes a defective total “ITMS”*

The first concept is about total integrated technical management systems and its parts. It contains many other characteristics. In this concept, the following characteristics could be introduced:

- quality
- effectiveness
- successful application
- evaluation
- defectiveness of any area

That means the effectiveness and quality of total “ITMS” or quality level, environmental protection or OH&S performance depends on their composed parts. **Figure 5.6** shows in the project of a bridge construction, all parts of piles, beams, connections, concrete and other parts affect the construction of the entire bridge.

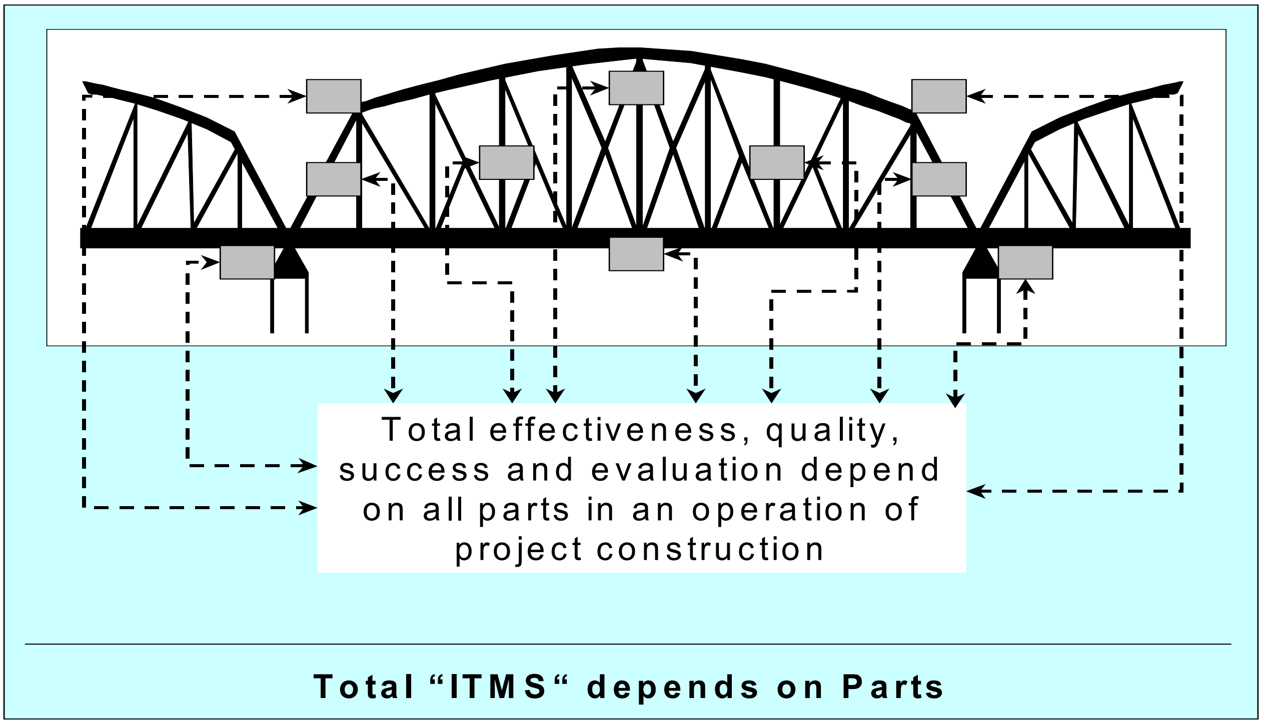


Figure 5.6 *Total “ITMS” depends on Parts*

The quality of each part, the effective participation of each part for environment protection and the effective participation of each part for safety affect the total effectiveness of the bridge. The same concept is true for their successful application and their working efficiency and their evaluations to which level they are motivated.
More precisely, this means that each part of the total “ITMS” depends on composed portion. This compasses the areas as well and they exhibit mutual dependence between them. Because any portion is vital in its role and the total is equal to parts, there is no total structure without parts.

By the same concept, it can be proved that the organization depends on its structures and departments. Furthermore, the total structure depends on its portions, because the whole organization consists of individual structures and departments. Similarly every structure is formed from its portions. It will be clear by an example of interdependence. The reviews of experts show that for each serious accident there are many minor incidents and even more misses, such as: “For each major injury there were 10 minor injuries, 80 property damage accidents and 600 incidents with no visible injury or damage” [Lawson, 1999, page 161]. Therefore, when dealing with accidents, we must consider the following series of events. Not only does this interdependence apply for quality, but also for other attributes such as performance, effectiveness, lacks, defects, evaluation, and so on. They will depend on the same features of structures, portions and departments. **Table 5.2** shows some examples of this mutual dependence according to the four structures.

Examples of Interdependency between Parts and Total	
Four Structures	**Examples**
Organizational Structures	Total effectiveness of the “ITMS” team depends on the effectiveness of each member. Total “ITMS” policy depends on a policy that is related to the three areas.
Operational Structures	Effectiveness of total documentation depends on effectiveness of documentation in three areas. Any lacks in them lead to lacks in total documentation. Total quality of the testing is contingent on the quality of testing of each area.
Products Structures	Evaluation of a car motor comes from evaluation of pistons, rings, cylinders, arms, valves, combustion chamber, etc. The entire design is defected, if any one of its components is defected.
External Structures	Total customer satisfaction relies on satisfactory delivery, time, packaging, safety, after-sale services, and so forth.

Table 5.2 *Interdependency between Total and Partial*

The second concept is about the defect in any one of the three areas: quality level, protecting environment and performing an OH&S with respect to an operation, product or service.
This thesis work professes that all processes and operations in the organization are functionally connected together in accordance with the achievements of the three areas. **Figure 5.7** provides an understanding to this concept.

This concept can be affirmed by any operational manufacturing. If the constitution of a technical integration is defective by any of the areas of quality, environment or OH&S, the whole "ITMS" will be defective. It is impossible to constitute technical integration with any one defective area because the defection of one area in any portion, structure or organisation will make the defective "ITMS". Also it is impossible to operate the "ITMS" with any one area defective. This situation causes inaccuracy and incompleteness in the constitution process of an integrated technical management system.

And because the technical integration occurs by unification of technical elements and integration of QMS, EMS and OH&S-MS, any defect of any one of the technical elements leads to a defective unification. Since the unification is one procedure in achieving and completing integrated technical management systems, if the unification is defective, the entire integrated technical management systems will turn out to be defective.

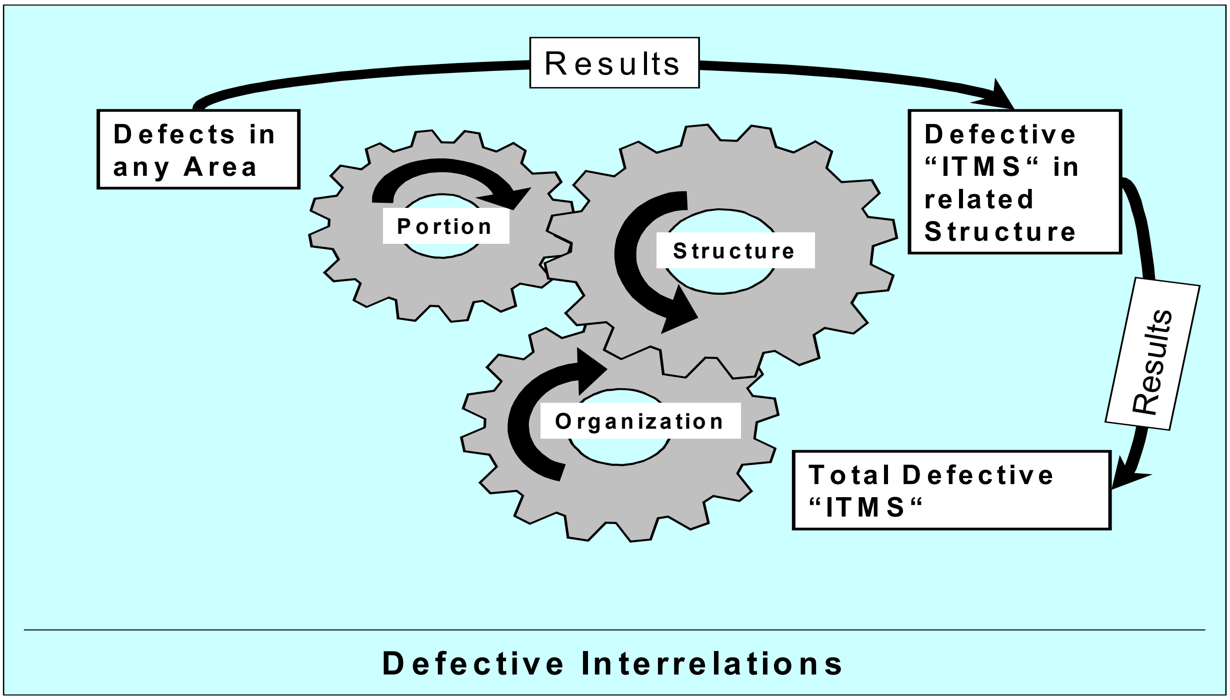


Figure 5.7 *Defective Interrelations between Portions, Structures and Organization*

Chapter 6- Standardized Integrated Technical Management Systems “ITMS”

6.1 Introduction

Integration in general means the merging of processes, operations, activities and people from different units of any organization into equal association and function, and incorporating them into one working group in order to achieve a certain goal. It refers to the unification of a number of independent units into one larger whole unit and to the formation of a whole from combined parts.

With regard to structure, integration means the interaction through which two or more systems make one structural system and adapt their functions inside it. Integration, as process, means the act of making an integral whole system or an entire system.

In the technical integration constitution process, certain steps should be achieved for gaining the objectives and targets. “During integration process, some steps should be undertaken such as processes of analyzing the quality, environment and safety, with preparation of separated checklists for them” [Pischon, 1999, page 325]. The constitution process of technical integration between QMS, EMS and OH&S-MS “ITMS” has to be performed through establishing some series of procedures. This thesis work will relate and do the constitution process across unification between common or similar technical elements, and bring them closer to each other, operate them as one combined unit integrating their management systems and making standardization according to NS, IS and GR. It is then implemented inside an organization through four structures and departments. This chapter explains the procedures that are composed of an “ITMS” constitution process, their motivation and execution, bringing examples for each state, and describing the elements of a framework of an internationally usable “ITMS” model.

6.2 Procedures of “ITMS” Constitution Process

Constitution of the “ITMS” could be achieved by series of procedures shown in **Figure 6.1**:

1. *Portioning the organization.*
2. *Unification of technical elements.*
3. *Integration of management systems.*
4. *Standardization of unified technical elements and their management systems.*
5. *Implementation of standardized integrated technical management systems.*

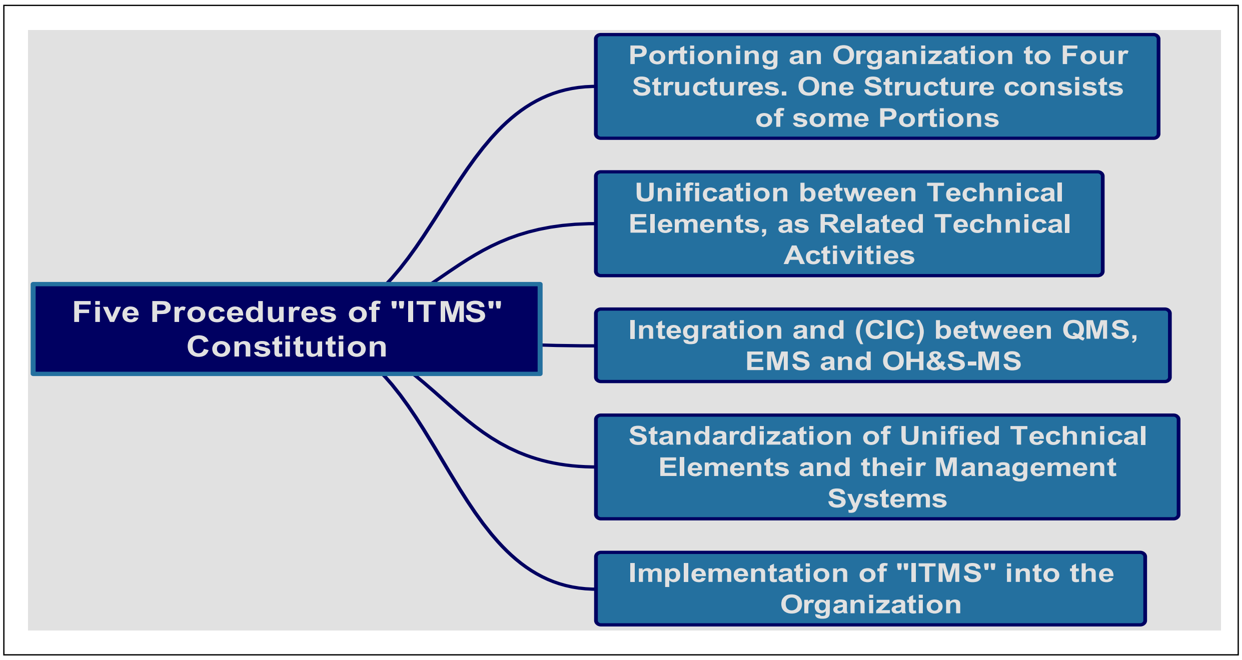


Figure 6.1 *Five Procedures of "ITMS" Constitution*

We call them "procedures", because it gives the right meaning. "A procedure is a specified way to carry out an activity or a process" [ISO 9000:2000, 3.4.5] and "The procedure is a way to carry out an activity or a process" [ISO 14001:2003, 3.16].

6.3 Portioning the Organization

Portioning is the procedure of separating the organizations into smaller parts, dividing the entire tasks and activities which represent the structures of organization, operations, products and external elements. These structures form other smaller parts of tasks and could be further divided into smaller portions. This procedure occurs for all types, nature and size of the organizations. Especially in larger organization the structures comprise of larger number of portions. The portioning will be achieved from two basic aspects: functional and divisional. The functional aspect is concerned with its functioning and working, while the divisional aspect is concerned with its distribution between the four structures as shown in **Figure 6.2**.

The main purpose of the portioning procedure is to demonstrate the importance of structures and their portions, and to show how they work. “The purpose of the structure is to judge the importance of the elements with respect to all other elements” [Saaty, 2001, page 1-2], and then to facilitate other sequential procedures. The portioning facilitates other procedure steps to be achieved in effective manner and leads to successful unification, effective integration, accurate standardization and deeper implementation.

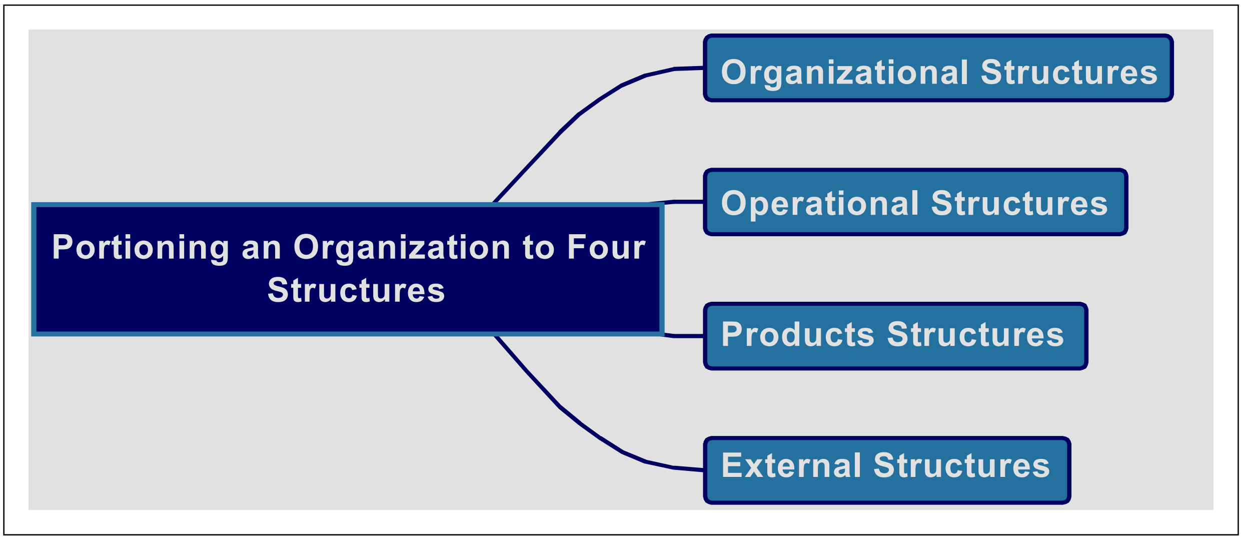


Figure 6.2 *Portioning an Organization*

The portioning is beneficial to successful technical integration process, because the manufacturing depends on the efficient portioning, and leads to higher quality and more control. “In Ford Corporation, the manufacturing organization depends on portioning in order to gain more control and quality” [Browne, 1996, page 207].

The portioning is necessary to be done, because every structure consists of many portions, and the achievement of one structure depends on the working of all portions. This is true in most operations relating to quality, environment and OH&S, as in the sector of the healthcare organizations, as referred before in chapter 5.3.1. “1,600 processes must be managed to achieve excellent care in a hospital” [Lee, 1999, 130]. That means in order to achieve a high quality level in health care services inside a hospital organization, it must achieve a larger number of portions (1.600 processes) which consist of (structure) healthcare operation.
Other motivation is to redesign a manufacturing organization for more benefits and cost recovery, time reduction, as in operational structure in Ford’s firm. “Henry Ford devised the assembly line to simplify the jobs of workers in the high volume automotive business, the resulting assembly line design reduced the work input required to produce

each car from 12 hours 28 minutes to 93 minutes and the cost of a car from $900 to $350 [Nof, 1997, page 201].

Still another motivation is the essence of portioning because no organization exists without operations activities, products or external relations. “Each enterprise is classified into three categories of functional, structural and behavioural” [Firesmith, 1999, page 224].

The procedure of portioning is one duty of the constitutor who plans at the beginning and preparation of “ITMS” constitution, with assistance from the rest of the technicians. The motivations for portioning an organization are:

- During planning, the portioning gives clear situation to help understand the current problems that are confronted and impede the ongoing operations in order to make them perfect the integration process.
- Entire organization will enter in the process of the technical integration by inserting and implementing integration into all structures and their portions, because the portioning covers all tasks and activities, hence the “ITMS” implementation covers all portions.
- Portioning assists to discover rapidly those related technical activities that need to be unified and inserted into the integration process, taking into consideration their size and location.
- It helps discover gaps and then filling them (as discussed in chapter 5).
- Portioning ensures accurate standardization and deeper implementation procedures, and continual improvement.
- Portioning leads the constitutor, who plans and executes the procedures of the integration process, not to forget any portion without integration and leads to discovering and then filling all gaps concerned with related technical activities anywhere in the organization.
- Portioning provides a basis for data modelling (chapter 7.8).

6.3.1 Organizational Structures

Organizational structure is the arrangement of responsibilities, authorities, transferring orders and relationships between workforces inside an organization. It deals with the process of how the arrangements are to be conducted and orders are to be transferred. Organizational structure is the function of workforce grouping according to their duties and positions, making lines of transferring orders from top management to the bottom and receiving replies from bottom, networking their communication process, and figuring levels of responsibilities as exemplified in **Figure 6.3**. The main principles of designing organizational structures are the division of workforce tasks by making departmentalization and specialization of jobs, and setting command levels.

Organizational structures comprise of functional and divisional structures. The functional structures reduce duplication of activities and encourage technicians for more achievement, while the divisional structures reduce any difficulties in coordination process among workforces and enhance their combination within managerial levels, improve decision making and fix performance accountability.

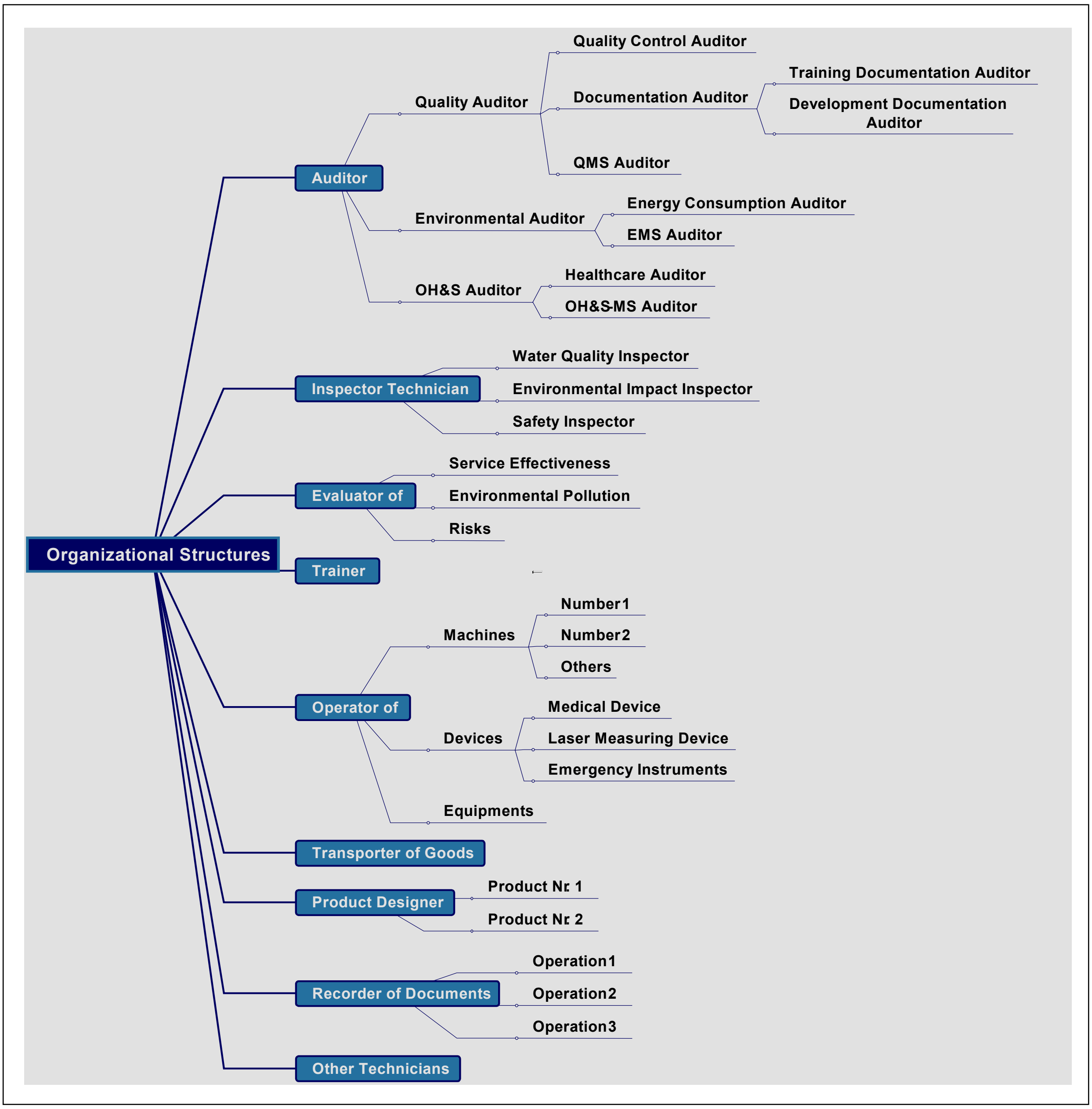


Figure 6.3 *Organizational Structures*

Determination of organizational structures is useful in integration process for all types of organizations resulting in a suitable degree of workforce arrangement and their connection. The external agents like customers, contractors, visitors, agencies and other cooperating associations play a role in determining the size and shape of organizational structures like those relating to quality, environment and OH&S. “The scope of an organizational structure can include relevant interfaces to external organizations, and a formal expression of the organizational structure is often provided in a quality manual or a quality plan for a project” [ISO 9000:2000, 3.3.2, Note 2, 3].
The motivations for the organizational structures are:

- Organizational structures make jobs and duties by workforce more specialized. This encourages workforce in different organization’s departments to adapt their working in favour of “ITMS” objectives and targets.
- The above is true about “ITMS” team as well.
- The adoption of these organizational structures gives ability to each member in the organization to effectively coordinate his interrelations about subjects of quality and environmental preservation by repairing failures, and reducing overall risks on workforce health by emergency preparedness,
- These structures are a logical way of designing small workgroups that could be managed more easily and significantly. It is an easy way of bringing workers close together. This will provide managers an important means of strengthening the coordination among workgroups which will bring greater competitive advantage.
- These workgroups can better realize the customer requirements and other external parties’ (agencies, governments and suppliers) needs.

6.3.2 Operational Structures

It concerns with production activity, operational manufacturing and service industry. It is concerned with all actions to be done inside and outside an organization. The operational structures are related to one operation, or series of operations, and any effort involved in the form of a work as in **Figure 6.4**.
Building operational structures is vital, because they deal with operations which are main purpose of any organization’s existence. It is an ideal way to manage, control and develop an organization. With assistance of modern technology, the operational structures enable an organization to coordinate overall activities among departments, and achieve “ITMS” objectives and targets more effectively.
In manufacturing organizations, these operational structures will assist standardization of organization’s operations, products, services and their design, that help “ITMS” to achieve objectives and targets of quality, environmental protection and OH&S because the standardization is one procedure of ITMS constitution. “In Toyota and Volvo, a break down of the elements makes it possible to establish 300 basic assembly proce-

dures, each of which is identified by its position in the assembly sequence, this method is used in all of the firm’s production plants and has led to standardization in product design and tooling” [Muffatto, 1999, page 18-19]. It enhances other operational manufacturing as re-engineering, re-construction and re-correction, and facilitates their improvement because it concentrates on the small parts and deals with them as vital portions. “Taylor is well known as the father of scientific management and industrial engineering, his approach was to systematically divide the manufacturing operation into smaller and smaller elements and then to concentrate on improving each element in turn” [Browne, 1996, page 20].

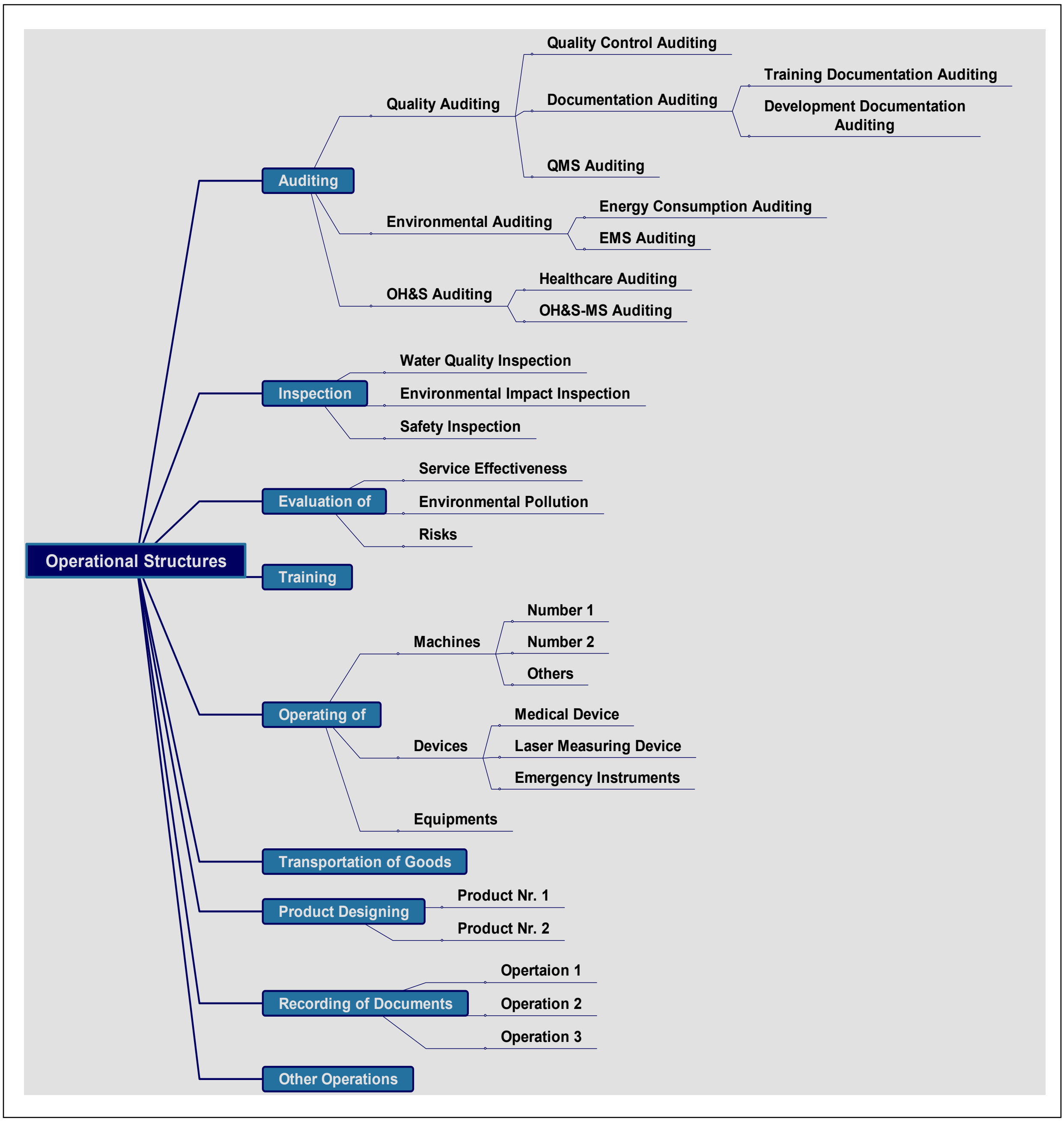


Figure 6.4 *Operational Structures*

6.3.3 Products Structures

Product is anything that can be offered to the market that might satisfy a demand or need, it is the end result of the manufacturing process.
In organizations, product is everything produced by specified operations in enterprise, labour, farm, etc and capable of being delivered to a purchaser and involves the transfer from seller to customer. In the project management, product is also the physical entity that is executed as a result of project work.

As stated about product definitions in (chapter 2.1), the product is the complete set of specifications, benefits and satisfaction that the customer requirements describe them. It is a commodity offered for sale. A product is the sum of all physical specifications, psychological attributes that are entered to the product components in the context of integrated technical management systems.
Regarding this subject, it is preferable to explain more about the product here, that is, it takes a new definition in the context of the new technical integration, which are given below:

- Consumer products (used by end users).
- Manufactured products (used by customers and other organizations).
- Industrial goods (used in the production lines or as semi-product for other end user products).
- Capital goods (represented by equipments, instruments, buildings, halls, raw materials, substances, installations, etc.).
- Results of operations or activities (as examples, represented by structured building, constructed bridges, welded materials, tested matters, folded plates, etc.).
- Commodities goods (represented by wheat, gold, sugar).
- Polluted elements (as air, water, soil, fauna and flora).
- Incident issues (as explosion, fire, dangers, etc.).

Figure 6.5 shows more examples of products structures and their portions and further smaller portions.

The motivation for products structures are:

- The portioning according to products is attractive to big organizations because functional management can readily supervise functional working of products and services.
- One benefit of the products portioning is realization of the parts of every product especially the complex ones, in order to give these parts more maintainability in their manufacturing.
- Other important benefit is to show any defect in the product and filling gaps (as discussed in chapter 5)

"The partitioning of complex equipment and systems into almost independent units is essential for good maintainability, and the portioning must be performed early in the design phase, because of its impact on the construction of the equipment or system considered" [Birolini, 1997, page 120].

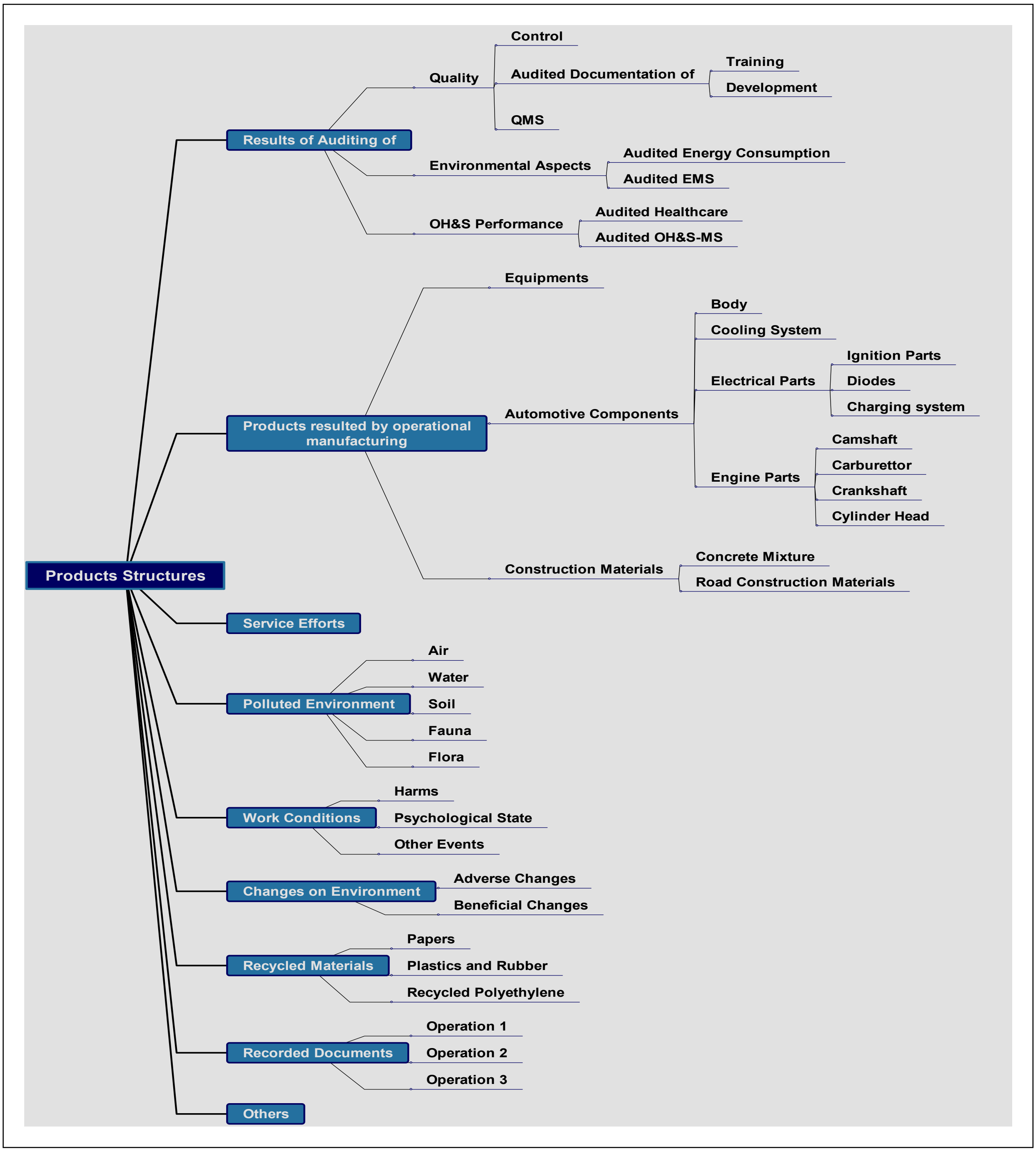


Figure 6.5 *Products Structures*

6.3.4 External Structures

External structures are outward, exterior and are related to the outside and foreign relations, and they are physically distinguished and connected with the outside or an outer part. External structures are those factors that could be influenced and changed by all organizations.

The external structures could be classified into groups of:

- Customers and outer elements relating to them (definition in chapter 2.1).
- National and international standards, and general regulations, and their associations ISO, NSO, authorities, agencies and others (details in chapter 3).
- Competitions in worldwide market to progress in production and services.

The motivations for external structures are:

- Every organization has external structures, there is no choice, and they should react with them such as customers, standards and other external parties.
- Organisation has a pressure to form shape of its outer relations and combination, at the same time, external structures affect negatively or positively on the organization’s activities. Here, they can not be neglected because the customers and standards are the main input components for the technical integration process.

The external structures must be assessed and continually evaluated because they are basis for the “ITMS” process. “One column of integrated management system is the combination with the external parts” [Molitor, 1999, page 3].
For example, the structures and portions of the customer are satisfaction, delivery time, customer’s communication and after sale service. Some more examples are shown in **Figure 6.6**. By assessing all faces of technical elements, the internal and external parties affirm their activities.

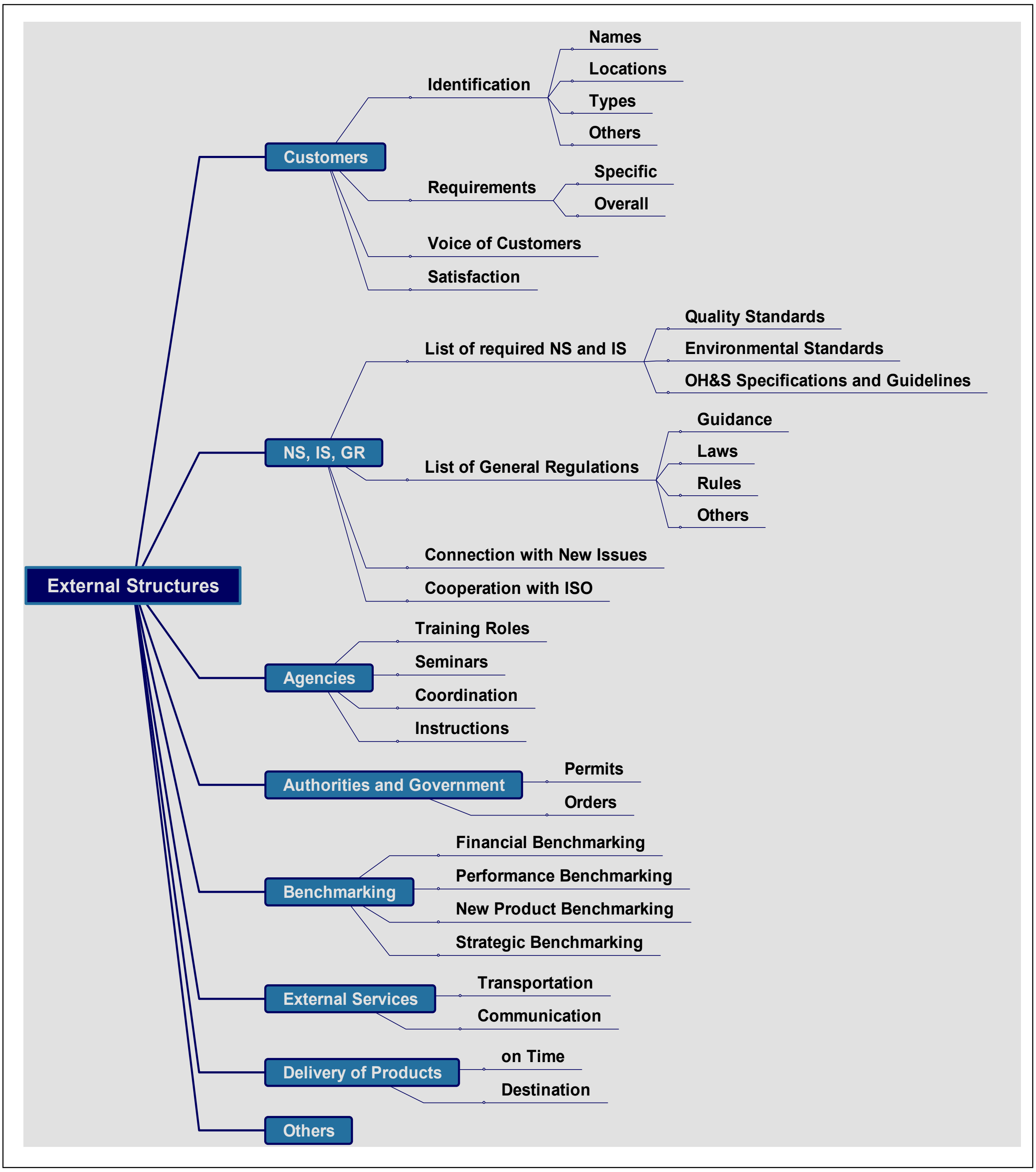


Figure 6.6 *External Structures*

6.3.5 Factors for Portioning

There are several factors regarding the process of portioning, they must be studied by the planner and constitutor for determining the nature and depth of the portioning. These factors could be known by gathering all data and information and then analyzing them for more details. Thus portioning could take place depending on the following factors:

- Type of products and services.
- Nature of objectives and targets.
- Role and volume of existing QMS, EMS and OH&S-MS inside the organization.
- Nature of existing organizational structure used in the organization.
- To which extent and level, the organization has standardized its tasks.
- Current actual role and power of the technical elements.

The **Table 6.1** below gives examples of comparison among four structures for understanding their differences.

Examples of Comparison between Structures			
Organizational Structures	**Operational Structures**	**Products Structures**	**External Structures**
Measurer Controller Auditor Transporters Inspector Tester Welder Drawer ……….. Team of “ITMS” Technicians	Measuring process Controlling process Audit process Transporting operation Inspection process Testing work Welding process Drawing activity ………. Working activity by team and members, Operating of machines and Maintenance working	Measured material Control machine Audited product Transported issue Inspected service Tested goods Welded material Drawing material ……… Shape, Hardness, Viscosity, Size and composition of a product	Related NS,IS, GR Related NS, IS, GR Related NS, IS, GR Related NS, IS, GR Related NS, IS, GR Related NS, IS, GR Related NS, IS, GR Related NS, IS, GR …….. Customer’s satisfaction, Goods delivery, Operating instructions, After sale service and Benchmarking

Table 6.1 *Examples of Comparison between Four Structures*

6.4 Unification between Technical Elements

Unification is the act of making a single unit or the act of coming together. Unification is one procedure among five procedures for “ITMS” constitution process which means unifying two or more elements of related technical activities, technology or engineering which are faces of technical elements. We should know that the unification occurs between related technical activities as one face of the technical element, and are same as described in clauses of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999. But usually technology and engineering will enter really into the procedure as a main element or as assisting element. In most cases the unification between related technical activities will not happen without technology or engineering principles, such as using technological experiences, equipments, devices, instruments, etc. It means that the activities of audit, testing, inspection, controlling could be done with the same devices and instruments. Those are used in most operations of manufacturing in different organization types using principles of all engineering sciences which could be unified here. Because they are intersected with many practical operations, as an example of (design process) in (Appendix B: Table B.2), there is illustration of elements of different engineering sciences that could be unified which include all design parameters considering the quality, environment and OH&S aspects. Therefore as general concept, the unification includes all faces, it means the unification encompasses many elements of technology and engineering science and is applicable towards integration process. Unification of two or more elements could be carried out if they have common activities, or are similar in their functions, and agree to undertake the same conducts and responsibilities.

The unification is the fixed combination of technical elements, and the way to operate them together at one time, one place, and at the same level of attention. They must be evaluated in the unification procedure with similar importance.

The unification is another procedure, which unifies technical elements represented by its three faces, especially related technical activities that are stated in clauses of ISO 9001:2000, ISO 14001:2003, and OHSAS 18001:1999, at the same time they are common or similar in their actions in QMS, EMS and OH&S-MS.

6.4.1 Motivation for Unification

A number of motives lead us to make unification as a primary step of the next step of integration procedure, it occurs on the technical elements (chapter 3.11 Faces of common elements and chapter 1.4 Technical elements) that cover the whole aspects of constitution process and operation of the technical integration.

As explained, the technical elements are similar in their efforts and operations, they need the common requirements towards technical integration process. The unification is suitable procedure because:

- The technical elements hold the common or same operation and efforts.
- It is only one procedure of the constitution process instead of many.
- There is no adverse intersection between technical elements, that means they are not operating against each other, but they help each other and move at one baseline towards organization’s achievement.
- It helps to reduce the volume of efforts, costs, time, and additionally it makes the implementation more easy and stable.
- It promotes processes for better continual improvement.

6.4.2 How to perform Unification?

Several factors are forced to limit the shape and volume of the unification before making it. The unification could be done under comparing with two concepts:

1. *How many numbers of technical elements have to be unified?*
2. *How many areas will be included?*

Covering the main points adequately, the procedure of the unification could be done between:

- *Two or more technical elements inside one area.*
- *Two or more common or similar technical elements among three areas.*

In relation with one area and three areas, the unification will be as follows:

First:

Figure 6.7 shows the unification of technical elements inside one area. It can be achieved by choosing two or more technical elements of any one of quality, environment, or OH&S and unifying them. The procedure could be expressed as summing them as logical issue:

TE (1) + TE (2) + TE (3) +……………………….. (only for quality).
TE (1) + TE (2) + TE (3) +……………………….. (only for environment).
TE (1) + TE (2) + TE (3) +……………………….. (only for OH&S).

For example, the following could be unified:

The design of the roughness on cylinder walls can be unified with the lubrication system design for an automotive engine (quality), because the first element is critical to ensure the satisfactory design of the second element. Similarly the unification of quality inspection and quality audit for one product could be done (by one person or one group) to improve the overall performance in the area of quality.

The programme of reduction in harmful gas emission is unified with the programme of reduction of waste water generated in an electrical power station in order to protect environmental aspects and surroundings.
The head protection regulations could be unified with noise regulations during a project execution to improve the performance of OH&S.

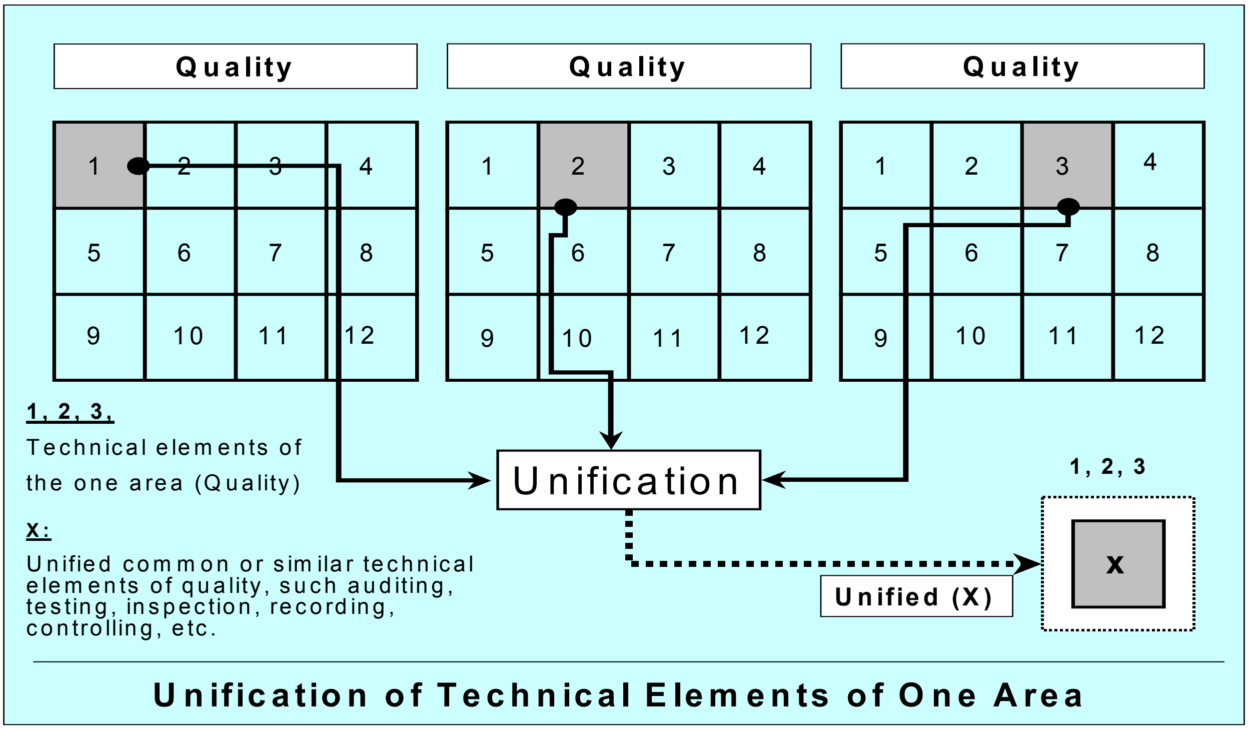


Figure 6.7 *Unification of Common Technical Elements of One area*

Second:

Figure 6.8 shows the unification of technical elements between three areas. It can be achieved by choosing common or similar technical elements from the different areas of quality, environment and OH&S and unifying them. Unification could be done between all three areas or between two of them.

This could be logically explained as:

TE (1) (Q) + TE (1) (E) + TE (1) (OH&S)......... (common or similar elements).

For example: In transporting tank of releasable and flammable materials, the design and construction of the tank (quality), the safety regulations in acceptance with the environmental standards (environment) and the instructions to the operator for safe handling and operation of the tank (OH&S) could be unified which means three areas (quality, environment, safety) are unified.

Considering two areas, the unification could also be logically explained as:

TE (1) (Q) + TE (1) (E) .... (common or similar elements).

For example: The quality of operating of a product (television manufacturing) unified with its rate of energy consumption (environment).

TE (1) (Q) + TE (1) (OH&S)......... (common or similar elements).

For example: The quality and degree of excellence of a product (computer display monitor) unified with its level of harmful affects on the human eyes (OH&S).

TE (1) (E) + TE (1) (OH&S)......... (common or similar elements).

For example: In case of controlling of hazardous waste treatment, storage and disposal activities can be unified with the safety regulations to the workers on handling and treating these hazardous substances.

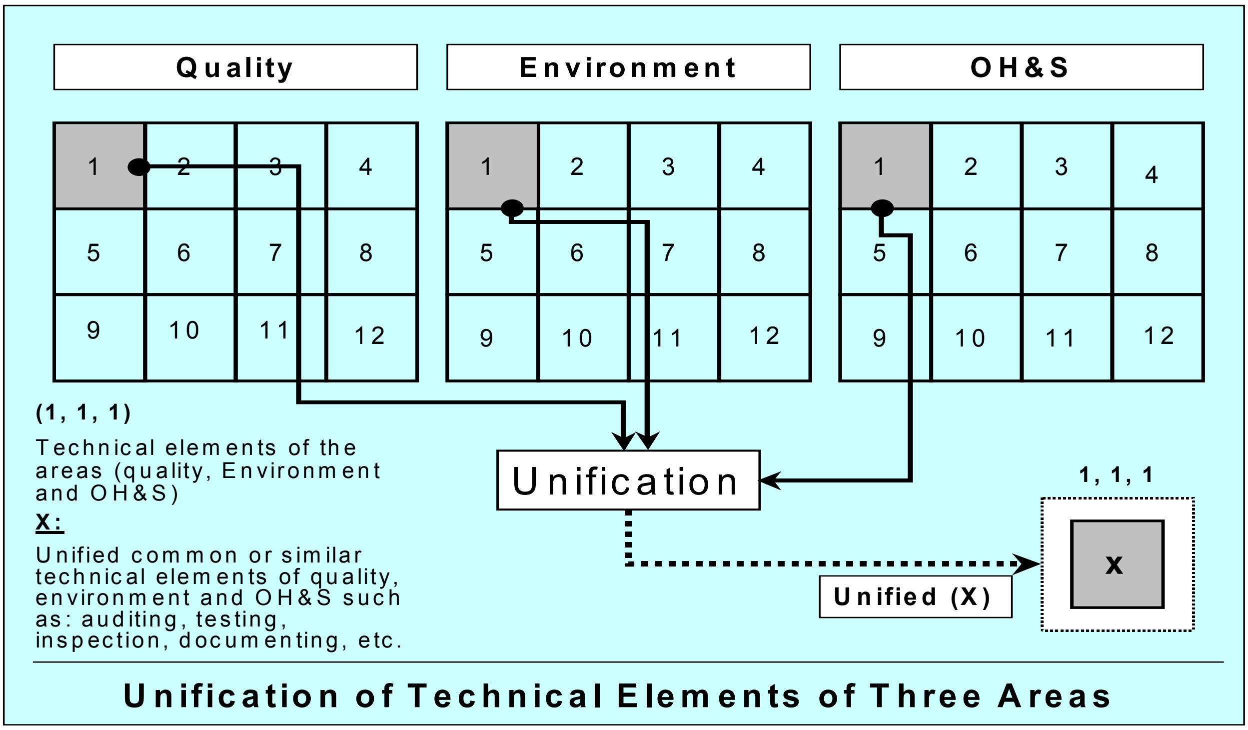


Figure 6.8 *Unification of Technical Elements of Three Areas*

The same can be achieved for testing, training, designing and so on. **Table 6.2** are other examples separated into four structures.

Examples of Unification- Face: “Related Technical Activities”				
One Area or Three Areas	Four Structures			
	Organizational Structures	Operational Structures	Products Structures	External Structures
One Area	Team of quality testing with team of quality audit	Quality inspection process with quality audit process	In one product: quality of acceptance, shape, size, hardness and operating can be unified	Quality of customer delivery with benchmarking on quality and satisfaction at the same time
Three Areas	Team of quality testing with team of environmental testing	Quality audit process with environmental audit process and OH&S audit process	Product quality with product effects on environment and product safety	Quality of packaging of goods with environmental protection requirements by this packaging and safety regulations by the same packaging

Table 6.2 *Examples of Unification-Face: “Related Technical Activities”*

6.5 Integration Procedure

The integration is a procedure of the constitution process of an integrated technical management system of quality, environment and OH&S. It means that the technical integration must be done between QMS, EMS and OH&S-MS resulting unified technical elements and their management systems will serve as constitution process, and this process will be performed during unification, as explained above, and achieved.

The procedure of integration must be enforced by means of bringing all processes, operations and peoples together to assist in building one structural form, and equate their functioning as a combined band in order to achieve overall objectives and targets of the three areas by this way. For each individual element, the ability extent should be recognized, because many elements are not in place to be integrated. “Elements which can not be integrated: objectives and targets” [krueger, 1998, presentations].

But objectives and targets of the quality, environment and OH&S could be integrated for making better results.

According to the description of the unification procedure and its example, the integration process here is based on several rules as it:

- *may be done only for designated technical elements.*
- *may take one or more kind of integration as described in chapter 4.6 (total, partial, vertical, horizontal, etc.).*
- *is achievement drives on the line of coordination, intersection and combination (CIC).*

The first rule of the integration for designated technical elements could be performed between common or similar related technical activities, for instance:

- *“ITMS” for audit.*
- *“ITMS” for documentation.*
- *“ITMS” for inspection.*
- *“ITMS” for designing the job description of employees.*

And the integration can be applied in operational processes by inserting all relations of quality, environmental protection and OH&S at the same time during its process, for instance:

- *“ITMS” for designing a product.*
- *“ITMS” for storing a material.*
- *“ITMS” for manufacturing of building materials.*

Figure 6.9 shows the partial integrated technical management systems in which there is an inspection team for every four structures (organizational structure, operational structure, product structure, external structure). Every structure must send reports related to quality, environment and OH&S to the inspection team of that structure to make the system partially integrated as well as vertically integrated (chapter 4.6). And when this partial integration is achieved for each structure, consequently it will make the system totally integrated. From the partial integration we can understand that the inspection team works for three areas of quality, environment and OH&S. The inspection of product means that the produced product must be inspected in three subjects, all these should fulfil the customer´s requirements so that the customer will receive inspected quality of product and receive the inspected environmental aspects and receive inspected OH&S relating to use of this product. By the same way we can integrate the other related technical activities (auditing, controlling, etc).

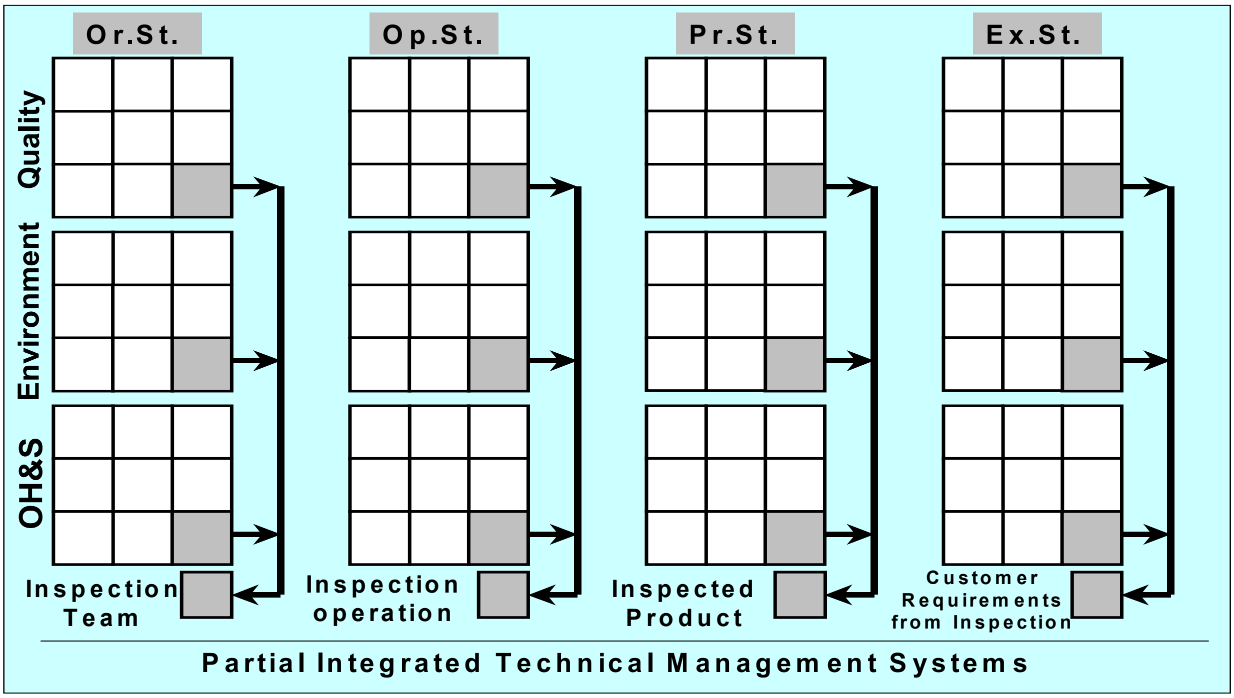


Figure 6.9 *Partial Integrated Technical Management Systems*

6.5.1 Coordination-Intersection-Combination Function

The consequent step of integration procedure here is coordination-intersection-combination function (CIC). The CIC function is an application of discipline, key towards complete integration between three management systems. Its motive is to perform efficient and effective implementation and assist to increase its extent. As the extent of CIC is increased, the implementation of “ITMS” constitution becomes better.

The CIC as a band function has the following features:

- It is one face of integration procedure.
- It facilitates the constitution process as primary preparation.
- It assists in building a team.
- It makes constitution process more concrete.
- It is a factor for successful “ITMS” operation.

The CIC function achieves its duty as follows:

<u>The coordination:</u>
It is one phase of CIC function, which holds the duty of first preparation of all three QMS, EMS ands OH&S-MS for their application and to be ready for immediate use and action, and collect them from documentation division if it exists, or designing any of them if it doesn’t exist, and then try to remove any expected impediments in order to be

active in the new integration process, and enforce by top management, who encourages it and have abilities to achieve this, and receive cooperation from all concerned sides in the organization. “The coordination is integration of the organization’s parts to achieve desired outcome”[Wright, 1996, page 413].
The coordination can be achieved by making proper internal communication, and between organization and external parties for this purpose. “The coordination is based on suitable communication process and encompasses all activities for coordinating” [Firesmith, 1999, page 196].
The coordination nowadays is necessary for operative management systems for any organization’s activity. It is estimated as a one pillar in the efficient task results. “The supply chain management today and traditional operations management lies in two dimensions of integration and coordination” [Lee, 1998, page 1].
With the coordination as basis, the following plan could be assembled and illustrated.

The intersection:
By making intersection between three management systems of QMS, EMS and OH&S-MS, the technical elements be more fixed, processes and operations be in higher intersected. This is the second phase, **Figure 6.10** shows three phases of the CIC function.

This phase is the front face of “ITMS” constitution and measures its qualified performance. The intersection means extending over each other by management systems, overlapping in their systems and share more in technical elements. It means covering common activities and having management systems with intransitive meanings, and finally is the act of harmonizing between them to perform “ITMS” constitution and their participation in common elements. “The intersection of two sets A and B is the set that contains all elements of A that also belong to B (or equivalently, all elements of B that also belong to A)” [Encyclopedia, 2004].

The combination:
Final phase of CIC is combination. It is the act of combining functions without separation. It could be assessed as a unit of processes, operations, persons, methods, equipments, tools, and arrangements in order to achieve main goal of “ITMS” constitution process and its operation later. “The act of combining things to form a new whole and the act of arranging elements into specified groups” [Wordreference, 2004] .
The combination phase tends (coordinated management systems of unified technical elements) to make more enforcement for previously fulfilled intersection phase and enhancing it.

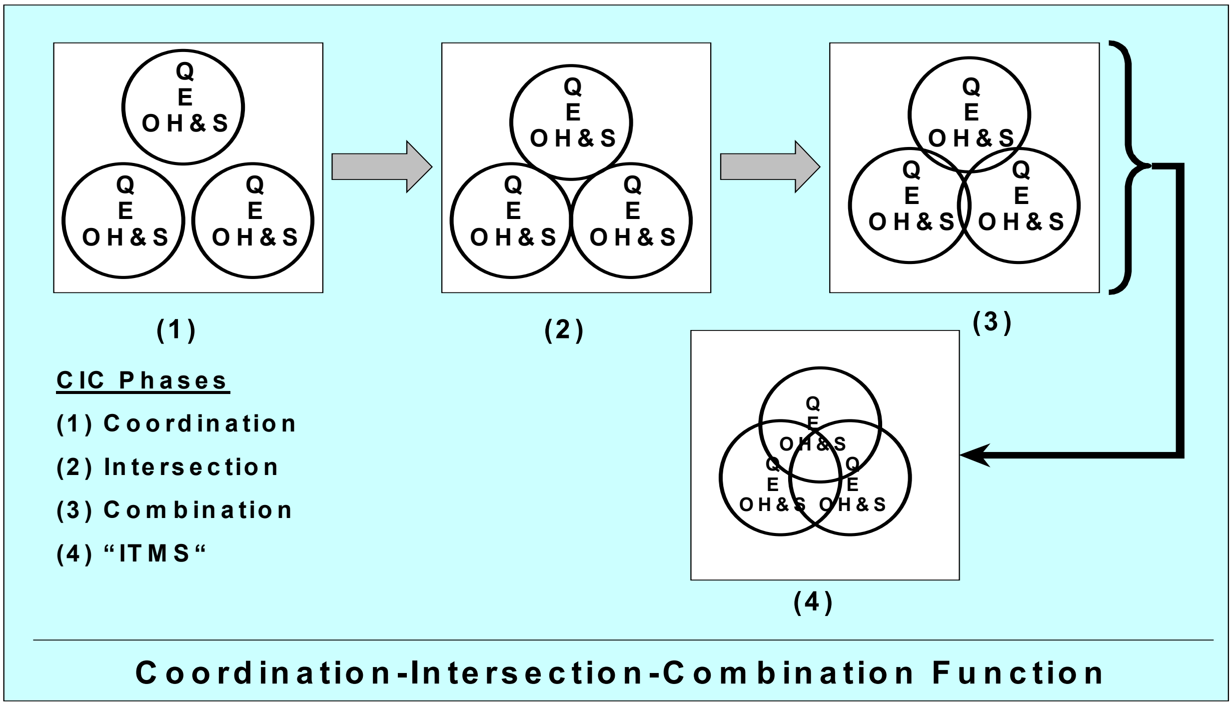


Figure 6.10 *Coordination-Intersection-Combination Function*

The communication between different related parties assures the effective combination. The communication in internal organization among processes of production and services is activated towards qualified CIC. The communication means many sides are exchanging their information within the organization especially between humans and machines. “The communication is between humans, humans and machines or between machines” [Woll, 2000, page 95]. This will produce high level of quality, environmental protection, and occupational health and safety. And external communication assures an increase in achieving level of overall objectives and goals of integrated technical management systems, and lead to more benefits with the internal parties. “Several organizations like Boeing have developed assured constant interaction between external parties and internal parties” [Hillebrand, 2001, table page 24].

To enforce above descriptions of phases of CIC, it could be summarized as follows:

- Coordination between QMS, EMS and OH&S-MS.
- Intersection between unified technical elements and coordinated three management systems.
- Combination between intersected management systems and unified technical elements.

As examples, the CIC function may be done for the four structures as follows:

1. *Organizational structures: CIC for testing team.*
2. *Operational structures: CIC for designing a production line.*

3. *Products structures: CIC for technical specifications.*
4. *External structures: CIC for customer satisfaction.*

6.5.2 Benefits of CIC Function

When the CIC function is achieved, it gives several benefits, which are introduced as benefits for integration procedure as well. The huge motivation for CIC function is shown in the **Figure 6.11** as series phase in order to reach the main goal of top “ITMS” constitution process in an organization.

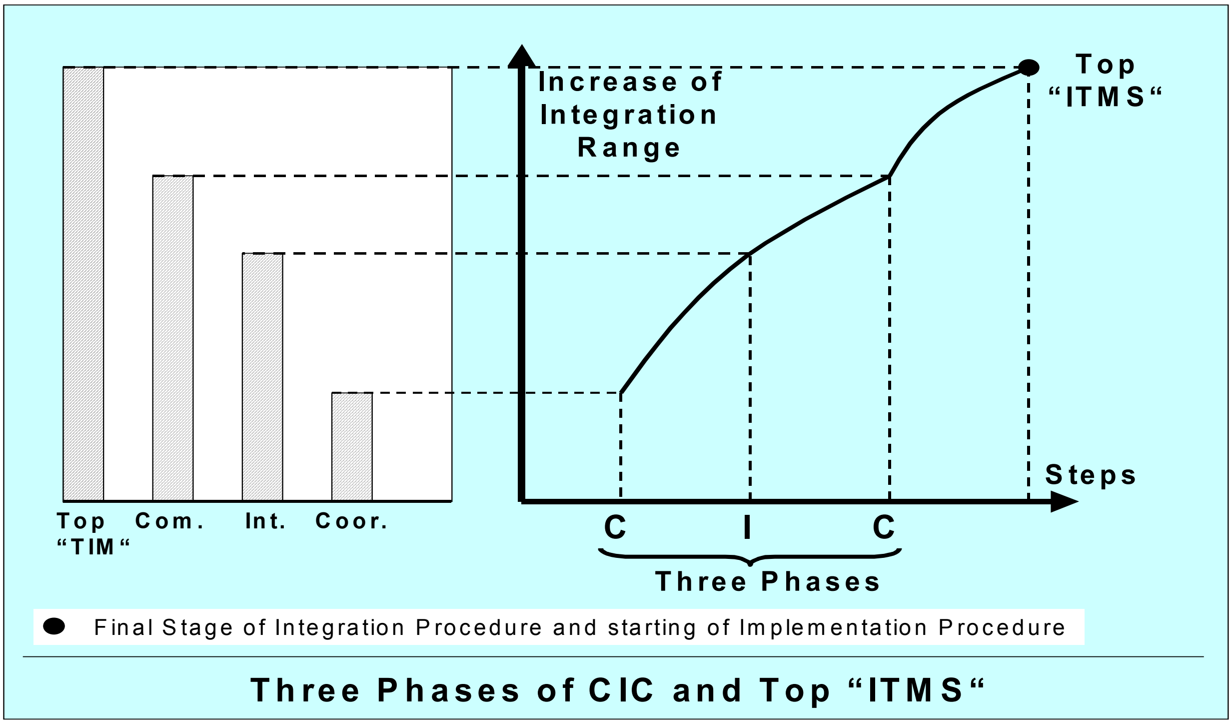


Figure 6.11 *Three Phases of CIC and Top “ITMS”*

Overall benefits of CIC function can be summarized as it:

- Increases status of quality, environmental protection and OH&S.
- Reduces duplication of costs and efforts.
- Reduces risks and hazards, and minimizes accident probability.
- Improves communication, relation and information changes.
- Facilitates training, acknowledgement and skills.

The motivation of integration procedure is same as the benefit of CIC because they lead to the same goal, and the benefits of CIC enforce the direction of overall motivation of this procedure.

6.5.3 Examples of Integration Procedure

The integration procedure occurs between management systems of quality, environment and OH&S, those systems in which their related technical elements have been unified or ready to be unified as explained, and these systems will be active together at one time and location, and their goals and objectives will be achieved in a balanced state. The procedure of integration can be expressed (as before explained in procedure of unification) between them as logical issue:

For common or similar technical elements between three management systems:

- QMS + EMS + OH&S-MS

For common or similar technical elements between two management systems:

- QMS + EMS
- QMS + OH&S-MS
- EMS + OH&S-MS

As examples, these management systems can be integrated in the following ways:

Any organization considering QMS(ISO 9001:2000) and EMS (ISO 14001:2003) registration could unify and integrate QMS and EMS audits to meet later integration process for the audit, which they, within an organization, commonly share with structure and responsibility , document control, records, corrective and preventive actions, internal audits (additional elements could be added depending on the organization’s type). Its better to remember that the savings of expended time, decreasing number of technicians, reducing of routine works and cost savings are depending on the level of integration.

In case of the building construction, the functional requirements may consist of quality of building’s design, construction engineering calculations, regulations to ensure the health and safety of people living in building, the public living around, environmental aspects preservation by promoting energy efficiency and heat transfer in buildings. The unification and integration of these management systems could be performed.
All the aspects of QMS, EMS and OH&S-MS are taken into account like conservation of power by adequate (Q) resistance to loss of heat from roofs, walls, windows and floor (E), ventilation provided to all necessary places (OH&S), and supply of fresh air to prevent carbon monoxide poisoning (E, OH&S) of a building's occupants, and design (Q) of drainage and waste disposal (E), structural element not be toxic (OH&S), sound resistance by walls and floor (Q, E), with adequate weatherproof against damp and rain penetration (Q, OH&S).

6.6 Standardization Procedure

Standardization procedure in this context is concerned with the national and international standards, and general regulations, and its application depends on technology and engineering principles. The standardization is related to organizations of manufacturing and service industries which find the need for establishing the integrated technical management systems. It takes various meanings but all merged into source of products and services development and other aspects will be in connection, which means that it could be assessed as the mechanism for optimizing economic use of products, resources and raw materials. At the same time it could be defined as the process of continual improvement and maintain required levels of compatibility in products, production, operations, materials, activities and administration.
The standardization is the action of inserting standards into entire organization’s relations such as workforce duties, equipments, QMS, EMS, OH&S-MS and overall tasks for which the organization works. The standardization could be checking, adjusting and measuring. “The standardization is the act of checking or adjusting the accuracy of a measuring instrument” [Wordreference].
The source of the standardization procedure is national and international standards, and general regulations, which are owned by international organization for standardization ISO, national standards organizations NSO such as DIN (Germany), ANSI (USA), BSI (Britain). JISC (Japan), etc. and general regulations (as shown in Figure 3.2) are owned by national or international associations and federations in the world, as in Germany. “Those federations and associations form guidelines and regulations, such VDA, VDI” [Ebel, 2001, page 301]

The standardization should be done as internationally be accepted, for example engineering standards are considered as technical standards among industries in various countries. In electric energy distribution, by using 230 Volt, 50 Hz AC, a compatibility of product is made and any decline from this line will be loss in quality and benefits, and this is true for any other products produced worldwide.
The standardized procedure results standardized operations, products and services, for example, standardized process, standardized equipments and standardized tools in water purification station will produce standardized drinking water. Standardized packaging of materials with standardized instruments will lead to standardized delivery and standardized safety, and so on.
The most sources of standardization of integrated technical management systems are ISO 9000:2000 family, 14000:2003 family and OHSAS series 18001:1999 & 18002:2000 by application of their requirements and specification stated in their clauses. For successful standardization, there should be compliance between needs and requirements of several sides, such as organization, customer, public, agencies authority, and other related parties.

In relation with integrated technical management systems, the standardization is concerned with technology and engineering, it is necessary to demonstrate the wide range of the standardization meanings and evaluation as assistance tools, in order to understand it in a better way. The assistance tools for standardization will show in more detailed meanings and definitions as a step of “ITMS” constitution process during its operation inside an organization.

6.6.1 Assistance Tools for Standardization

There are some functions working as assistance tools for standardization procedure in order to enhance the unification of technical elements for gaining perfection in resulting integrated systems and achieving objectives and targets of quality requirements, preservation of environmental media and OH&S performance. They could be modification, arrangement, measurement, calibration and assessment. They assist the success concepts for “ITMS” constitution (referred in chapter 8.2) and aid them to perform. The description and examples are as follows:

Modification: Making changes in internal and external composition and shaping them to bring more standards.

- Modification of product’s shape for suitability with transportation rules and environmental protection.
- Modification in inner space of cars for more comfort and customer satisfaction.

Arrangement: Setting up or putting up a proper systematic order to facilitate operations.

- Arrangement of products according to their technical specification in storing house, and saving them according to assembling design in computer-aided collection data.
- Arranging production line in a way that gives more space for working, in order more occupational health and safety, and suitable ventilation.

Measurement: Making basic comparison between two or more technical activities, to fix a certain dimension as an original.

- Determining measure of inner diameter of used cylinder of automotive engine after certain period to know the oil linkage and then the rate of emissions.
- Measuring the traffic movement during a day for knowing the rate of noise and pollution, and for a high quality planning in traffic engineering.

Calibration: Checking and adjusting all devices and instruments and their level of operating effectiveness by comparison with standards.

- Calibrating devices and equipments, laboratory and medical instruments and electrical circuit in order to gain accurate results to avoid risks of inaccuracy and accidents during their operation.

Assessment: Setting and determining the amount, size, volume and various other properties in order to assess the quality, environmental protection level and OH&S performance.

- Assessing viscosity of a solution product for determining quality and the shape of container.
- Assessing the dangers of work place for determining the suitable regulations and programmes.

6.6.2 Motivation for Standardization

The standardization carries a number of important advantages, and it is an important issue for products and services. In relation with the three areas, it leads to higher quality, more environmental protection, and increasing in occupational health and safety. In addition, it leads to an increase in productivity, lowering the cost, reducing time and relatively higher customer satisfaction. “General Motors recently has standardized its automobiles components of brake system, electrical systems by reducing variety, it saves time and costs, and increases quality and reliability in its products” [Stevenson 96, page 145].

The standardization is a way for achieving higher systems flexibility and improvement, and make integration process more efficient. “The standardization and transparency of the processes leads the process of integrated management systems to the advantages of higher flexibility of the system, efficiency increase and improvements” [Winzer, 2000, page 35].

The standardization is a vital matter worldwide, all organizations dedicate themselves for it, and now almost all prizes are considering it as an important factor. “The Deming prize evaluates the operations of a firm against ten criteria, such as standardization” [Wheaton, 1999, page 96]. And other example of its beneficial role follows. “The standardization of nuts and bolts had saved industry millions of dollars” [Wordreference]. Which relates to manufacturing of vehicles, ships, machines, aircrafts and so on.
In manufacturing and service industries, the standardization leads to economical benefits and balancing with operation time, and facilitates trade and exchange of goods and experiences, diffusion of the new technology, minimizing the cycle time and increase

productivity. “The standardizing of operations attempts to three goals of minimum work, balancing within the cycle time and high productivity” [Browne, 1996, page 248].

About the integrated technical management systems, the standardization performs its constitution process, implementation and continual improvement, and it also holds the same benefit that explained (in chapter 3.4), and following are its benefits:

- Equalizing the operation of unified technical elements and integrated management systems with NS, IS and GR.
- Verifying the objectives and targets of products and service by higher quality, reliable products, more environmental protection and customer’s occupational health and safety.
- Making stronger ability for constituting an “ITMS”, reducing its complexity, avoiding unnecessary design, and stronger ability for fitness of the purpose of products and service, risks reducing and solving problems.
- Assuring greater protection of public life by health and environmental aspects protection, and products quality.
- Leading to lower costs of each one of planning, management implementation, application, training, maintenance and system development.
- Helping to fill gap between systems, operations and to achieve efficient continual improvement at all stages.
- Assisting in establishment of SD.
- Simplifying the next step of implementation procedure.

6.7 Implementation Procedure

Implementation is to carry out, execute and practice a plan to achieve a goal and result as an output. The implementation of “ITMS” is the action of its operation to the actual happenings. It compasses all the works involved in getting new condition, and it refers to all the activities focused on the actual operating process of “ITMS”.

It is an applied procedure to ensure conformance to standards and general regulations within organization’s activities by applying an integrated management systems. It is the way to stay right on objectives, implement and monitor the procedures according to the constituted “ITMS”. “The ways of setting meaningful objectives is implementing an integrated management system and improving the monitoring procedure”. [Smith, 2002, page 5].

In this work study, the implementation includes execution of “ITMS” and means of achieving its requirements. It is the final phase of overall procedures of the constitution process. This procedure is the application phase for goals and planned objectives. It is the practical function in putting standardized integrated management systems into the organization for performing goals of the three areas. Therefore a part of “ITMS” framework entails both technical and managerial consideration for enhancement of its existence and making it a beneficial application.

6.7.1 Motivation for Implementation

Without implementation procedure the organization stays without technical integration process, and the constitution process will be useless.
The motives are same as for integration and benefits of the integration because both serve the same purposes within organization. But the individual motives of the implementation procedure could be as:

- Gaining wider and more reliable integrated technical management systems.
- Filling those places remaining without “ITMS”.
- Performing objectives of higher quality, environmental aspects protection and occupational health and safety in departments and bringing all operations of the organization in to these objectives and targets.

6.8 Degree of Executing Procedures

The degree of executing procedures of “ITMS” constitution process is the intensity of carrying out procedures. The degree as a unit could be scaled by specific number or ratio, where the ratio could be a better representation according to complete achievement of any procedure. Complete integration is marked by 100 %. For instance, in a project constitution its complete execution must be fulfilled and nothing less than 100% should be accepted. This can be achieved by confirming the completion of all the required activity with the help of checklists. Any degree of completion which is less than 100 % would not produce the expected results from the project.
In case of “ITMS”, one should realize that the procedures of portioning and standardization would have to be incorporated 100% in the constitution process whereas the other procedures of integration, unification and implementation could be total (100%) or partial (<100%). Every procedure achieves 100% and less than that would mean that it did not reached to maximum size of integration. For effective “ITMS” they must take ratio of degree of executions as **Figure 6.12**.

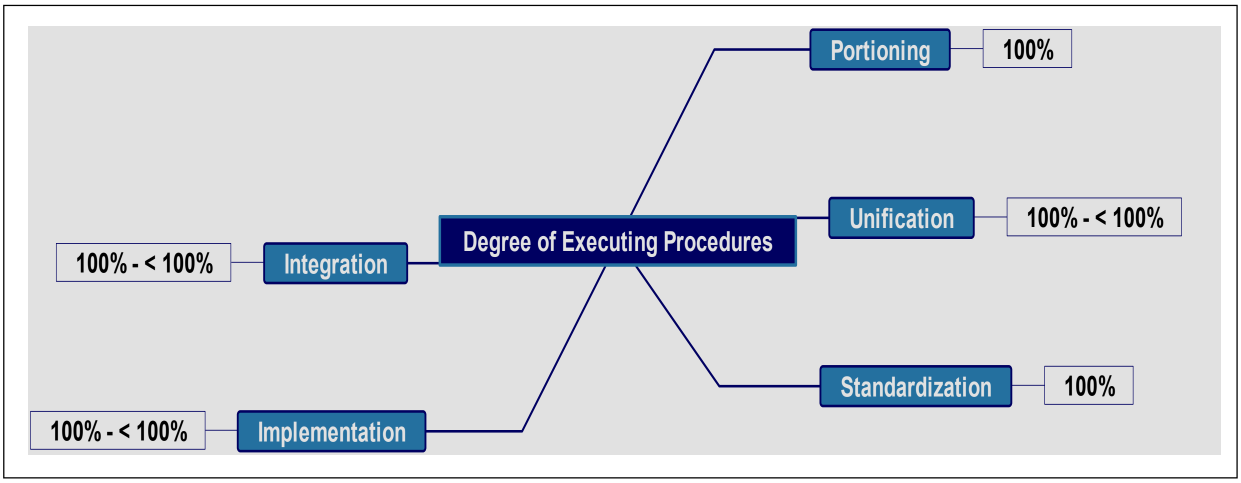


Figure 6.12 *Ratios of Degree of Executing Procedures*

The organization must be entirely portioned to its structures, and the structures to its little portions, in order to gain more benefits as explained before in this chapter, the same status in regarding with standardization. It should be 100% because incomplete standardization would be unacceptable. It will be impossible to standardize some unified technical elements and leave others without accordance with NS, IS and GR, because it leads to other adverse effects on other areas and does not conform to the right direction of standardization goals.
But about other three procedures of unification, integration and implementation, they may take partial degree of execution between 100% to less than 100. It depends to the decision of the management that which elements should be chosen for inserting the constitution process. Higher degree of the execution leads to more effectiveness and more useful integration, because higher degree will compasses more technical elements for unifying and integrating, and result an increase in quality level of products, processes and services, more protection of environmental aspects, reduction in pollution, increase in occupational health and safety for workforces and public.

6.9 Framework for an Internationally Usable “ITMS”-Model

The framework focuses on factors that are common to provide a model of systems, situations and any problems that appear during organization’s activities. The framework can specify how an integrated technical management systems be designed. Technically, it is a process of participation through which workforce, customers and public work together to achieve desired objectives and targets.

The framework is not specific to any particular type of organization but it represents a general model for any “ITMS” constitution, and the structure of the framework exhibits

the characteristics of flexibility. The framework of an internationally usable “ITMS” model consists of basic elements for an integrated technical management system for any organization, and it can be optimized for the different types and sizes and as a general conception could be initiated and followed by all organizations.
A composed framework for an internationally usable “ITMS” model is described in Appendix (C). It gives arranged steps as guidelines for achieving the top goal of an “ITMS” constitution which suitable everywhere in order to perform the provisions of a model. “A model is a sequence of steps arranged logically to serve as a guideline for process implementation in order to achieve the ultimate goal” [Ho, 1995, page 44-45].
A functional model should be made which describes the system requirements and contains series connections and is structurally connected. “A functional model is a hierarchical and systematical description of the plant, and the top function is decomposed into lower level functions” [Bouissou, 2000, page 66].
In addition, the model has some other connected attributes which are represented by framework elements, they must refer to international responses, social needs and technical aspects which are all poured into the integration process. “The system architecture is structured as a set of nested relationships consisting of framework of international responses, social solutions, technical solutions, problem and activities” [Choucri, 1999, page 275- 276].

The purpose of the model is to hold all operative requirements to design a specific framework for an integrated technical management system and be applicable in all types of organizations.

Other motives are to define the operations relating to quality of products, environmental elements protections, and OH&S performance, and demonstrate relations with external parties as customers, agencies, national and international standards, and other suppliers for gaining more effective results. “The model identifies the internal operations and relations to the external environment such as customers, suppliers, banks and other agencies” [C. Matos, 2000, page 65].

The overall advantages of framework are as follows:

- Provides a basis of how an “ITMS” be designed.
- Facilitates the understanding of components of an “ITMS”.
- Enables an organization to identify its strengths and weaknesses in order to begin the constitution process.
- Identifies the internal and external relations with customers, suppliers and agencies in issues relating to the three areas.
- Helps top management in decision making to improve the performance.

In order to determine the effectiveness of the “ITMS” framework, and its elements, while they are fulfilling the requirements of quality, environment and OH&S, the checklists must be prepared and done for more assurance. The checklists are management

tools to help planning of constitution processes and show its quality. “The checklists are used for review of quality and planning” [Molitor, 197, page 24-25].
In addition, the checklists show the gaps, defects and lacks in all procedures, and they work as indicator for many problems. “The checklists will show the weak and strong points of the process and deviations from design guidelines, and show results of analysis and tests”. [Birolini, 1997, page 75].

In relation with this framework, there are:
Appendix (C) shows the description of a composed framework for an internationally usable “ITMS”-model.
Appendix (D) shows the common elements of “ITMS” framework which can be used internationally with reference to ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999.
Appendix (E) shows the checklist of gap analysis of “ITMS” framework with which we can easily identify the existing gaps and remove it, and make the system totally integrated.

Chapter 7- Computer-Aided Collection Data Centre

7.1 Information of Technical Integration

Information is the knowledge which is derived from study, experience and instruction. It is the knowledge of quality level, events and accidents that has been gathered or received by communication or news.

The information is the act of being informed. It is a collection of facts such as technical information. It is the knowledge to be communicated such as quality standards by the electrical industry and the safety regulations which are provided for the workers in a transportation firm. The information is the processed, stored and transmitted data such as collected and modelled data.

The information could be in the form of numerical measures obtained as a result of experiments such as:

- *10% of higher quality with 20% reduced time in delivery of products.*
- *The ratio of 20 incidents per year in a drug firm.*
- *2000 accidents per year in traffic sector.*
- *The melting point of aluminium oxide is about 1926 C, and of pure aluminium is 660 C.*

In engineering, information contains a group of techniques to assist organization's activities. "Information engineering is a set of formal techniques in which process models and data models are used to maintain data processing systems" [Kelly, 1997, page 61].

As technical integration process, it plays vital role for directing information system to assist unification of technical elements and to serve the process of integrated technical management systems constitution. It is necessary for the team members to do their work with right information about all issues of quality, environment and OH&S. It supplies what is essential for computer aided collection data centre CACDC and data modelling, and this information brings success to an organization. "The success of information products depends upon understanding who will use them and how they will be used" [Orna, 2001, page304-305].

The dimensions of quality and safety of information are accuracy, quick processing, communication, completeness, accessibility, compatibility, security and validity. But the experiences of the team members and their level of usage will play a huge role in successful establishment of an information system in the organization. "Research in the last 20 years has shown that the key factor of information system design failure or success lies in user participation" [Zhu, 2001].

7.2 Data of the "ITMS"

Data is a collection of processing facts, observations or in formations which are related to a particular question or problem, such as:

- *The technical data shows the increased quality of resistance of steel fabrication during two months of operation.*
- *The engineering tests show that the cracking of aluminium-magnesium alloy welds decreases as the magnesium content of the weld increases above 2%.*
- *The OH&S data will show how the number of injuries is minimized after implementing an "ITMS" model and how losses have been decreased since six months.*

Data represent instructions in a formalized manner for communication and interpretation of its processing by humans with other technological means such as computers, networks, medical devices, laser, electronic and mechanical measurement and liquid crystal display LCD screen. The data representation will be in the form of curves, numbers, words, text, symbols, analog quantities or other meaningful assignments.

7.3 Comparison between Product, Data and Information

The information is the data that has been processed for a purpose. "Data and information are often used synonymously in the literature and practice. Managers intuitively differentiate between information and data, and describe information as data which has been processed" [Wang, 2001, page 2]. The data would be a record, images, sounds, accident and a fact, but the information is a study, experience or instruction in departments and divisions of the organization.

Table 7.1 illustrates the comparison between product, data and information, and compares them with reference to computer-aided collection data centre CACDC. The raw data enters the system and is converted into information through formatting and summarizing. CACDC receives desired raw data, and then makes the actual data that would be needed for technical integration process and its operation.

Comparison between Product, Data and Information			
Three aspects	Product manufacturing	Information Manufacturing	Balancing with "ITMS"
Input	Raw materials	Raw data	Desired or raw data
Process	Manufacturing line	Information system	CACDC
Output	Physical Products	Information Products	Actual data or information product

Table 7.1 *Comparison between Product, Data and Information*

7.4 Computer-Aided Collection Data Centre (CACDC)

The computer-aided collection data centre is the central computer network in the organization to manage, control and organize data relating to integrated technical management systems for quality, environment and OH&S throughout all departments and divisions. CACDC has many roles in executing its goals, following are descriptions of these roles:

As a centre: The computer-aided collection data centre (CACDC) is the main computer centre for collection actual data in an organization for the purpose of implementing and operating an integrated technical management system. It is a central computer centre which collects stores and processes data about "ITMS". The centre has connected computers and works as a network.

Figure 7.1 represents the operational relations of installed CACDC in the organization, it shows both internal and external inputs to the system's network in order to achieve its tasks. The information and data are received and delivered by those sides which are involved with the centre.

As a function: The computer-aided collection data (CACD) is a process and action of collecting actual data and information, and grouping their objectives in order to be processed, worked, seen, studied, documented and kept together. As concerned with the "ITMS" operation, the computer-aided collection data centre's function is collection, formation and analysis of data and information, which is related to technical elements, QMS, EMS, OH&S-MS, in order to achieve their objectives and targets.

As a data mart: One aspect of database (or collection of databases) is that it is designed to help managers make strategic decisions about their businesses on the quality of products, environmental protection and OH&S performance. Some of data marts are called dependent data marts which are subsets of larger data warehouses, whereas a data warehouse combines databases of organization's all departments and divisions. Sometimes the single-purpose data warehouse is referred to as data-mart, which is usually smaller and focuses on a particular subject of the technical integration process.

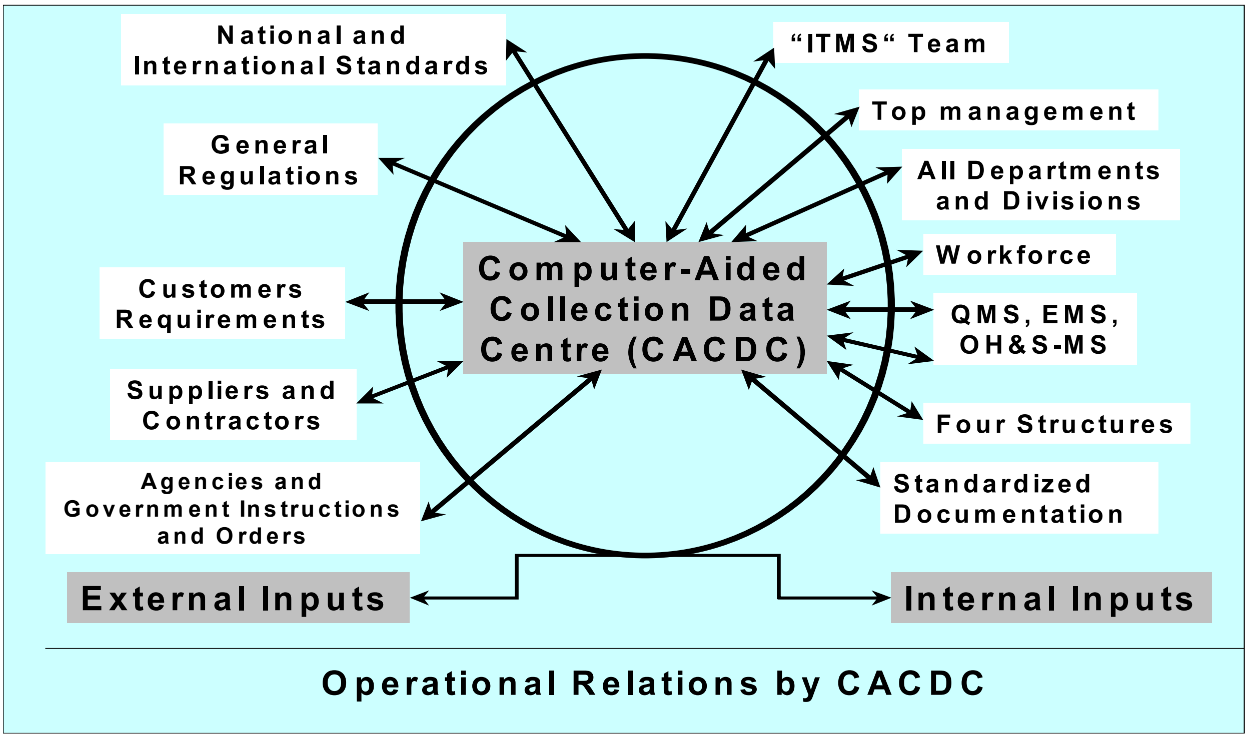


Figure 7.1 *Operational Relations by CACDC*

As a data warehouse: The CACDC as a data warehouse is a collection of technologies aimed at enabling the knowledge of workforce to make better and faster operations and decisions at the same time in different locations. A data warehouse is simply a pool of integrated and enriched corporate data which can be used as database server for members of the "ITMS" team and other technicians in departments.

As a data mining: Data mining is the process of analyzing data from different perspectives and all concerned issues and summarizing it into useful information. Data mining is the process of finding correlations among dozens of fields in a large database. It is used today by organizations with a strong focus on customer requirements and satisfaction, product marketing and financial issues. It enables organizations to determine the relationship between internal and external components of product quality, skills by workforce and cost of production, external economic indicators that have relationship with internal products, worldwide competition and cooperation with agencies, authorities and others.

As a database: A database is a collection of information organized in such a way that a computer programme can quickly select desired pieces of data. It could be an electronic filing system. Databases are organized by:

- *Field: a single piece of information.*
- *Record: one complete set of fields.*
- *File: a collection of records.*

This organization of data can be used as a type of data modelling as discussed in chapter 7.8.

For example, an equipment can be named as file, and each group of similar parts as record and each smaller part as field, this classification depends on the nature and complexity of the products and operations, and depends on the decision of technical staff. This type can assist how the data modelling is to be achieved as described in chapter 7.8. As the data modelling is essential for an organization's success. "The basis for the successful development of a complex system is the generation of a stable and practical data model" [Woll, 2000, page 95].

An alternative database design is known as hypertext. It is a special type of database system in which objects (text, picture, film, sound, etc.) can be linked to each other, that is when an object is selected, all other objects could be seen and linked to it, and could be moved from one object to another even if they have different forms.
It is useful for data modelling of the technical integration process, for example, in selecting the instructions of OH&S that is used in an organization. It could select (by clicking) the phrase of equipments of occupational health and safety, and by this clicking or selecting, various regulations and illustrations of the concerned matters should appear on the screen.

As a database management system (DBMS): It is a collection of programs that enable organizations to enter, store and organize data in a database, and modify, select and extract information from it. The organizations need to have a database management system (DBMS).

The DBMS applications can be seen in:

- *computerized library systems (library organization).*
- *computerized parts inventory systems (logistic firms).*
- *services of flight reservation systems (service enterprise).*
- *automated bank teller machines (banking service).*
- *computer-aided collection data centre (CACDC).*

In all cases the CACDC will take duty of presenting the right data that is to be used in the organization. **Figure 7.2** represents CACDC right decision arrangement which shows that right data and information should be placed on right place for the right time, it used by "ITMS" team (constitutor, managers, implementer, etc.) for better, faster and stronger "ITMS" operation.

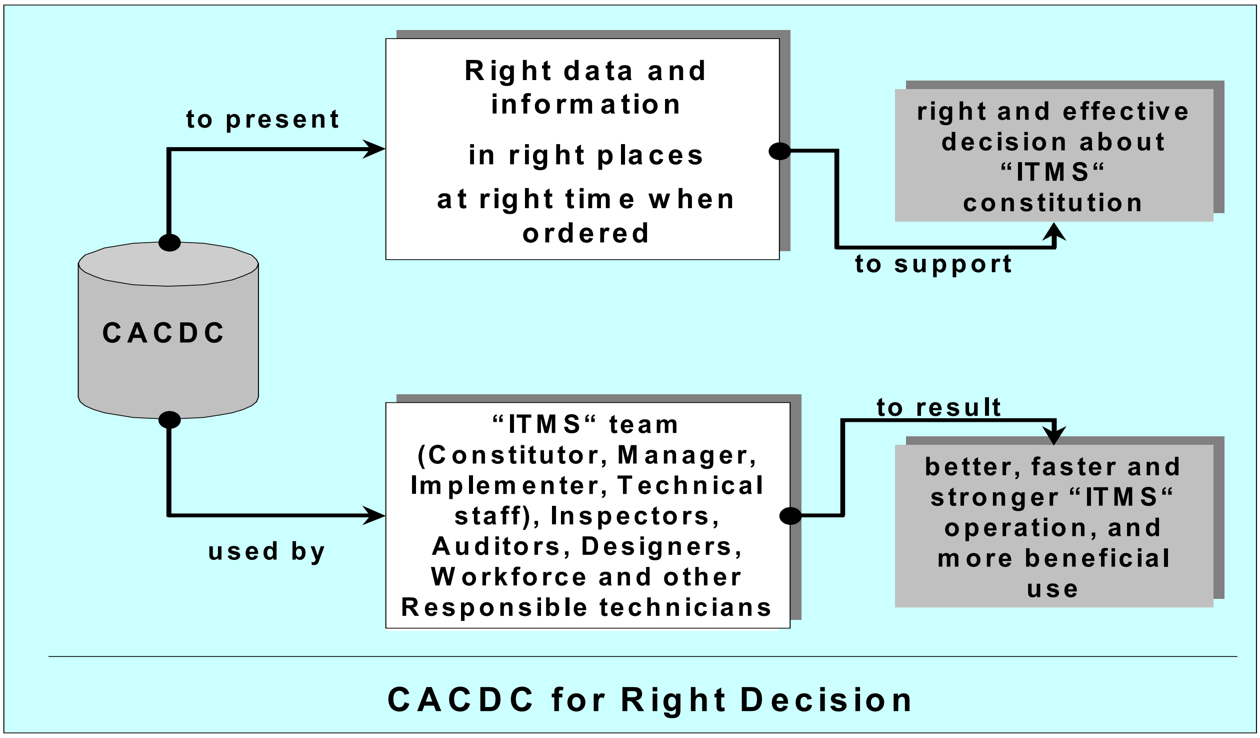


Figure 7.2 *CACDC for Right Decision and better "ITMS" Operation*

7.5 Functional Requirements

CACDC has some functional requirements as it makes planning, programmes and draws its activity and functions, in order to achieve its purposes. As general technical specifications, computer-aided collection data employs modern technology consisting of software and hardware that are relevant to be used for integrated technical management systems.

The functional requirements are described by technical specifications that should be met in order to achieve high quality of the centre in dealing with those that are needed by managing and directing of the "ITMS". Its application compasses all functional and operational requirements. "The specific requirements of data base application are functional and operational requirements" [Atkinson, 2000, page 299].
In relation to "ITMS" data and information, CACDC should have these functions:

- Partition files: partitioning of files into separated segments and processing each segmented file independently as names, functions, processes, connections, specifications and so on.
- Files evacuation: able to listen, view, transform file into text, copy, print, save and edit.
- Saving and indexing: the data can be indexed in relevant database, sourced, dated, modified, selected and saved, and formatted into new fields.
- Search and recall: the system should provide auto search process for any data and information through specifying their format, title, area, technical element or any group of their fields, including the new installed files formats and their related fields.
- Exchange files among users: the system must ensure the capability of exchanging files among users (all members and departments), so that a user can send the file to another user or to a group of users, and between managers, technicians and departments. The process of exchanging files should be performed on the basis of sending a copy of the file, therefore any modification or repairing a file will not affect the original one by the manager or CACDC.
- Streaming the files to the network: the system should sponsor the faculty of transmitting the files to the network where the users can read, listen and view them at the same time receiving these messages, which can be restored and recalled by the centre management.
- Programming the departments: the system must ensure the possibility of programming the departments so that it is possible to control, modify, select, order, record and repair data and information and any files in all departments.
- Security in the system: the system should include the installation of different levels of security in the system and connecting each user with one of these levels. Safety of CACDC requires that the data should be adequately protected against accident and corruption, and the relative merits of various forms of protection must be set up.
- The quality requirements of data inside CACDC should be strong, accurate and can be processed. The data should have the quality specification of: correctness (satisfies its specification and fulfils the system objectives and targets, reliability (performs its intended function with required accuracy), efficiency (resources and codes required should perform the planned function), integrity (the data cannot be controlled by unauthorized persons), usability (the degrees of operation and preparation are high), maintainability (the degrees of repair of failures and errors is high), flexibility (the degree of modification of an operation is high), testability (the degree of an intended function's performance is high) and portability (the degree of transfer programs within software and hardware system environment is high).

7.6 Establishing a Networked Computer Centre

7.6.1 Elements of a Computer Centre

The computer centre has several elements for its operation, as the personal computer used by members of the centre and other technicians in departments in order to send and receive data. Input is any data that enters into a computer system. An output is any information that comes out from a computer or CACDC network; it can be meaningful information in the form of numbers, characters and printed pages. An object is any item that can be individually selected and manipulated, this can be shapes and pictures that appear on a display screen. A file is a collection of data or information that has a name, called the filename, the computer stores all kinds of data in files. Folder or directory is a logical organization of related files; the folders are organized in a hierarchical structure for efficient management of data files inside them. A report is a formatted and organized presentation of data, most database management systems include a report writer that enables one to design and generate reports. A computer programme is an organized list of instructions; it contains a list of ingredients called variables which represent numeric data, text or graphical images, and a list of directions called statements that tell the computer what to do with those variables.

7.6.2 Organization of Networked Computer Centre

A computer network is two or more computers that are connected together to share software and hardware resources. Computers over a network can communicate with each other. Computer networks can be categorized on the basis of range, network topology and functions. **Figure 7.3** shows the main categories of computer networking. The organization of networked computer centre will be designed by the range and network topology:

By the Range:

By the range, a computer network can be designed by following types:

a) Personal Area Network (PAN)

Personal area network (PAN) is a computer network used for communication among computer devices (including telephones and personal digital assistants) close to one person. It uses short-range radio communication. The devices may or may not belong to the person in question. The range of a PAN is typically a few meters and is usually suitable for a range up to ten meters. Personal Area Networks can be designed in public places, homes and offices (service industry), and even in a car (by technical representatives for after sale services), and could be used in the rooms of engineers, technicians, auditors, inspectors, etc. (those are working in “ITMS” operation) and as regarding with their jobs inside an organization.

b) Local Area Network (LAN)

A local area network or LAN is a computer network covering a local area, such as a small firm, hospital or administration circle. Most LANs are restricted to a single building or group of buildings. The wireless technologies are starting to evolve and are convenient for mobile computer users. A wireless LAN or WLAN is a wireless local area network that uses radio waves as its carrier. This type of network is suitable for computers located within a single building such as a large office or a university computer lab or library, or a firm containing several departments of production and assembly and other divisions as marketing, general relations, and so on. The connection between CACDC with departments (production 1, production 2, assembly 1, assembly 2, etc.) may be done by star topology network, the same thing is true also about connecting CACDC with various divisions (financial, human resource, material storing, etc.).

c) Metropolitan Area Network (MAN)

Metropolitan area networks or MAN´s are large computer networks usually spanning a campus or a city. For instance a university or college may have a MAN that joins together many of their local area networks situated around a several hectare site. It is similar to (LAN) but it will be larger in size and number of devices.
This type of networking is used for organizations having several far away production and service places in one city or one region, they could be connected by MAN, such as industrial organization and banking services. The connection could be executed either by Internet network or by wireless system, or by use of both of them.

d) Wide Area Network (WAN)

A wide area network or WAN is a computer network covering multiple buildings, often across the world, and the best example of a WAN is the Internet. The WANs are used to connect local area networks together so that users and computers in one location can communicate with users and computers in other locations. Many WANs are built for one particular organization and built by Internet service providers that provide connections from an organization's LAN to the Internet.
This type of network is used between two cities or two locations that have large distance between them, such a company has two or more production locations in two or

more far away cities and they should have interrelations in regarding with production and services, and in relation with subjects of quality, environment and OH&S. The connection can be executed either by Internet or by wireless system, or by both. The internet network uses an evolving system of World Wide Web. “The World Wide Web is an evolving system for publishing and accessing resources and services across the internet” [Coulouris, 2002, page 9].

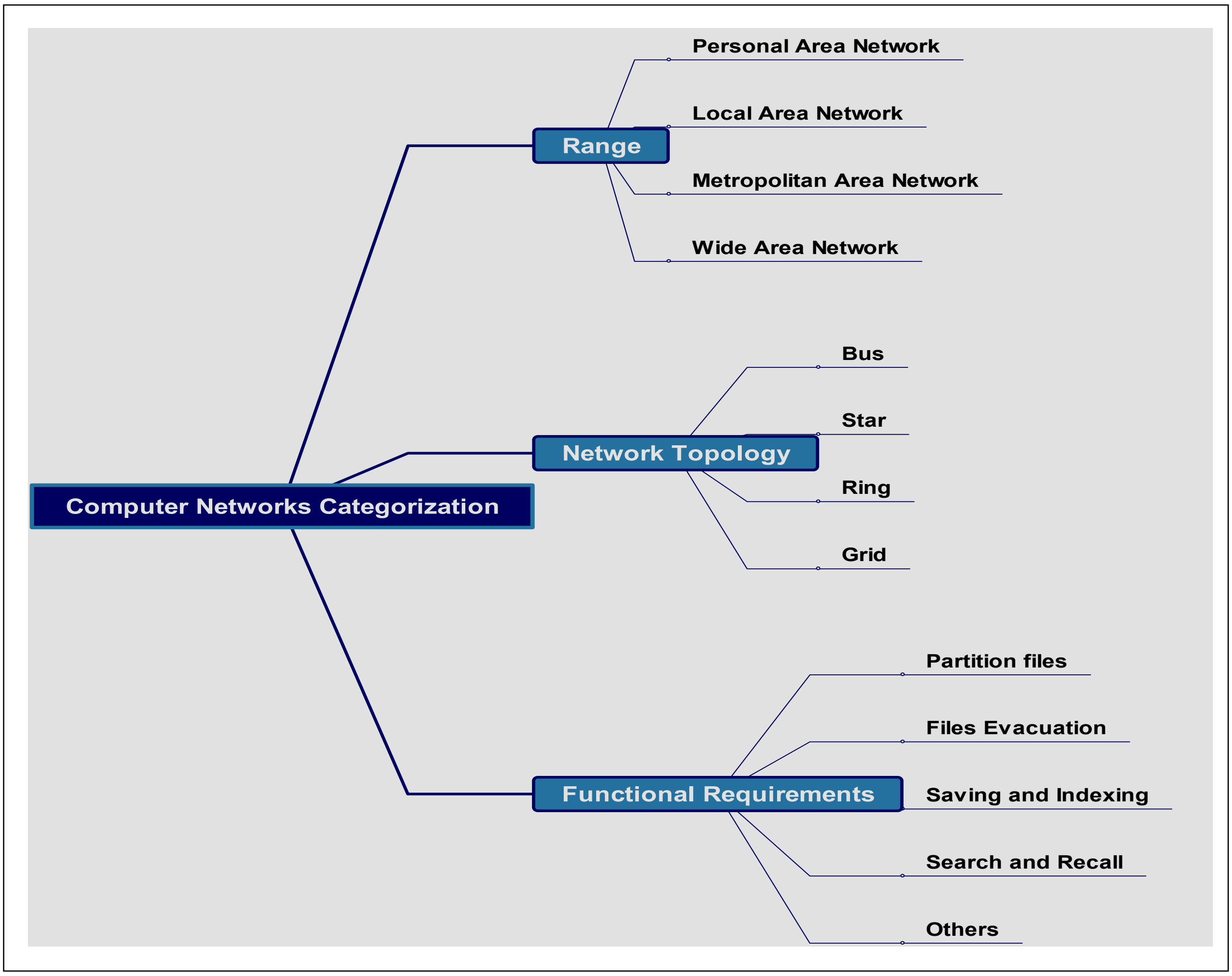


Figure 7.3 *Computer Networks Categorization of “ITMS*

By Network Topology:

The network topology is the physical and logical arrangement of interconnections among network stations. [Wikipedia, 2005]. There are some possibilities of network design such as bus, star, ring and grid. It should be mentioned that choosing any type of them is decided by the administrator and the organization that needs to design a network. All of these approaches have certain advantages or disadvantages in using any of them, an organization may implement one or more of these types in their network depending upon various factors:

a) Bus

A bus network is a network architecture in which clients are connected via a shared communications line. Bus networks are the simplest way to connect multiple clients, but often have problems when two clients want to communicate at the same time on the same bus. Bus architecture is generally used only on local area networks and is most suitable for computers located inside a single room.

b) Star

A computer network with a star network topology, in its simplest form, consists of one central or hub computer which acts as a router (a computer networking device) to transmit messages between connected computers by a store-and-forward or switching system. The hierarchical state of the star topology allows each node to be connected to a hub and offers centralized resources and management because each computer is connected to a central point. But if the central point fails, the entire network goes down, but if one or more computers stop communicating, the rest of network still works and is independent of functioning of individual computers. An illustration of bus and star network topology is shown in **Figure 7.4**.

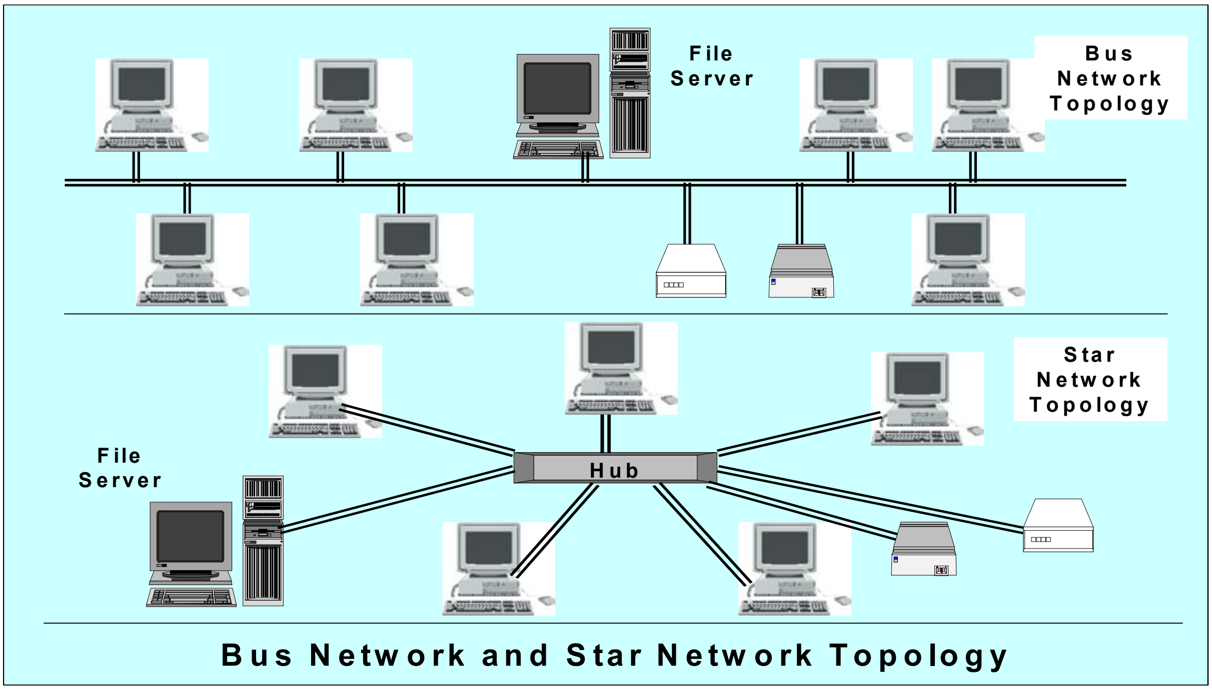


Figure 7.4 *Network Topologies used in “ITMS"*

c) Ring

A ring network is a topology of computer networks where each user is connected to two other users. Ring networks tend to be inefficient when compared to client/server networks because data must travel through more points before reaching its destination. If one computer stops communicating on the network, the whole network crashes.

d) Grid

"A grid network is a kind of computer network consisting of a number of computer systems connected in a grid topology. In a regular grid topology, each node in the network is connected with two neighbours along one or more dimensions." and the chain of nodes is connected to form a circular loop, the resulting topology is known as a grid.

Most of the identifications between 7.6.2 and 7.6.2 d) were referenced from [Wikipedia, 2005].

7.6.3 Choice of a Strategy for CACDC

The choice of implementing a computer network for the computer-aided collection data centre depends upon various factors. A particular choice between types of network or topology has associated advantages and disadvantages. Cost, size/volume, speed, efficiency, reliability and maintainability are various factors which govern a particular choice. It depends upon type and size of the organization. An example of CACDC network is shown in **Figure 7.5** that the centre is connected with small networks in overall needed departments of the organization.

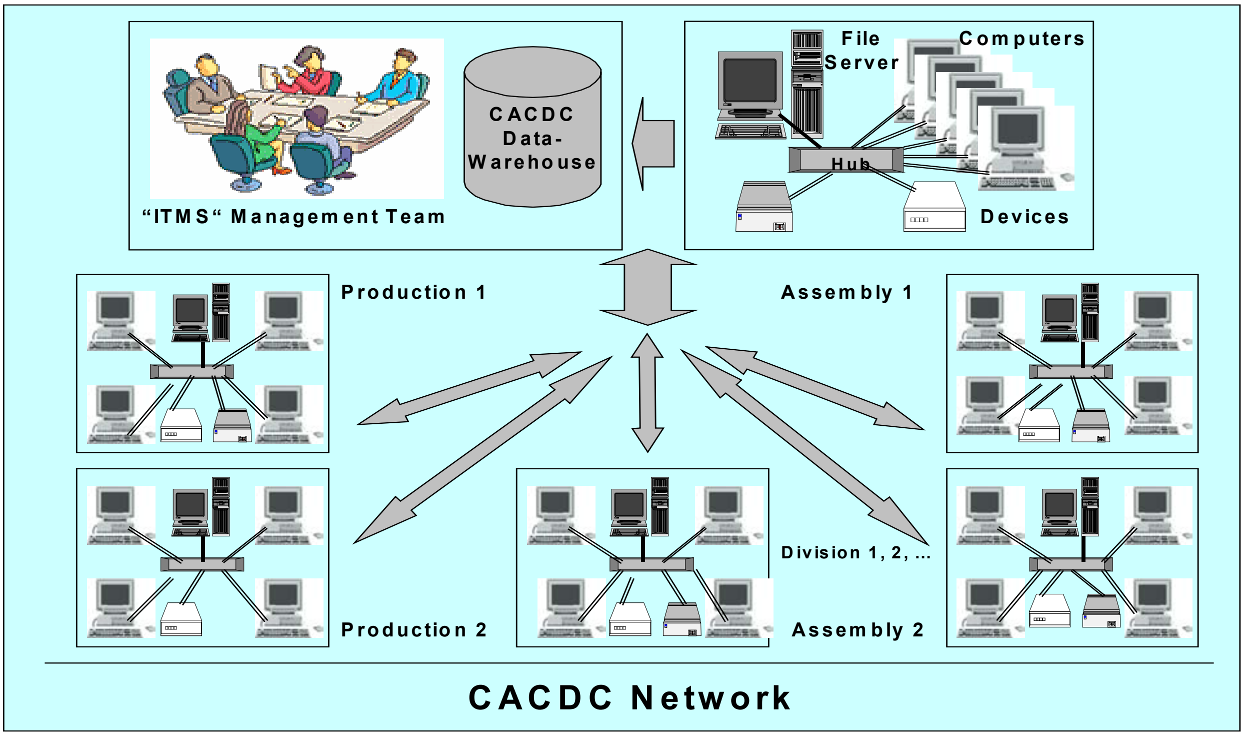


Figure 7.5 *CACDC Network*

7.7 Why CACDC?

Through an established CACDC, the standards can be imposed in overall operations and manufactured products, because it streams and distributes NS, IS and GR to whom they are required. This leads to improve the overall objectives and targets of quality, environmental protection and OH&S performance, and results to confirm to customer requirements. "Empirical investigation provides strong evidence of a positive relationship between use of electronic data interchange (EDI) and improved customer service" [Lim, 2001, page 209].

The purpose of building a CACDC is to serve the "ITMS" constitution and its operation by achievement of rapid distribution, transformation and movement of the actual data and information inside and outside an organization, and to be received and provided just in time with effective cost and higher quality. It deals with the distribution and movement of data and information inside the organization between departments and members effectively in order to achieve the goals of unified technical elements and integrated management systems.

Here, the circulation is a systematic process in which the data are distributed and changed, and it identifies the shape and ways of movement. The purpose is to make effective formal connection between the centre and ISO, NSO and GR, agencies, gov-

ernment, associations and institutes, and also between customers' ideas and requirements with the team of "ITMS" for more improvement**.**
On the other hand, the CACDC will operate and manage the designed data modelling within its structure that gives the successful development for the organization. "The basis for the successful development of a complex system is the generation of a stable and practical data model" [Woll, 2000, page 95].

Another purpose is to make rapid decisions i.e. decisions should be taken just in time that are required for various operations and processes those concerned with the three areas. For example, in happening of accidents the decision should be made quickly for required product quality for conforming to the market needs, and reengineering an operation without cost losses, and so on.

7.8 Modelling of Data

Modelling of data is the analysis and design of the information in a system, concentrating on the logical entities and the dependencies between these entities. Data modelling is an abstraction activity in which the values of individual data can be observed by designing structures, relationships, names and format of the data.
The data should be accurately gathered in CACDC, and this data is then modelled according to:

- specifications
- affect on quality, environment and OH&S

The data modelling process uses a data model which constructs and forms the description and specifications of the data structure of "ITMS" handled by a database application in the CACDC.

7.8.1 Why Data Modelling

Modelling summarizes the data to its purposes and the right places in an organization to be more understandable by team members, technical staff and other workers. The biggest advantage of data modelling is drawing of accurate explanation of products, sequence operations, and technical integration process. "The advantages of the method of modelling are clear representation of the sequence of functions, product and resources" [Woll, 2004, page 153].

The data modelling helps in communicating requirements among team, user, customer and any other internal and external parties. It gives the main representation to enable technicians to achieve planned quality, environmental aspects preservation and OH&S performance.

Modelling of data in the “ITMS” constitution is vital, because it makes the system easier to understand, and simplifies procedures of the constitution process. It is necessary to perform data modelling and separating data to its components, because without it, the system may get false data which leads to an unsuccessful integrated management systems. “Data without dispersion information are false data" [Foster, 2001, page 46].

The data modelling enables designers and manufacturers to develop products and services, and assists an organization in several ways:

- shows more details about three areas and stores overall information of integrated technical management process.
- shows more details in using four structures.
- provides a transactional mechanism to control revised information.
- indicates failures, weak points and gaps (what, where, how).

7.8.2 Modelling Action

Modelling action is an organizational and functional structure of data, an arrangement to show them in adequate way and manage them effectively. The process is achieved by making groups and classes of data and building specific forms of know-how, and can be performed by organizing data into several structures such as naming, sorting, indexing and grouping. The classification can be done in such a way that fulfils all their meanings in implementation and operation. “Different methods of classification are based on the five stages: specification, design and implementation, installation and commissioning, operation and maintenance” [Kletz, 1995, page 5].

Data modelling can be achieved in depending on some principles, as discussed in previous chapters they can be used as structure of the data modelling. As following:

- Chapter 6: (Section 6.3, Figure 6.3, Figure 6.4, Figure 6.5, Figure 6.6).
- Chapter 7.4: under “Database”

7.8.3 Examples of Data Modelling

Examples in an organization of material testing are testing of automobile engines parts in automobile industry, asphalt testing and concrete testing, and in order to know the quality requirement of the asphalt (used for road construction) and quality concrete (used in building construction) as their quality level is connected with environmental protection and occupational health and safety, data modelling is offered for their equipments for assuring their preparation and achieving inspection in a suitable manner. The use of data modelling brings effective process, more accurate operation and higher safety, it leads organization not to neglect any part of the testing and not omitting any component, and in addition it helps in filling gaps and repairing backwards.

Data modelling can be applied to any organization or part of it. **Figure 7.6** represents the data modelling in a car industry for its engine parts (cylinder head, gasket, valve, crankcase, filter, etc.). In this case the data modelling should be in such a way in the computer centre that the data can be selected, deleted, added or retrieved at any time when needed and we can use this data modelling for making each part, removing gaps, making compliance between parts, for supply and sale and other aims.

Another example of data modelling is shown in **Fig 7.7** which is about concrete testing equipment, in which we must keep the records of various tests which we will carry out along with its optimum values, and arrange this data base in such a way that the retrieval of data becomes easy, faster and more useable. Another example which is shown in **Fig 7.8** is about the data modelling of asphalt testing equipments, it is clear from the figure that which tests we have to perform during our data base management and under each test which parameters vary. This leads us not to forget any test and equipment in order to confirm total high quality level which assures the long life of product (concrete, roads) due to which the accidents will decrease either on roads or due to collapse of buildings which consequently results in saving people's life and increases the occupational health level.

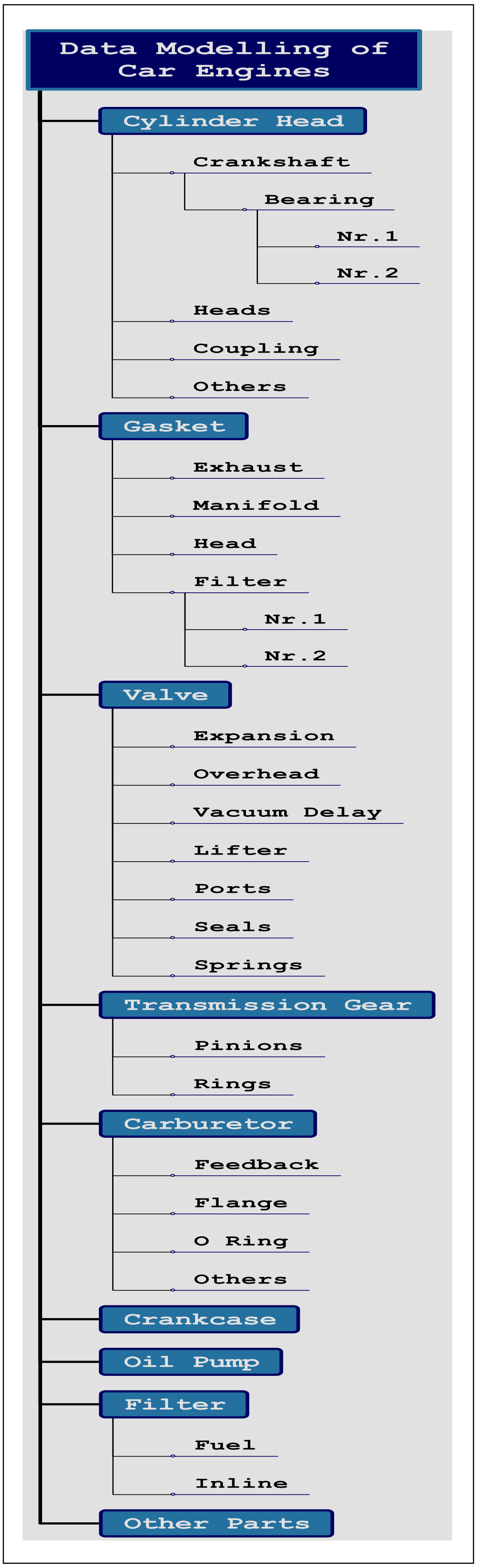
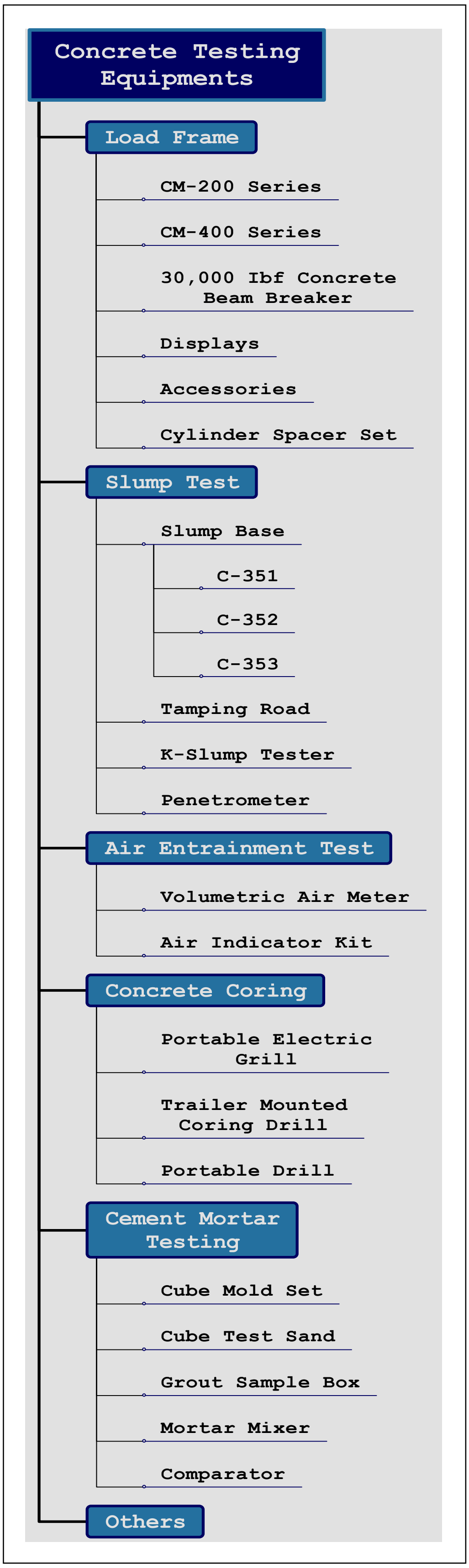


Figure 7.6 *Data Modelling of Car Engine Parts*



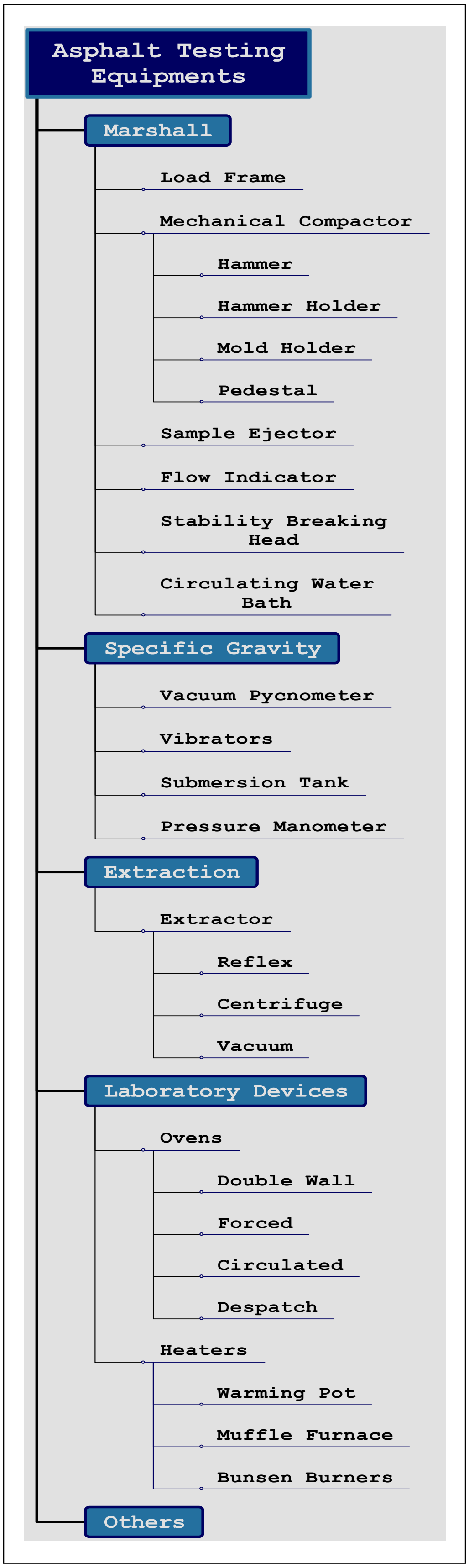


Figure 7.7 *Data Modelling for Equipments of Concrete Testing*
Figure 7.8 *Data Modelling for Equipments of Asphalt Testing*

Chapter 8- Success Concepts, Auditing and Evaluation

8.1 Introduction

This chapter tells how the technical integration process can be successfully achieved and how success concepts including all the procedures of "ITMS" constitution are adapted and implemented and also checks the implementation level of these procedures termed as "auditing and evaluation". It will be checked during auditing how the various procedures vary from the defined constitution process, and on the basis of auditing we will perform continual improvement till we achieve the planned objectives or targets. But for better continual improvement we need to perform periodic evaluation, because this will be the only way on basis of which we will do our continual improvement in a successful way. This is clear from the "ITMS" cycle in **Figure 8.1**. In general the "ITMS" can be considered as a new successful system if the objectives and targets of high level of quality, environmental protection and OH&S performance are achieved accurately and can be implemented correctly and the gaps are filled. The degree of success is increases if all departments, structures and their portions implement "ITMS".

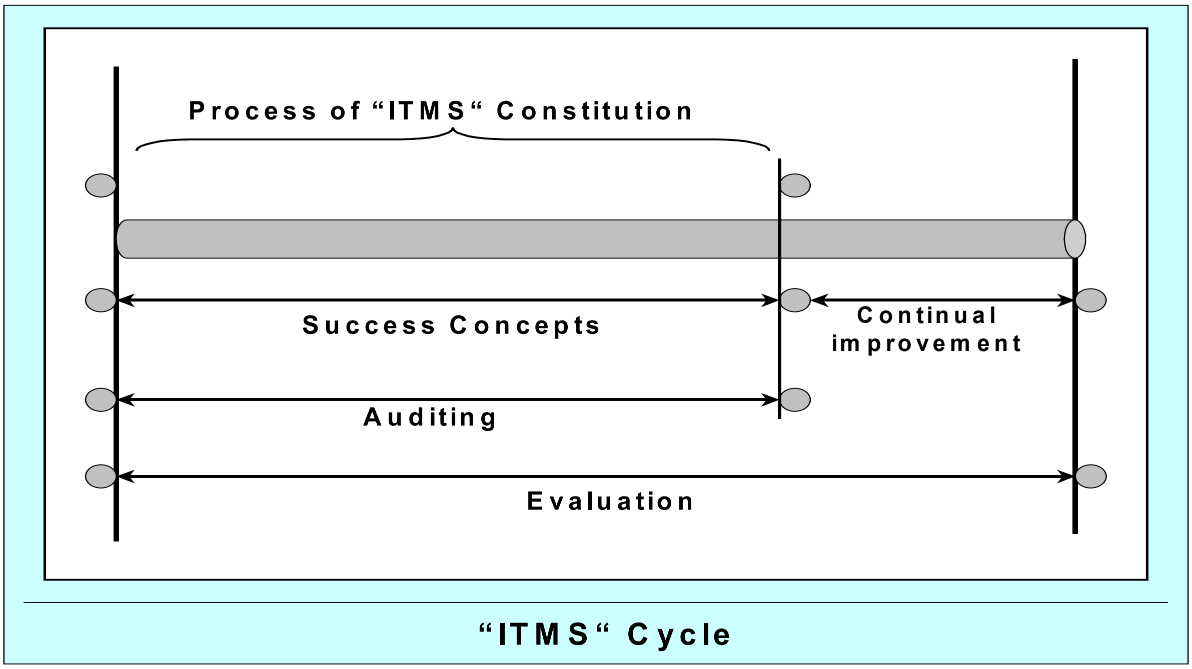


Figure 8.1 *"ITMS" Cycle*

The detailed “ITMS” cycle is shown in **Figure 8.2**. It shows the tasks which must be performed under success concepts, auditing and evaluation. It also shows the different stages of technical integration success concepts, auditing and evaluation, the procedures of “ITMS” constitution that must be taken into account for its perfection such as technical compliance and balancing, equilibrium among related technical activities and finally the criteria of performance-cost-time. These concepts take a vital role in bringing constitution process of a technical integration into the success state. The procedures, as steps of constitution, must be strengthened by these concepts because without them, the base of the process is weak.

All these procedures and concepts should be audited and evaluated in accordance with standards and their methods. For more confirmation, the operations should be performed in the way as they are described during technical integration or inserted into the practical situation and must be audited and evaluated at the time of working. The constitution and operation of “ITMS” must be followed by permanent process of continual improvement by using related methods and tools and must be audited and evaluated.
When the completion of one turn of the cycle flows into the beginning of the next, following the spirit of continuous “ITMS” improvement, the process can always be reanalyzed and a new test of change can begin. This continuous cycle of change can be represented as the ramp improvement for each procedure steps and “ITMS”´s implementation.

The description of inter processes of the “PDCA” cycle (Plan-Do-Check-Act) can be described as follows: Plan (identify the problems and analyze them, and develop an implementation plan). Do (develop solutions, implement correction actions, document the procedures, and use data-gathering tools). Check (evaluates the results, analyze information, monitor trends, and compare obtained results against expected results from the plan). Act (standardize the solutions, if the result are as expected do nothing and if it is not so repeat the plan-do-check cycle, do again the documentation of the processes and revise the plan).

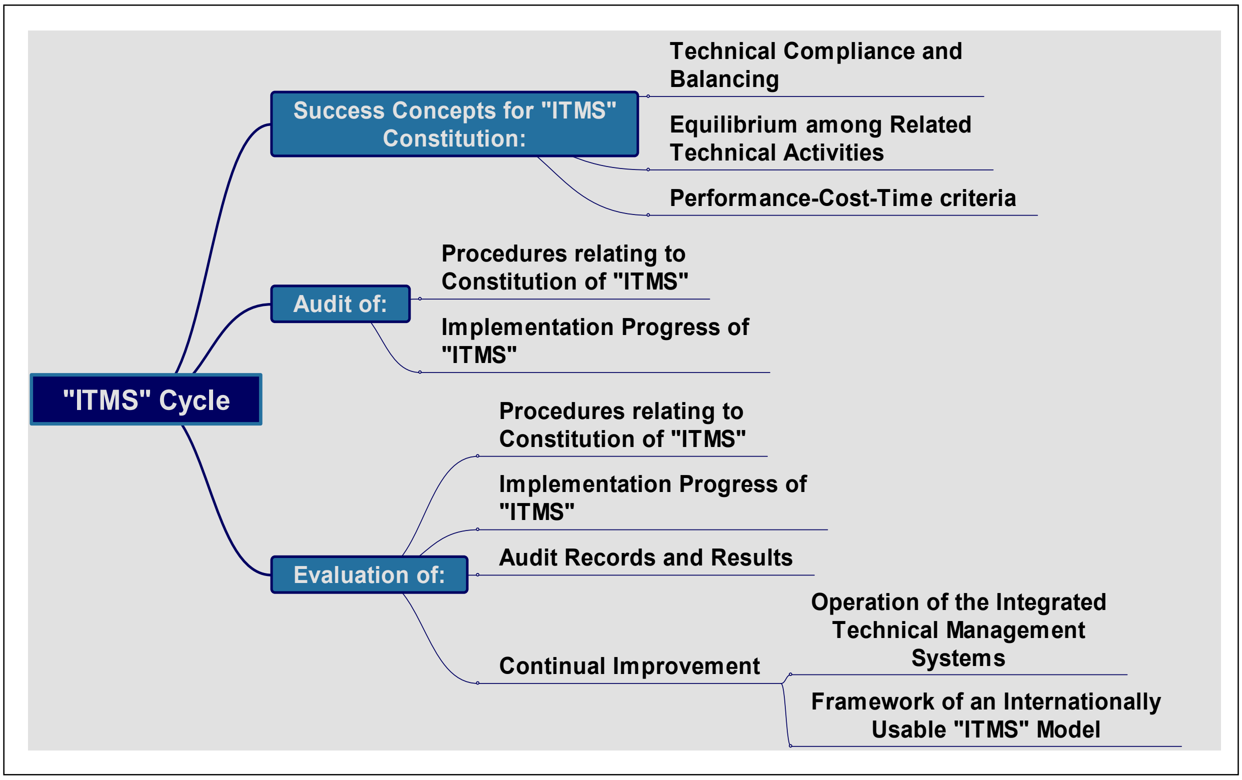


Figure 8.2 *Detailed "ITMS" Cycle*

8.2 Success Concepts for "ITMS" Constitution

8.2.1 Technical Compliance and Balancing

Technical compliance and balancing is a concept concerned to processes, operations, products and services, the sum of conformity and suitability between those articles (shown in **Figure 8.3**) and the relation between them. To understand this concept, the technical compliance must be achieved if an activity is agreed upon:

- Planned objectives and goals.
- Unified policy that represents all three areas policy.

The compliance occurs when the state would be according to the context of the national and international standards and follows all regulations, codes, laws, rules and guidance; the state must be reached by the right method and achieved at the right cost and at the right time. Another identification of technical compliance is the action in accordance with other's needs and requirements such as customers, society, environmental agencies instructions and others. "The compliance is the act in accordance with other's wishes, like those of customers, public, environmental agencies and government's command, and it acts according to certain accepted standards" [wordreference, 2004]. The same meaning is illustrated by other associations. "According to the American Heritage Dictionary, third edition, the compliance is the act of complying with a wish, request or demand" [UAMS, 2004].

Non-compliance is the state opposite to this technical compliance and it could be estimated as failure in products or in occupational health and safety which leads to large losses. "125,000 people lose their lives each year due to non-compliance and the total price of non-compliance in one year is $100 billion" [UAMS, 2004].

As an illustration of technical compliance and balancing in operational tasks of computer systems, it would mean here that the system stores, collects data and displays it accurately, clearly and efficiently. Non-compliance in its manufactured hardware will generate bad or incorrect data.

As a wide-scale application of technical compliance and balancing in design and manufacturing is necessary and required in order to gain more quality and environmental protection. "In a case study of engines for passenger cars and trucks, the achievement of low fuel consumption requires low weight combination of silicon-aluminium sleeves in a cast aluminium alloy block" [ImechE, 1999, page 5].

But the technical compliance is also connected with many other requirements of customers, costs and design specifications in order to gain more success in three areas. "A balance must be struck between technical boundaries, economic needs and consumer" [Schlabbach, 2001, page 84].

The principles of technical compliance and balancing should be audited and evaluated in all departments and divisions, and in four structures and their portions. Following this concept it should be inserted into manufacturing, assembly, producing, engineering specifications, designing, physical and chemical specifications, structural specifications, products and so on. It should be implemented into most parameters of products and services such as their size, volume, nature, composition, compound, colours, viscosity, resistance, packaging shape, measurements, etc. All these cases should be compliant and operated in balance for the achievement of objectives and targets.

Any odd situations should be removed, gaps should be filled, failures must be avoided, negative states and non-necessary parts in products must be removed because they affect others and lead to a defected final product. When this happens, the "ITMS" is defected, as explained in detail in chapter 5 under "Special rules". More technical compliance and balancing will bring more benefits and thus bring more success to technical integration for gaining its overall goals. The organization must make such programmes and use checklists for technical compliance and balancing achievement.

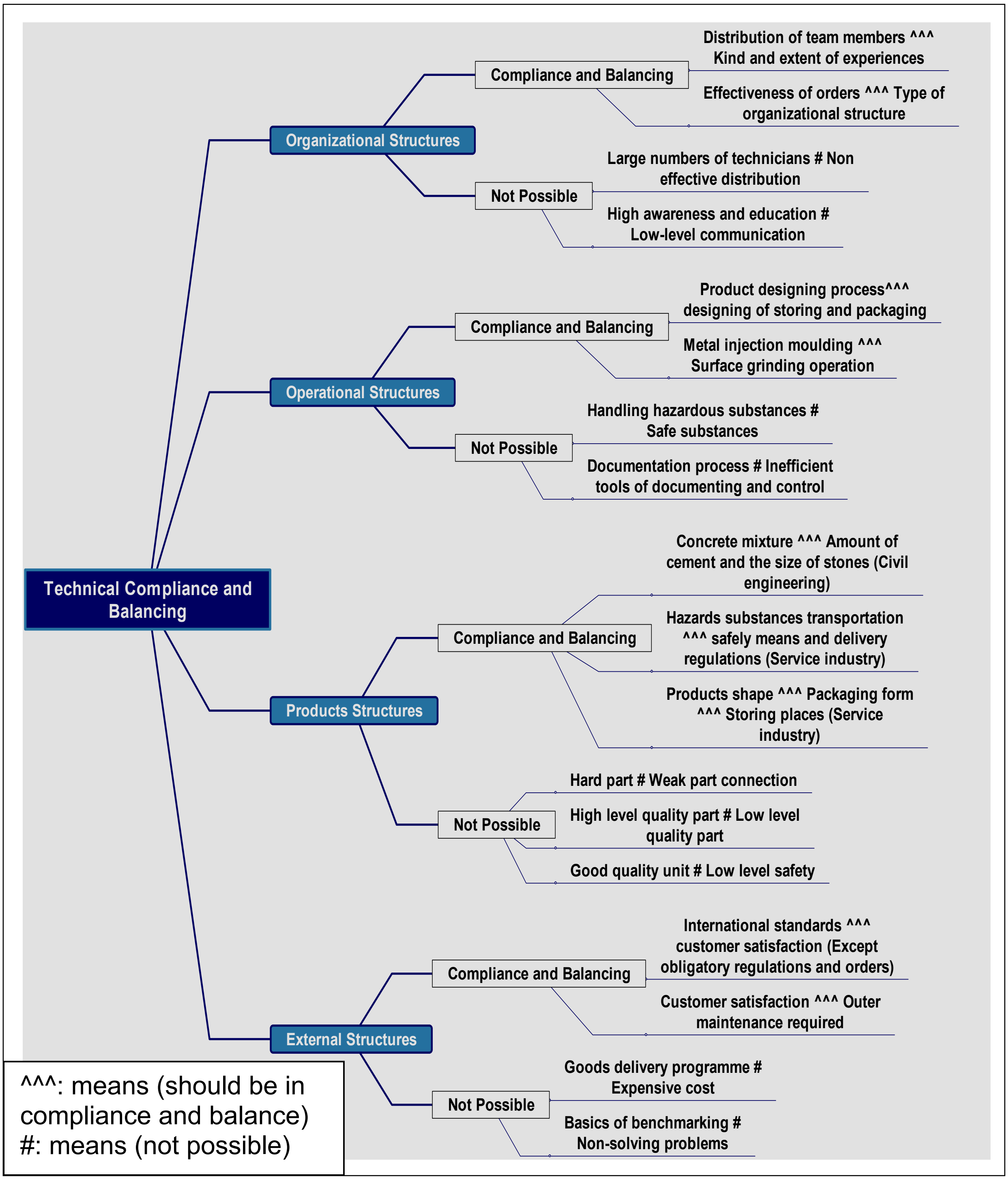


Figure 8.3 *Technical Compliance and Balancing*

8.2.2 Equilibrium among Related Technical Activities

Related technical activities RTA have vital roles as they are considered as one face of technical elements (chapter 1.4), and they are figured as one face of common elements of quality, environment and OH&S (chapter 3.11), and at the same time they exist as requirements and are mentioned in each of ISO 9001:2000, ISO 14001:2003, and OHSAS 18001:1999.

The equilibrium is the set of functions between two or more related technical activities, and it has to produce equivalent objects or states between articles of quality, environment and OH&S or between articles in one area only, and it also means to remove any non-compatibility or non-conformity between their working. As discussed in chapter 5 under “Technical cycle” that the technical cycle refers to irrefutable link of the interactions between the areas of quality, environment and OH&S on one hand, but on other side the technical equilibrium here refers also to indisputable interactions between requirements of three areas, which means it has vital advantages in both interactions.

Equilibrium among RTA makes them suitable and results in complete running processes without any states of intersection. In all cases it is one step of successful technical integration and facilitates its implementation and continual improvement.

In the production sectors and service industries, there should be equilibrium in operational manufacturing, among aspects of designing, testing, measuring, packaging, correcting, auditing, etc. for three areas of quality, environment and OH&S, because they are closely related to each other. They cannot be implemented alone and there is mutual independence between them, and each of these three areas must be integrated with other parts of the organization, such as safety cannot be operated alone without reflecting to every part. “Safety should be integrated throughout the company since the safety effort is involved with nearly every part of the organization at one time” [Lack, 2002, page 299]. The non-equilibrium between three areas of production and operations will increase the failures rate and decrease the quality, (like here between quality as failure and environment as temperature) “The experiences show that the failure rate of semiconductor components will double for an operating temperature increase of 10 C to 20 C” [Birolini, 1999, page 3]. The same is about the manufacturing of an auto engine. “In auto manufacturing engine, the design and production of an engine is focused on customer safety, quality and emissions” [King, 1999, page 65- 66].

These requirements are obligations on manufacturers to look for permanent equilibrium and running after the designs that insure the state according to rules and regulations of environmental preservation and user safety besides quality. For the better understanding of technical equilibrium, it must be known that any state effect by quality can disturb the environmental protection and safety, or any state effect by safety can be disturbed by quality and environment, and so on.

Figure 8.4 shows examples of equilibrium of related technical activities with referring to international standards that these elements must be taken as the state of equilibrium in order to make the technical integration successful, where as non-equilibrium state is defected in the three areas and cannot gain their objectives and targets. This equilibrium not only affects the "ITMS" but the overall organization's competency. The actions of assistance tools for standardization strengthen this concept as referred in chapter 6.6.

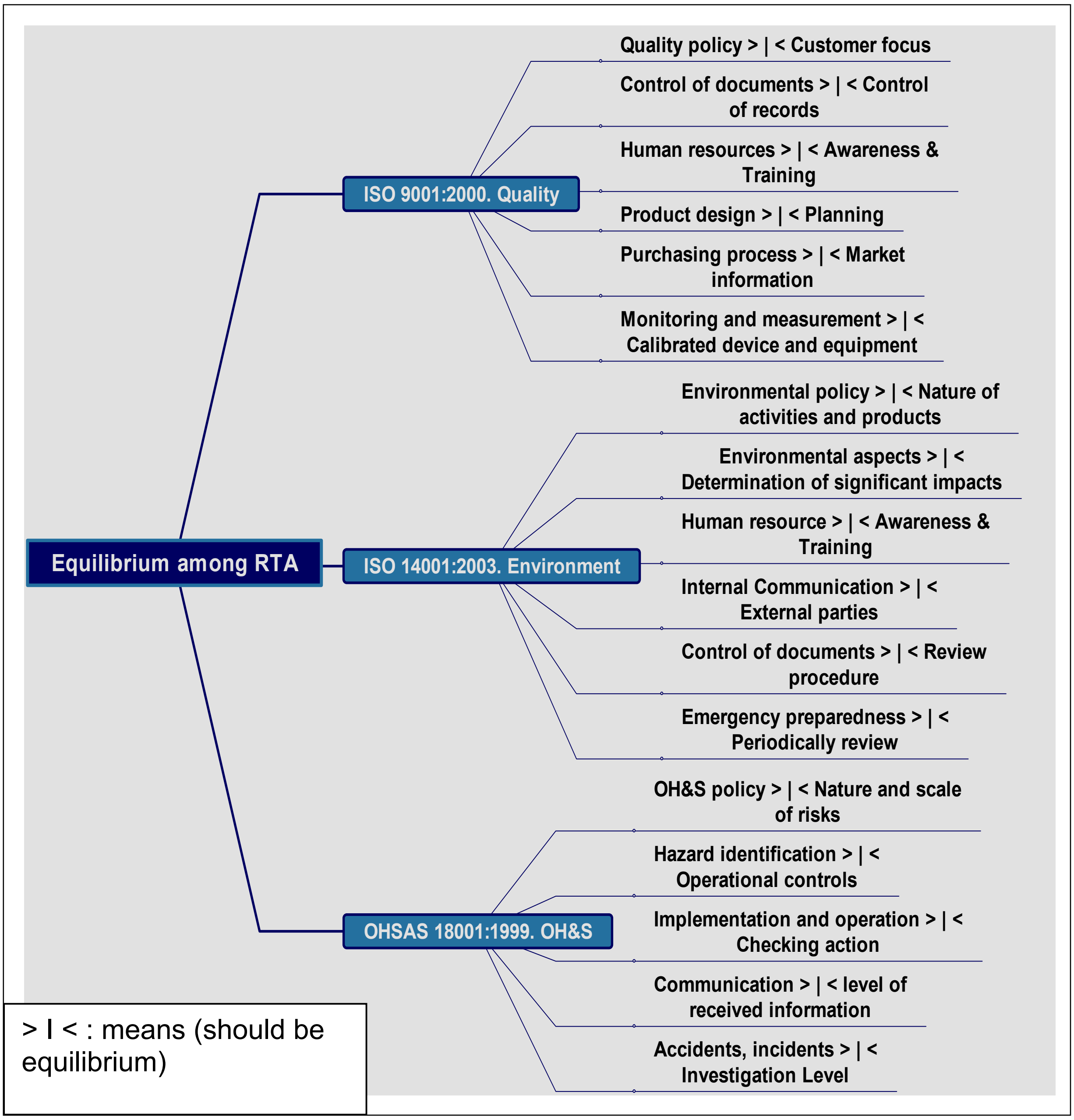


Figure 8.4 *Equilibrium among RTA*

8.2.3 Performance-Cost-Time (PCT) Criteria

8.2.3.1 What is PCT Criteria?

PCT criteria are uniform guidelines which can be processed, identified and acted as an indicator for goal achievement. Here the criterion is an interrelation of performance-cost-time. It analyzes three vital aspects of the “ITMS” as the performance of “ITMS” operation, the cost of “ITMS” constitution process and the time of “ITMS” implementation. **Figure 8.5** shows the PCT criteria.

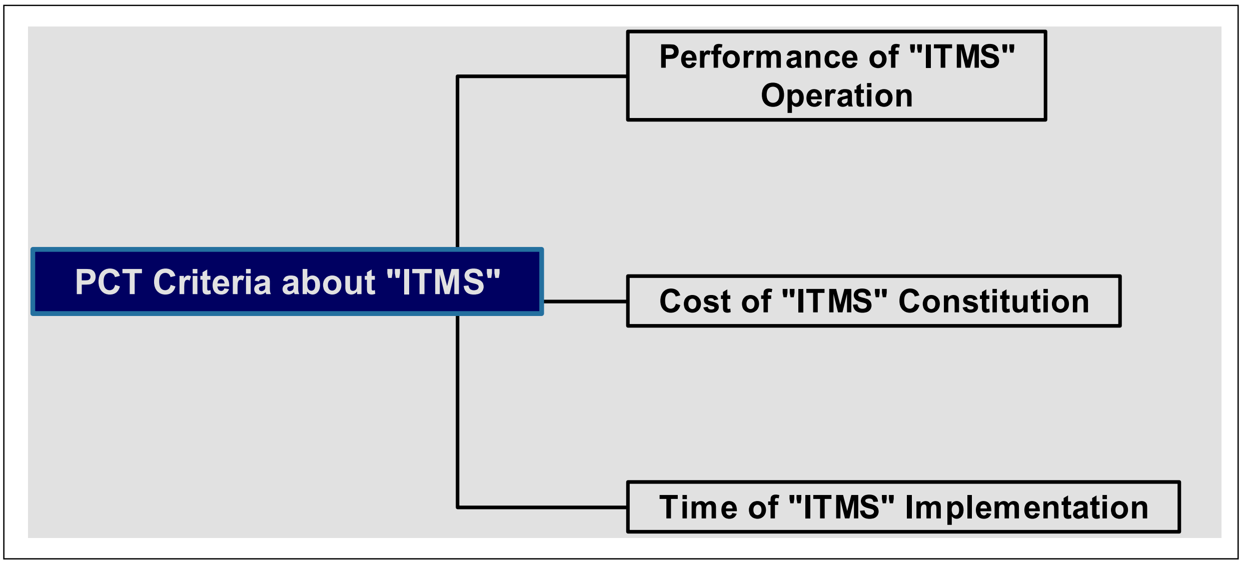


Figure 8.5 *PCT Criteria about "ITMS”*

In many previous studies the criterion is an interrelationship measurement triangle between quality, cost and time, but we can modify it to be as (performance, cost and time) criteria for the new constitution process of an “ITMS”.
The previous investigations and study cases have showed the strong interrelation of operating time with cost of production and service industry affect on the quality level, and consequently they have effect on the integrated technical management systems constitution process. The experiences showed that any reduction in time of an activity achievement in the organization relatively will lead to lower overall costs. “The reduction of 1 day in cycle time has been evaluated as a reduction in overall cost” [Bonal, 2001, page 11].

The time is an important factor for each of quality, environment, and OH&S, because it takes a great role as the time of:

- Production or operation.
- Delivery goods to customers.

- Environmental preservation by long life of the products.

The cost shows its large affects on the quality of overall operations in the organizations because the gaining cost will lead to higher research on quality, the loss will remove the ability in ongoing development and bringing a new technology. The loss of costs come from low level operation performance, low quality of produced goods, range of accidents and injuries and the rate of pollution to the environment. “The environmental protection agency EPA finds annual costs of air pollution control at $32 billion [Sunstein, 2002, page 23].
Therefore the cost review is one demand by international standards. “The project organization should carry out regular reviews of the project costs, as defined in the project management plan, and take into account any other financial reviews” [ISO 10006:2003, 7.5.4].
The performance-cost-time must be connected in continuous state, and takes a role in manufacturing framework with others. “The level of the framework shows manufacturing’s four performance objectives: quality, cost, delivery and flexibility” [Gilgeous, 1999, page 41].
This relation will increase the other improvement of an organization’s activity because they are also interconnected in their goals, and also the quality cannot be improved without increasing manufacturing costs or the production time, at the ame level the manufacturing time cannot be shortened without suffering quality losses or increasing the cost. “The connection between quality improvement, manufacturing costs and production time are under the name of (magic triangle) is the first paradigm for the quality management” [Herrmann, 2004, page 164].
Because of the larger requirements of quality and since these three are connected with each others, here the performance can be used in order to contain more meanings and aspects.
The performance of “ITMS” operation could be represented by:

- *Quality of implemented “ITMS” results.*
- *Productivity of the organization.*
- *Excellence of the integrated system.*
- *Technical compliance and balancing.*

The cost of “ITMS” constitution could be represented by:

- *Resources and reduction in cost of energy consumption.*
- *Low cost of materials of construction.*
- *Lower cost of using equipments and new technologies.*
- *Cost of tools application.*

The time of “ITMS” implementation could be represented by:

- *Duration of released pollutants.*

- *Exposure duration to toxic chemicals.*
- *Time of control on firing accident.*
- *Time of event occurrence.*

These expressions will represent the three areas of quality, environment and OH&S. Their performance with reliability and customer expectation are also considered as the main properties in PCT criteria. On the other hand it could be seen that the organizations are dealing under this triple relation as TQM. “TQM considers all processes of an enterprise as a complete system by regarding all aspects of quality, time and costs” [Herrmann, 2000, page 20].

8.2.3.2 PCT Requirements by International Standards

All three international standards of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 are pressing on the performance-cost-time criteria as active tool towards development of any organization, project, system and operation, and as successful support. The represented clauses are shown in **Figure 8.6**.

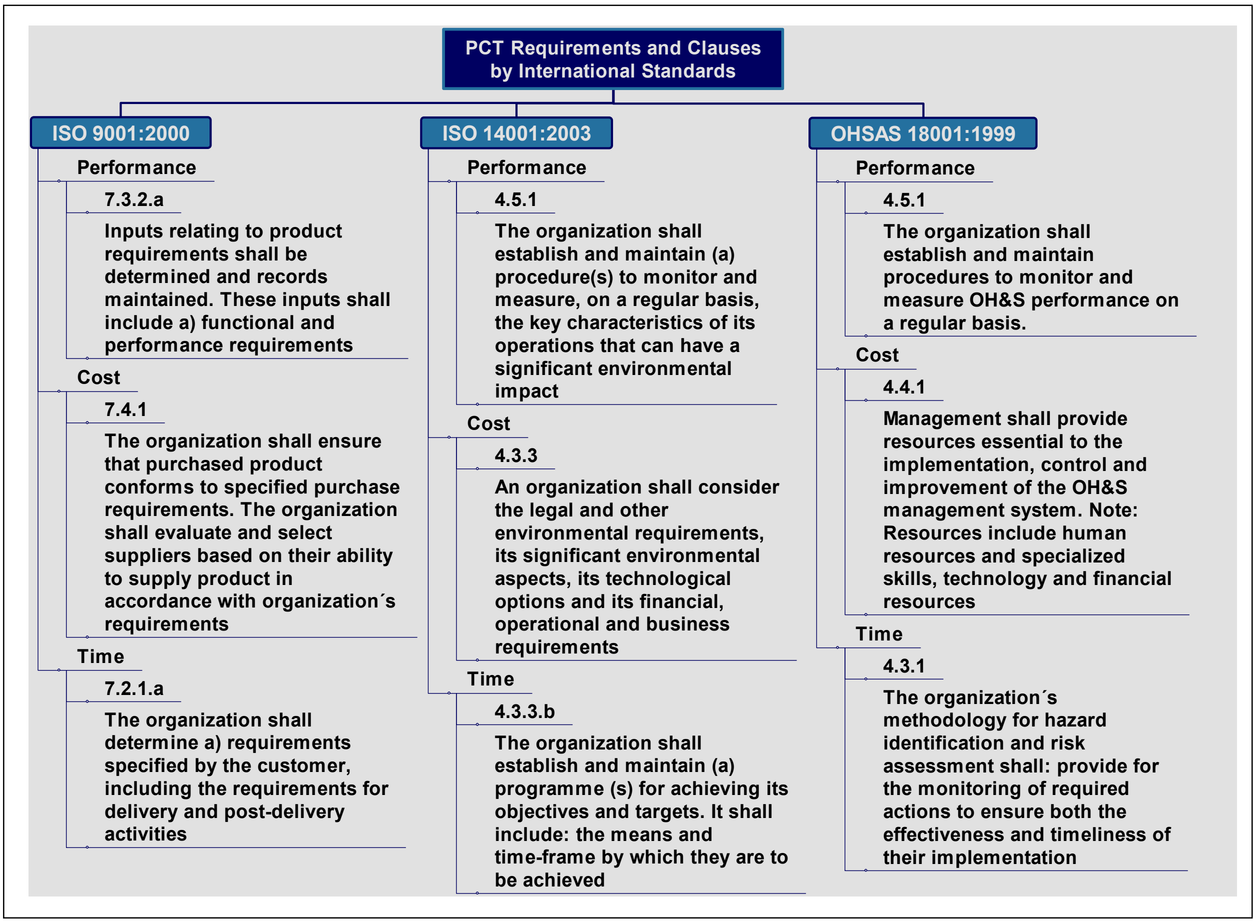


Figure 8.6 *PCT Requirements and Clauses by International Standards*

8.2.3.3 Benefits of PCT

As seen in international standards, there are claims for doing performance-cost-time criteria, and by implementing them we can achieve an efficient and successful technical integration. This is clearly affirmed in their clauses and requirements.
There is certainly a need to control quality, reduce impact on the environment and minimize OH&S risk. However, if the organization has the best quality product in the world, with absolute control over the environmental and OH&S aspects, it may be possible that no one will buy the product or service because it is too expensive. There has to be equilibrium. “The organization should consider the economic effects of all possible quality improvement actions. To have cost benefits, the organization may go through the following stages: a) ensure that the proposed improvement action is clearly defined; b) estimate the changes in the costs of conformity and nonconformity, both internal and external to the process” [ISO 10014:1998, 9.3, a. e].

Reduction of environmental adverse impacts could be obtained from technical improvement and technological uses, and then the reduction of environmental pollution will save the overall costs of an organization. “With reduction of 35 to 40 Kilograms of CO_2 , there are savings of maximal 200 Euro “[Energie, 2003, page 19].
The demand of new implementation of “ITMS” in an organization will be accompanied by increasing costs and time, it could be the demand assessed as performance and will be directly proportional to them, because in many studies this has been proved. “The impact over cost and time is directly proportional to the degree of deviation of actual demand” [Louis, 1997, page 2].

On the other hand the cost reduction could be achieved by some factors, all of them are connected with three areas. “Cost reduction achieved by fewer supplier related problems, more rapid assembly speeds, increased robustness, standardization, higher level of consumer satisfaction” [Wheaton, 1999, page 31].
Time plays a huge role in saving costs and improvement of quality, so many studies and investigations have proved this fact, and many of them have taken a strategy about this matter. “Just-in-time production is one of the two cornerstones of the Toyota production system, the concept is making items when they are required and in the quantities required” [Louis, 1997, page 75].

The benefits of PCT criteria are:

- Helps to achieve higher quality level of products and services, it enables organizations to cost effective management and optimize time and attendance procedures.
- The analysis of PCT will increase the accomplishment of goals at lower cost.
- There is mutual independence between PCT in most operations and activities, the activation of this subject leads to balancing them.

- The investigations on PCT lead to obtain the actual demand by customers, society and public.
- Leads to higher degree of standardization and robust processes.
- The time is vital in many large manufacturing organizations, as Just in Time as a system it is an approach for developing and operating a manufacturing system.

The interrelation between PCT is shown in **Figure 8.7** and is represented by XYZ axis. The interrelation as explained above is huge and necessary at the same time for increasing effective operations of all aspects of the criteria. The following are some of their interpretations:

- In general, better performance of “ITMS” operation can be achieved, if more time for its implementation is available, under the condition of no cost losses.
- For the same performance of “ITMS” operation, costs of the constitution will increase when implementation time is increased (**Figure 8.7 d**).
- For the same time of “ITMS” implementation, the performance of “ITMS” operation increases, if cost is increased, but there is a limit after which performance decreases. Here the performance decreases because increment of cost will destroy the basis of performance that is why low cost is required (**Figure 8.7 b**).
- For the same cost of “ITMS” constitution, the operation performance increases, if it has sufficient time for implementation into structures and departments (**Figure 8.7 c**).

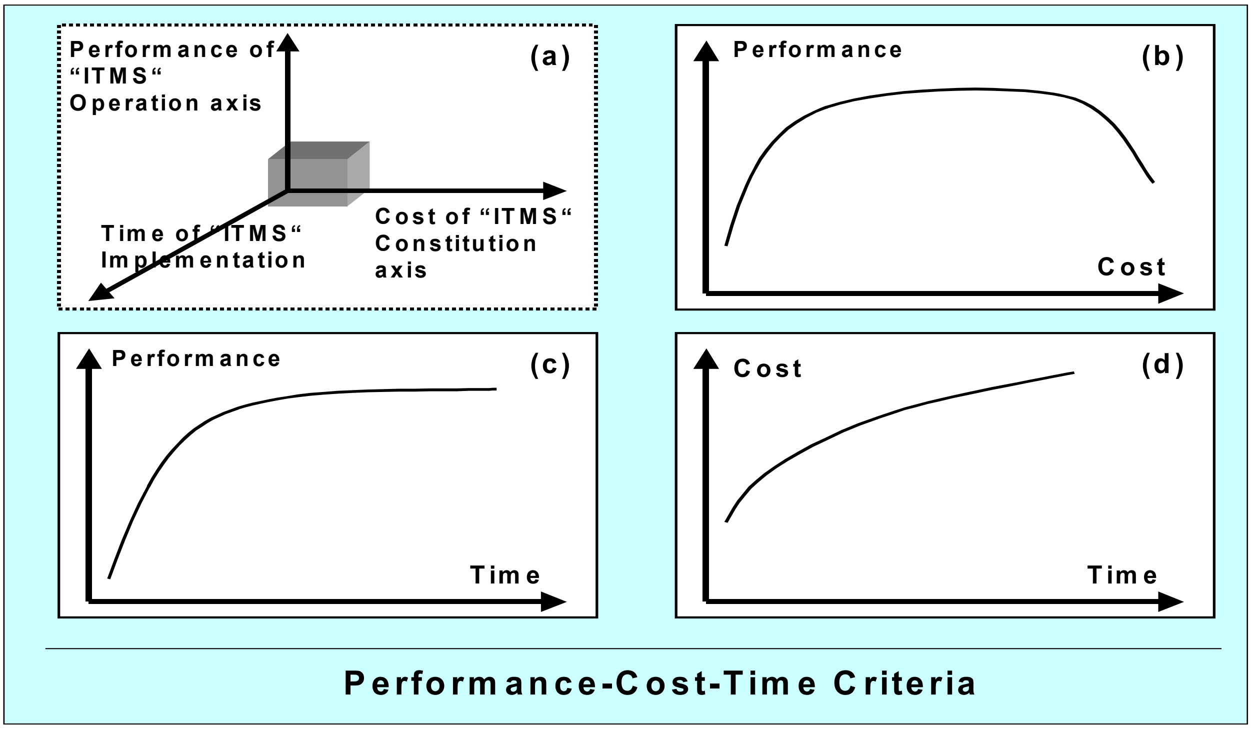


Figure 8.7 *Performance-Cost-Time Criteria*

8.3 Audit of “ITMS”

8.3.1 What is “ITMS” Audit?

Auditing is a method of review, a judicial process, accumulating evidences about an activity, and reporting on the degree of correspondence between planned and established activity (product, service, process, operation, systems or model).
As a function, auditing determines the analyzing of records to give a clear situation of the activity in order to arrive to our needed information.
In relation with the integrated technical management systems “ITMS”, the main function of auditing could be defined as:

- Gathering data and information about technical activities in order to achieve equilibrium state and see if the equilibrium is implemented and maintained.
- Methodical judgment of technical compliance and balancing, and review their effective implementation.
- Reporting on PCT criteria conformance and its compliance with planned arrangements and according to the requirements of international standards.
- Recording events and statistics about integrated management system’s performance.
- Analyzing records to present all data about the constitution process.

The auditing must exist at all stages during and after “ITMS” constitution process also with its implementation to review and record the constituted “ITMS” and its completeness, ensure compliance with planned requirements, and reporting on success concepts and “ITMS” operation about their conducts to the management responsible.
It is done and delivered by an auditor, as internal auditing, who is trained and experienced in the stages of the “ITMS” constitution and its implementation. Also he must hold the specific technical experiences about the subject. “The audit should be conducted or led by a person who has sufficient knowledge in audit techniques and who is impartial towards the facility or area being audited” [Howlett, 1996, page 330].
In addition, the auditing could be achieved by external auditing by experienced legislated auditors in order to examine results and to ensure objectives have been confirmed with the standards, obligations and agencies orders.

Table 8.1 shows the components that must be audited relating to technical integration process.

Components that must be audited	
Components	**Features**
Technical elements	Finding and demonstrating them
Five procedures	Each step during "ITMS" constitution
Portioning Structures	Organizational structures, operational structures, products structures, external structures
Three areas	Preparing, inserting, integration kind
Implementation	Execution, where, how
NS, IS, GR	Existence, documents, implementation
"ITMS" Team	Numbers, experiences, communication, skills, training

Table 8.1 *Audited Components*

8.3.2 Audit Requirements by International Standards

All three international standards of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 are stressing on the auditing as an active tool towards development and for success of any organization, project, system and operation. **Figure 8.8** shows the clauses by these international standards about their demands for auditing process and what is to be audited. The same statements of clauses could be executed for "ITMS" constitution and implementation.

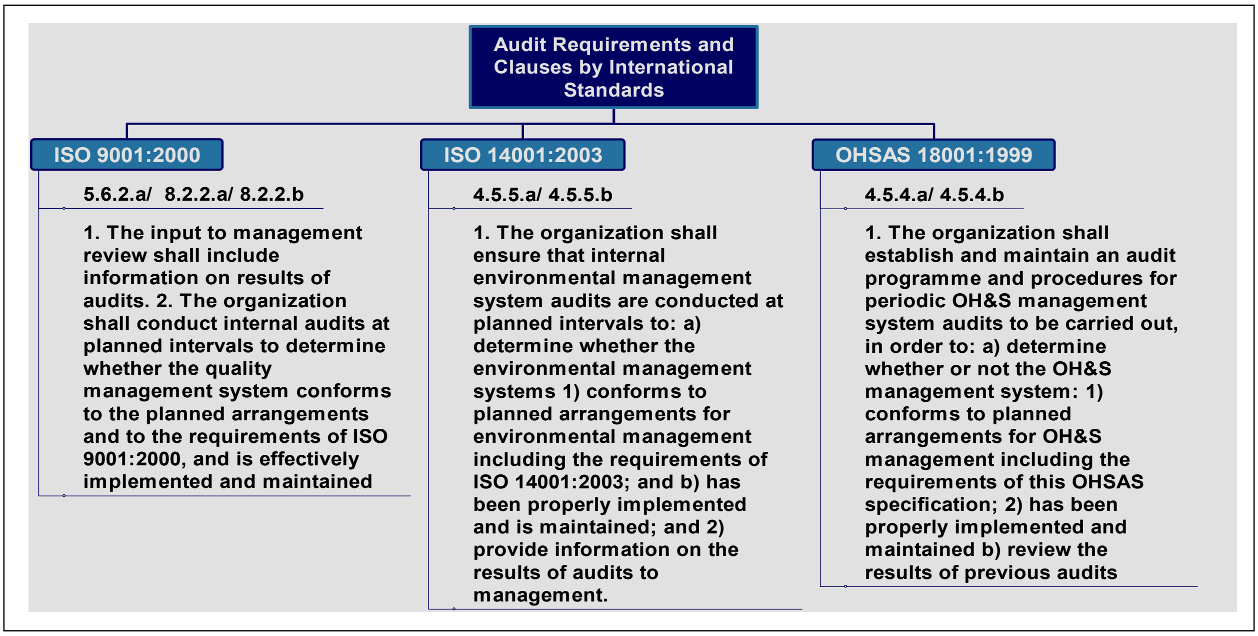


Figure 8.8 *Audit Requirements and Clauses by International Standards*

8.3.3 Benefits of “ITMS” Audit

The purposes of auditing are to ensure that all “ITMS” constitutions are implemented within the organization, ensure its operation, and to ensure that resources are properly safeguarded and used efficiently, it measures the efficiency and competence of the degree to which the organization responsibilities follow the “ITMS” policy and internal five procedures.
The audit process may also incorporate organization’s business as a fiscal audit that concerned with the costs of “ITMS” constitution and also its time of implementation.
Also the auditing will provide information required to determine failures and investigate what happened and when an incident occurred, and provides the possible evidence to support their solution.

In addition of the above described of main functions of auditing, the following are some other benefits:

- Determine that the “ITMS” constitution process has met its goals.
- Discover internal gaps of constitution process and defects.
- Determine that “ITMS” conforms to planned objectives and has been properly operated and reporting this to the top management.
- Find out if the organization’s objectives and targets are fulfilled.
- Observe efficiency of the success concepts.

8.4 Continual Improvement

The continual improvement is the activity to increase the ability in order to fulfil the requirements, increase the profitability and enhance the customer’s satisfaction. “Continual improvement: recurring activity to increase the ability to fulfil requirements” [ISO 9000:2000, 3.2.13].

The aims of continual improvement stated in international standards are to:

- “Increase the profitability of enhancing the satisfaction of customer and other interested parties” [ISO 9000:2000, 2.9].
- “Achieve improvements in overall environmental performance” [ISO 14001:2003, 3.2].
- “Achieve improvement in overall occupational health and safety performance” [OHSAS 18001:1999, 3.3].

The same aims can be transferred as a motivation for the operation of continual improvement of the integrated technical management systems, because the first purpose is figured for improvement of all three QMS, EMS and OH&S-MS and on that basis the “ITMS” can be improved.

The continual improvement is one of the factors which makes the most organizations successful, and on which integrated management systems is based on. This is a basic factor for the integration process of many organizations. "The Eastman Chemical Co. with 16,000 employee and 400 chemical products, has been able to transform itself into an integrated management system based on human potential, continuous improvement and customer satisfaction" [Lee, 1999, page 68].

Here, the objectives and targets that must be improved, a plan for possible solutions during any operational manufacturing in the organization is needed to be drawn, and then try to implement the selected solutions in order to perform the effective outcome of quality, environmental performance and OH&S performance, and if needed, the change could be followed anywhere in the organization's structure.
Besides standardization, there are several methods and tools for improvement of systems. The Plan-Do-Check-Act (PDCA) cycle have been designed and could be used for effective continual improvement. The PDCA cycle or Plan-Do-Study-Act (PDSA) cycle was originally conceived by Walter Shewhart, and later adopted by W. Edward Deming. It has been designed to be used as a dynamic model, and is a valuable process that can be applied practically to any system.

In appendix (F) the PDCA cycle is referred for the framework elements of an internationally usable "ITMS" model and about the methods and tools, those are used for continual improvements (referred here as (C)) and problem solving and decision-making (referred here as (P)). They could be used in the three management systems either separately or integrated. "The tools are: Flow chart (C&P)/ Check lists (C)/ Pareto analysis (C&P)/ Brainstorming (C)/ Control charts (C)/ Interviewing (C)/ Quality circles (C)/ Benchmarking (C)/ Cause-and-effect diagrams (C&P)/ Run charts (C&P)/ Fail-Safe methods (C)/ Histograms (P)/ Scatter Diagrams (P)" [Stevenson, 1996, page 120]. These methods and tools could be taken as methods of continual improvement of "ITMS" in various stages of its operation.

8.5 Evaluation of "ITMS"

8.5.1 What is "ITMS" Evaluation?

Evaluation is a method of examination, a collection of skills to determine whether a service or a correction is needed, or service and correction is conducted as planned and what has been done of this activity that confirms to the planned objectives.
As a function, evaluation prepares to determine of how much level or how the value of activity changes in order to arrive to the point of our judgment about it on the basis of criteria that have been defined.

In relation with the integrated technical management systems “ITMS”, the main function of evaluation could be defined as:

Methodical examination of all success concepts that have been audited as referred above.

- The same thing applies to continual improvement.
- Determine if the gathered information about success concepts is sufficient and they are correct and conducted accurately or not.
- Conformance of PCT criteria is in accordance with planned arrangements and according to the requirements of international standards.
- An appreciation and analysis of the actual operation of “ITMS” and real conditions.
- A comparison between state “ITMS” policy and actual outcomes.
- Assessment about effectiveness and efficiency of “ITMS”.

The above definition is applicable here for a constituted “ITMS” anywhere in an organization, it could be an overall process to evaluate an “ITMS” before, during and after constitution process.

Evaluation must exist at all stages during and after “ITMS” constitution process also with its implementation to examine if the constituted “ITMS” is complete or not, and if it could be conducted in the right location. “During the project, evaluations should be carried out at each phase of the work plan to ensure satisfactory completion of the work and compliance with the statement of requirements.” [ISO 15188:2001, 4.4]. The evaluation must be undertaken in accordance with goals of success concepts and their auditing for gaining the intended results. “The evaluation shall be undertaken in accordance with the goals and scope of the study, and should take into account the final intended use of the study results.” [ISO14043:2000, 6.1].

As translation, these provisions could be translated to the “ITMS” parts, here the evaluation is directed to reply the three key questions of:

- What is the extent up to which the constitution process is reaches to the appropriate objectives and targets in the organization?
- Whether the implementation inside departments and four structures is delivered and operated or not?
- What are levels and extent of overall goals, continual improvement and benefits?

There are many tools that could be used for the evaluation, and by indicating the role and results of quality, environmental protection and O&HS, a suitable model could be built from them. There are some general devices which are used for the evaluation. “Evaluation matrix , anecdotal record form , expert review checklist , focus group proto-

col, formative review log, implementation log, interview protocol, questionnaire, user interface rating form, evaluation report sample" [CEISMC, 2004].
Regarding with "ITMS" they can be used as: evaluate kind and quality of information and collected data, errors and incidents observation, effectiveness and programmes review, describe what is planned to happen during the implementation, sketch the involved issues that are part of the evaluation, determine the evidence that relates to all subjects, and give the recommendation based upon the evidence.

8.5.2 Evaluation Requirements by International Standards

All three international standards of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 are stressing on the evaluation as active tool towards successful development and of any organization, project, system and operation. **Figure 8.9** shows the clauses by these international standards about their demands for evaluation process and where it has to be audited. The same statements of clauses could be executed for "ITMS" constitution and implementation.

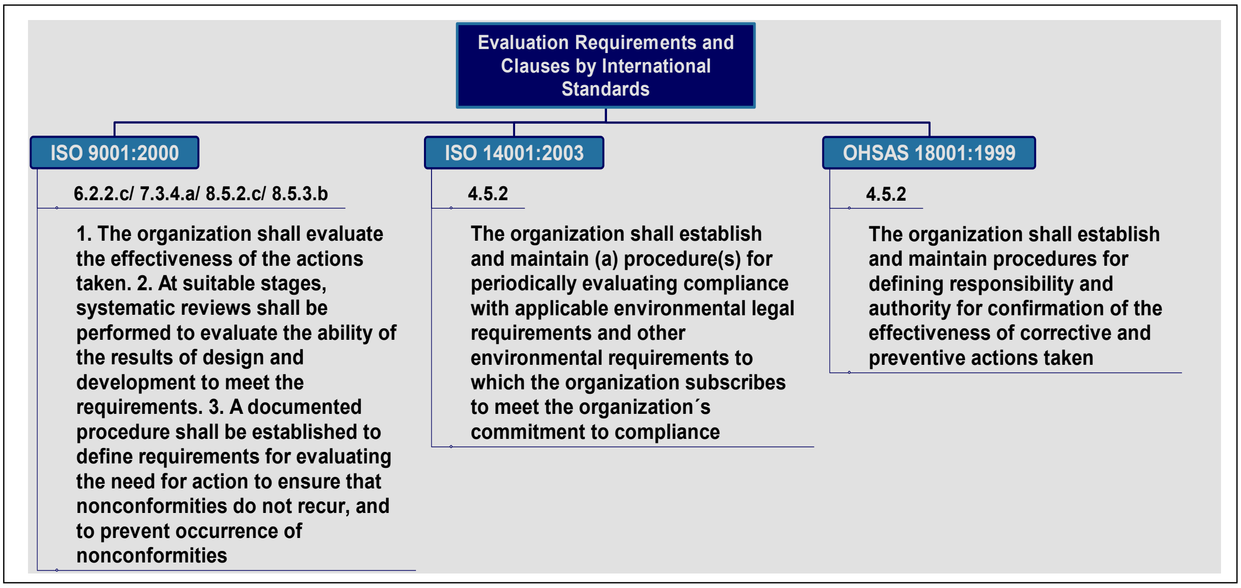


Figure 8.9 *Evaluation Requirements and Clauses by International Standards*

8.5.3 Benefits of "ITMS" Evaluation

There are some motivations and aims to make evaluation of the constituted "ITMS" successful. It is to be done in a way that provides feedback to managers and see whether the program is carried out as it was planned and in an efficient manner, and the guidance should be provided for modifying and correcting to ensure that it meets its objectives and the mistakes are found and removed.

The evaluation must be executed in order to assess the level of followed standards through technical integration process. “The focus of evaluation is to assess a design on a particular dimension (e.g. interface features, recommendations, standards)” [ISO/TR 16982:2002, 4.3.2].
The evaluation works as tool in the hands of the implementer and other technician staff for analyzing the problems and then their correction process. “The evaluation is a designer’s tool for identifying and correcting problems and reducing technical risks” [Priest, 2001, page 28].
The evaluation is one way by which the quality of “ITMS” could be evaluated and measured generally by showing if it has low or high quality in each of the four structures and their portions, and to demonstrate any existing gaps in overall operations and products (as explained in chapter 5.3) in order to remove any low quality of any one or structures or portions. The same thing is also valid for their performance and effectiveness.

Another benefit of the evaluation is to determine whether the members of the “ITMS” team are experienced in the objectives, what are the levels of their activities in training and the level of the training materials in order to make improvement.
The early planning for the evaluation process must be set according to the international standards to achieve its benefits. Other benefits from evaluation can also be sought by questions such as:

- Is the auditing process is carried out and documented?
- Are the procedures producing the desired results?
- Does the current unified policy meets all objectives and targets?
- Are the procedures of “ITMS” constitution process effectively achieved and implemented?
- Are the success concepts taken into account during evaluation?
- Is the continual improvement achieved?

Chapter 9- Standardized Documentation of “ITMS”

9.1 What is a Document?

A document is recorded information regardless of the medium or characteristics. It is a representation of information that is designed to be read or presented on paper, screen or played through a speaker, and it can be in any form or medium. A document may include extensive hyperlinks and it can be a part of large web of information, so that a web information may itself be considered as a document. The document is any written information describing, defining and specifying activities through a medium. “The medium can be paper, magnetic, electronic or optical computer disc, photograph or master sample or a combination thereof” [ISO 9000:2000, clause 3.7.2].
About the international standards, the definitions are related to each other as shown in **Figure 9.1**.

In general, document is an original or official paper, any writing, book or any other instrument conveying or storing information. The definition has been expanded because of continuous development of technology in recent years. “The supreme court has recently expanded the legal definition of document to include documents produced or stored by electronic media, including hard copy, diskettes, videos, movies and documents stored in computers” [Bufete, 2004]
A document is different from archives. An archive is a document accumulated by an organization and preserved because of their continuing value and may be used in later investigations, such as historical documents. They are useful when needed to return to the old information and data for the next planning. In accordance with the “ITMS”, following are some examples of archive:

- *Documents of statistical process control (SPC) in last two years by production department Nr. one.*
- *Number of workforce injuries during working within last 10 years.*
- *Economic losses from nonconformities of products with customer requirements in recent six moths by external deliveries.*
- *The NMHC/CO emission ratios in the city in past five years.*

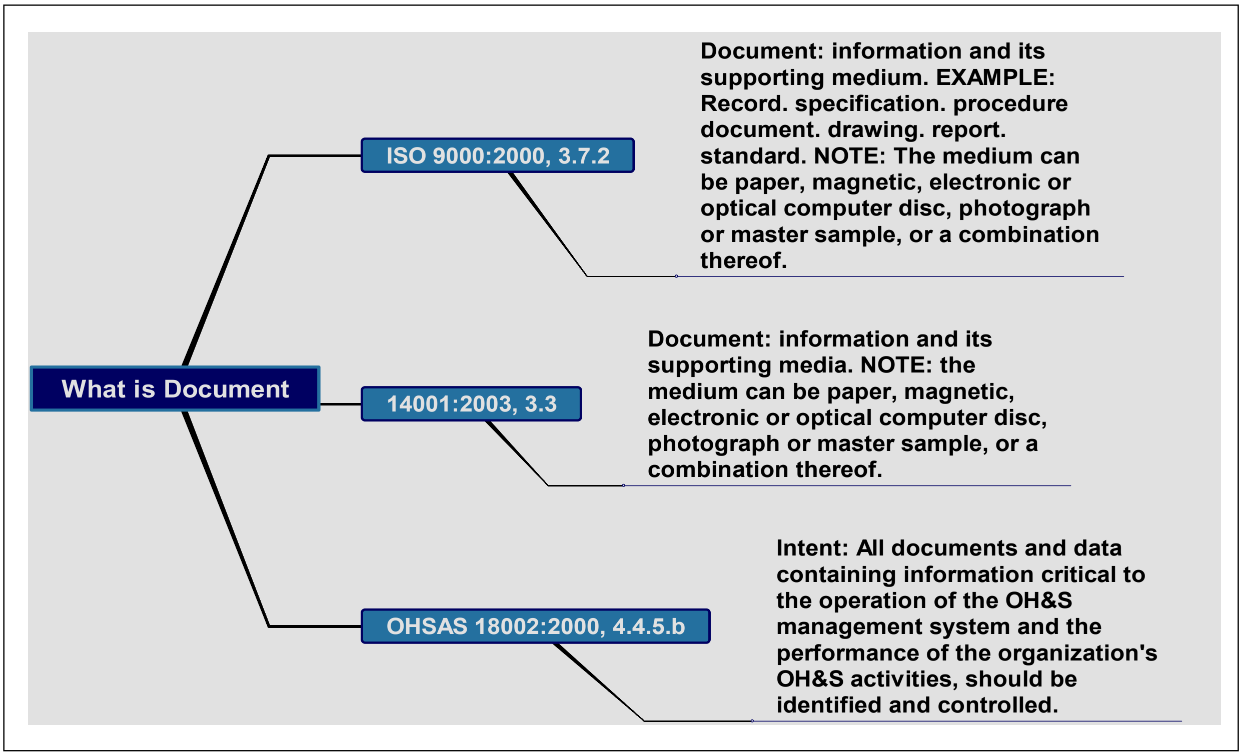


Figure 9.1 *Definitions of Document by International Standards*

9.2 What is Documentation?

Documentation is a written information gathered from the document sources, it is the act of supplying of documents or records or the process of acknowledging others by writing under using a paper. Thus by documenting writings, it could be shown which ideas or words have been processed and where these ideas or words can be found. Documentation is the process of managing, writing and recording documents. “A set of documents, for example specifications and records, is frequently called “documentation” [ISO 9000:2000, 3.7.2. Note 2].
International standards describe the documentation in their issues and statement clauses, and give a vital role to documentation and records, it could be seen that a large number of their clauses refer to this subject:

- *ISO 9001:2000, (4.2.1/ 4.2.3/ 4.2.4/ 7.1.b/ 7.3.7/ 7.6.a)*
- *ISO 14001:2003, (3.17/ 4.2.e/ 4.4.3.b/ 4.4.6.a/ 4.5.4/ 4.4.4/ 4.4.5)*
- *OHSAS 18001:1999, (4.3.4/ 4.4.1.b/ 4.4.4/ 4.4.5.b/ 4.5.2/ 4.5.3)*

The documentation is the confirmation that some facts or statements are true and it contains complete information. But its purpose is different according to the place where it is used. For example, in computer science, the documentation is the organized collection of records that describes the structure, purpose, instruments, operating system, computer program, operation, maintenance, data requirements, and instructions for hardware device and supported software.

In related technical activities RTA, it is the resulted records from testing, inspecting, auditing and any other technical activity. In applied engineering, it could be as specific information and identification regarding the nature, extent, duration, composition, stability and hardness of the materials being processed

9.3 Standardized Documentation (SD)

The documentation of integrated technical management systems contains all documentation of QMS, EMS and OH&S-MS, it is a composed and a unified documentation between them, and gives the goals that be given by each individual documentation. The unified documentation encompasses technical elements, constitution procedures, implementation and their continual improvement. It is the determination of what the organization needs from the documents and understanding the overall needs of each one of above management systems.

Here, the establishment of a standardized documentation SD must address three provisions, that means the SD holds three specific characteristics of:

1. Unification between documentation of QMS, EMS and OH&S-MS.
2. Imposition of international standards into the above unified documentation, and it be established in accordance with the requirements of them.
3. Representing the constituted integrated technical management systems of quality, environment and OH&S.

Consequently the standardized documentation be defined as: unified documentation of three management systems and be standardized according to ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999. **Figure 9.2** shows the SD.

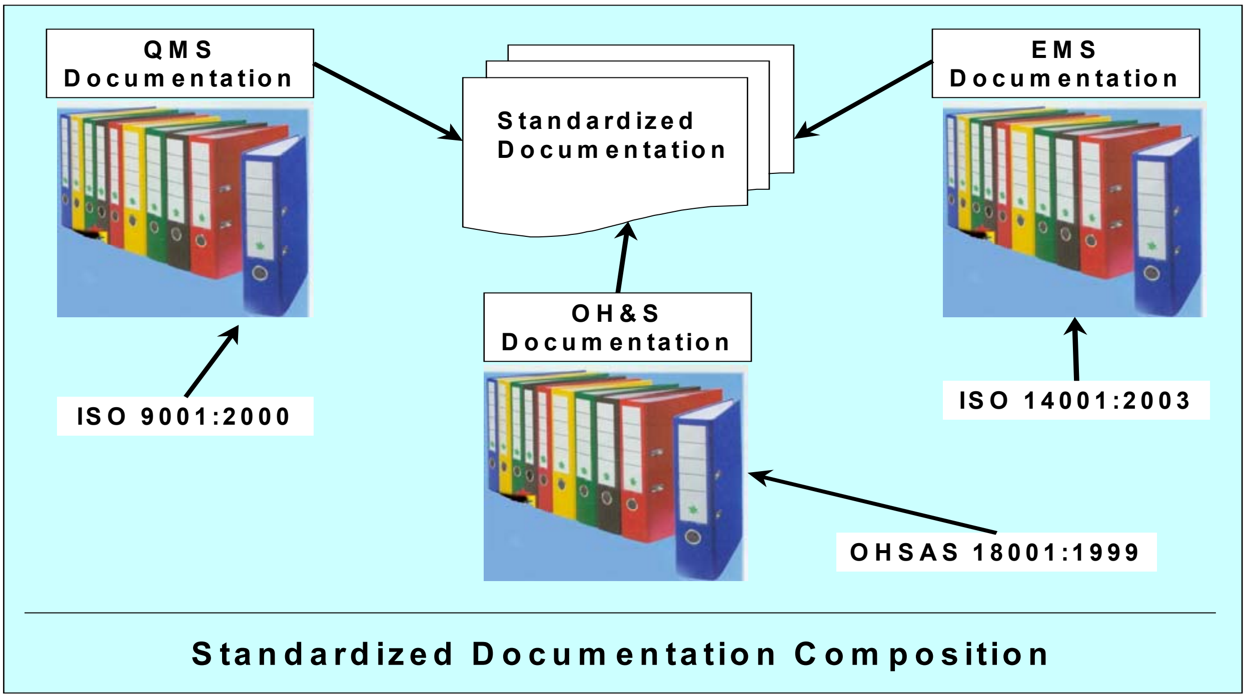


Figure 9.2 *Standardized Documentation Composition*

9.3.1 Motivation of SD

Today organizations face precedent pressure to maintain a rigorous set of standards for production and services, and for performance of each of quality, environmental protection and occupational health and safety. Proper and adequate documentation of organization’s tasks and activities is urgently required to demonstrate the highest level of operational integrity by preparing and maintaining such documentation.

The solution to this dilemma is the consolidation of their efforts towards those needs and methods that bring compliance data, information and documents in order to meet requirements of customers, regulatory and society.
Documentation clarifies duties of every member, and defines their responsibility levels. It helps the actions to be accurately performed and removes any confusion in the technical integration.

The realization of SD is the key to success as guidelines contribute to develop quality, environment, and OH&S, and inform how to convey the right information to the right people with the right level in the right detail. And SD is vital for maintaining consistency in an “ITMS” over time in all departments and four structures and it preserves the flexibility during any change. **Figure 9.3** shows the importance of documentation according to international standards, and why the documentation is needed by the organizations.

The SD assists projects by developing team work and gives clarity of technical elements, management systems, management functions, procedures, implementation, forms and continual improvement. It also assists the increasing of communication and more understanding between members.

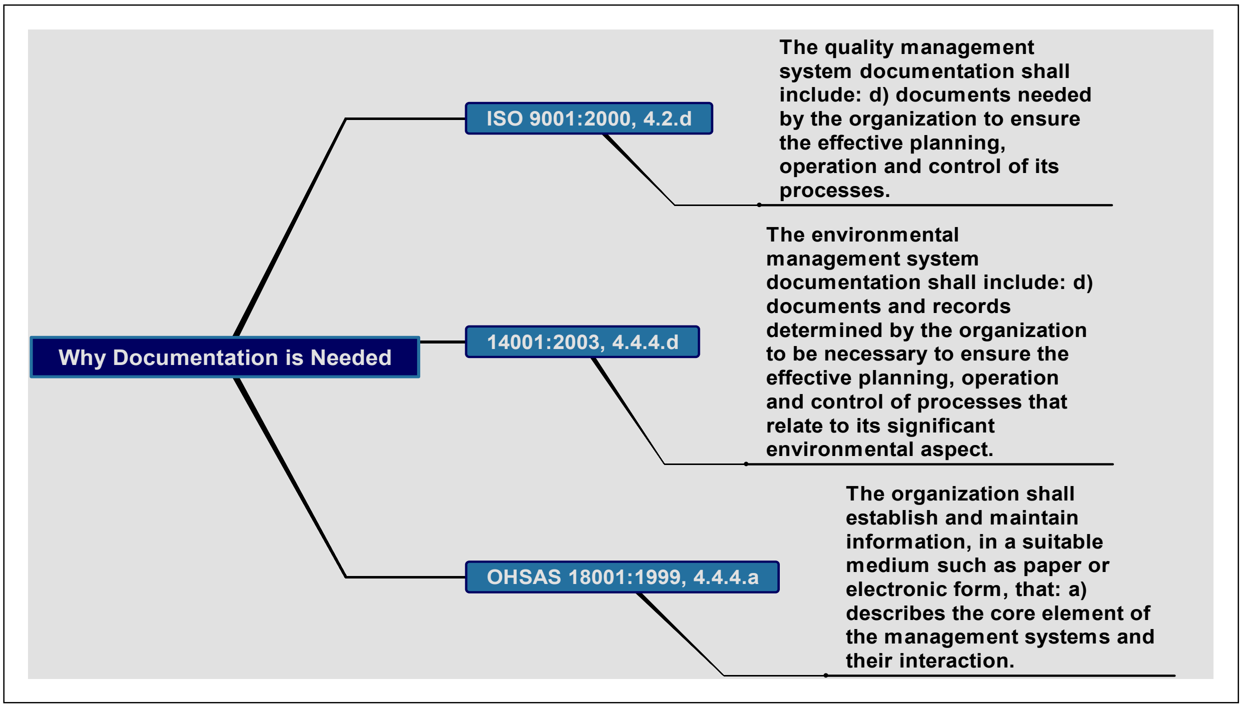


Figure 9.3 *Why Documentation is needed*

For quality issue, the SD is technical manuals and publications that enhance the acceptance of products and services by a customer. For environmental protection issue, it is written documents of energy consumption and level of emissions. For health care, it is recording facts, observation, examination, test, treatment and other findings in order to evaluate treat and actuate health preservation, and for safety, the SD is evidence of promotion of safe conditions, risk information and codes. "Standardized documentation have proven number of specific benefits that provides duplication of positive outcomes, enhanced accessibility to services, clinical care approach, cost efficiency of standardized process, system-wide accountability, meeting certification and national accreditation, compliance requirements, more objective reviews and audit process" [Ohio, 2003] The standardized documentation is a key to success for the organizations because it:

- contains all three documentation of QMS, EMS and OH&S-MS.
- has been recognized by the international standards.
- is one of the most important requirements of "ITMS" constitution process.
- contains description of technical integration constitution and its implementation.

- provides a basis of work performance, a clear framework of operation, a basis for training, finding answers to real problems, explaining of installation and maintenance, equipments and devices operation and instruction, applicable forms and lists, basis of auditing and evaluation.

In sight of technical integration, the "ITMS" documentation is the same with SD, and referring to same means because they have similar form.

9.3.2 Four Establishment Conditions

In subject of adapting any documentation, there is a question of what is the existing level of documentation of an organisation and what it will be after acquiring a new documentation of "ITMS"?. In general there are four conditions of establishment of "ITMS" documentation. **Figure 9.4** shows them. Every organization will meet at least one of these conditions.
An organization with an existing and implemented documentation for one, two or three management systems, should not need to rewrite all documentations in new dimension, but can make the changes towards "ITMS" and can make modification in accordance with the new documentation requirements ensuring that it meets requirements of IS, NS and GR.

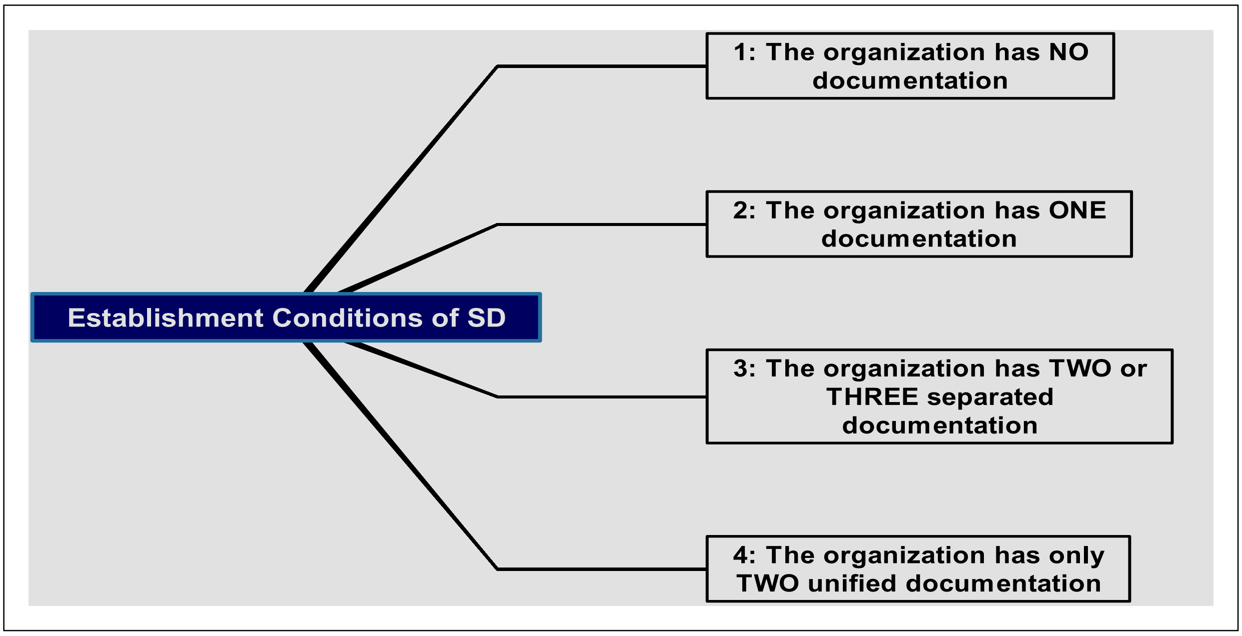


Figure 9.4 *Four Establishment Conditions of SD*

An organization (new or old) with no documentation or with no experience in this SD approach has to pay particular attention in establishing a new required documentation, and it must try for making definitions, scopes and sequence, at introduction to the establishment process.

9.3.3 Levels of SD

The levels of SD are the description of the questions of “what and how” it be established and specify the stages. The levels are the stages of “what and how” of standardized documentation in all three international standards, and each one reaching their goals. They all give the similarity levels for documentation of each one of QMS, EMS and OH&S-MS, they describe their objectives.

Relevant international standards demand, by their requirements, for documentation and its control as well, and guide right methods for establishing a level as shown in **Figure 9.5**. The ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 specify the levels, at the same time they require in urgent to establish their management systems. The designing of standardized documentation levels could be:

- *Figured as their specification.*
- *Determined by organizations according to their requirements.*

According to the above standards, the management system documentation should include:

a. documented statements of policy, objectives and targets.
b. a manual of management system.
c. documented procedures of required processing, elements description, procedures interaction.
d. documented work instructions of tasks description, planning, controlling aspects and job description.
e. forms, records, external documents, checklists, lists, instructions and training index.

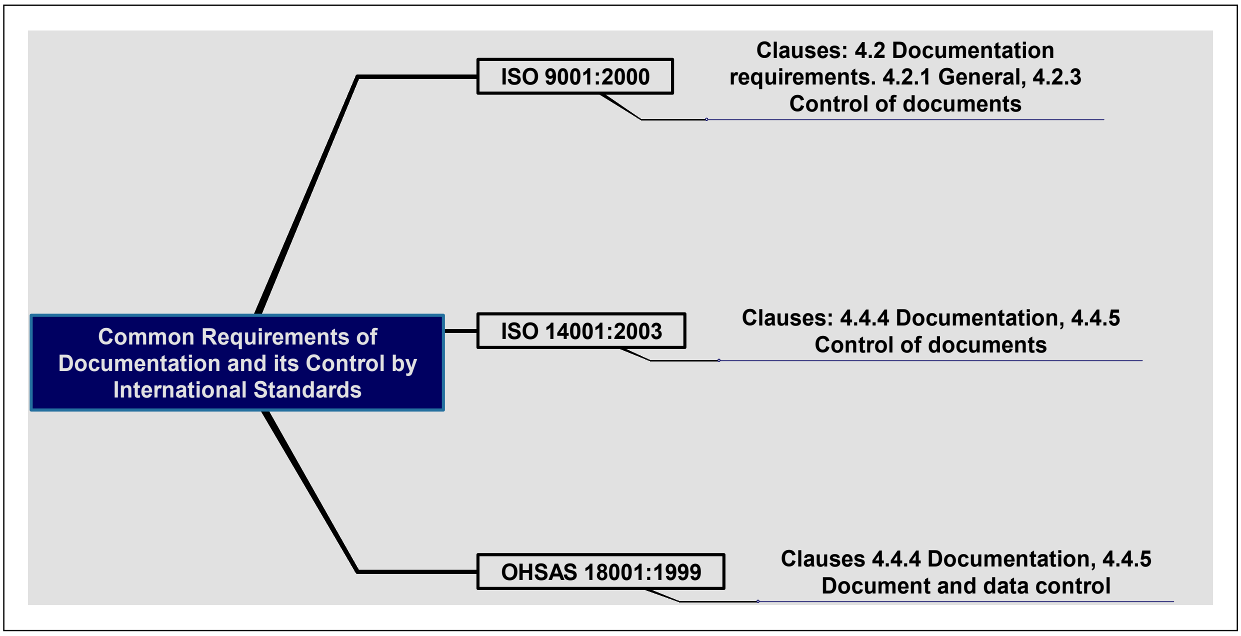


Figure 9.5 *Common Requirements of Documentation and its Control*

According to previous practical experiences and many studies, the same level of documentation exists which is presented here: "The quality documentation is composed of quality manual (who makes what), instructions for procedures (how does it run off in principle), work instructions (Information about how to perform work at each workstation) and evidences (documents and recording)" [Buchmeier, 1996, page 398]. In another study a similar level is offered. "QM- Documentation consists of QM-handbook (description of the firm-specific QMS), QM instructions for procedure (internal purposes), work and examinations, and quality recordings (record documents)" [Thierfelder, 2000, page 104]. The same level is required by others as well. "The basic structure of QM documentation is QM-hand book (manual), QM-procedures instructions and QM-work instructions" [Szyminski, 1999, page 18]. And in more details, the documentation may contain the aspects of environment and occupational health and safety for more totality. "The documentation may consist of QM- handbook, environmental programmes, work safety programmes, instructions for procedures, work instructions and operating instructions" [Molitor, 2000, page 6].

Therefore, as a result **Table 9.1** shows four levels of standardized documentation with same levels of the three management systems (unified policy is included in level one). And **Figure 9.6** shows a consideration of a pyramid of five SD levels.

In addition to the above, in order to get specific standardized documentation, the following must be included:

- List of technical elements, NS, IS, GR, requirements of customer, legal, authority, associations, public society and agencies.
- The basic operations of CACDC (hardware, software, designing) and data and information system.
- Requirements of training and education, continual improvement methods and tools, verification, audit and evaluation principles.
- work instructions for maintenance, manuals for test, laboratory, installation and ergonomics.

Establishment of Standardized Documentation				
Levels	**Areas**			**SD**
	QMS	EMS	OH&S-MS	
Level 1	Quality manual	Environmental manual	Corporate safety statement	“ITMS” Handbook
Level 2	Quality procedures	Environmental procedures	Safe operating procedures	Procedures Instructions
Level 3	Quality work instructions	Environmental work instructions	Safe job and health practices	Work Instructions
Level 4	Quality records and documents	Environmental records and documents	OH&S records and documents	Applicable Forms and Lists

Table 9.1 *Levels of Standardized Documentation*

9.3.3.1 Handbook

The handbook is larger than manual. It is a concise reference book providing specific information about subject of management systems and its location in an organization.
It is a reference book for contents of management, and it must be carried in hand as a guidebook for management system’s operation. Here, as regarding with standardized integrated technical management systems, it will be specific for the integration of the QMS, EMS and OH&S-MS, and it could be named as handbook of the “ITMS” because it refers only to this side. “The handbook is concise reference book providing specific information about a subject or location” [Wordreference, 2004].
There are so many handbooks for applied science as mechanical, chemical, biological handbooks but they all carry the same goal of guidance. “Handbook: a book of reference, to be carried in the hand, a manual and a guidebook” [Knowledgerush, 2004].
It is a book containing reference information for this field as specific issues, but encompassing all what are concerned with the project of the “ITMS”, and sometimes the policy

will be part of the handbook. A "handbook consists of policy, organizational processes, documentation" [Molitor, 2000, page 340].

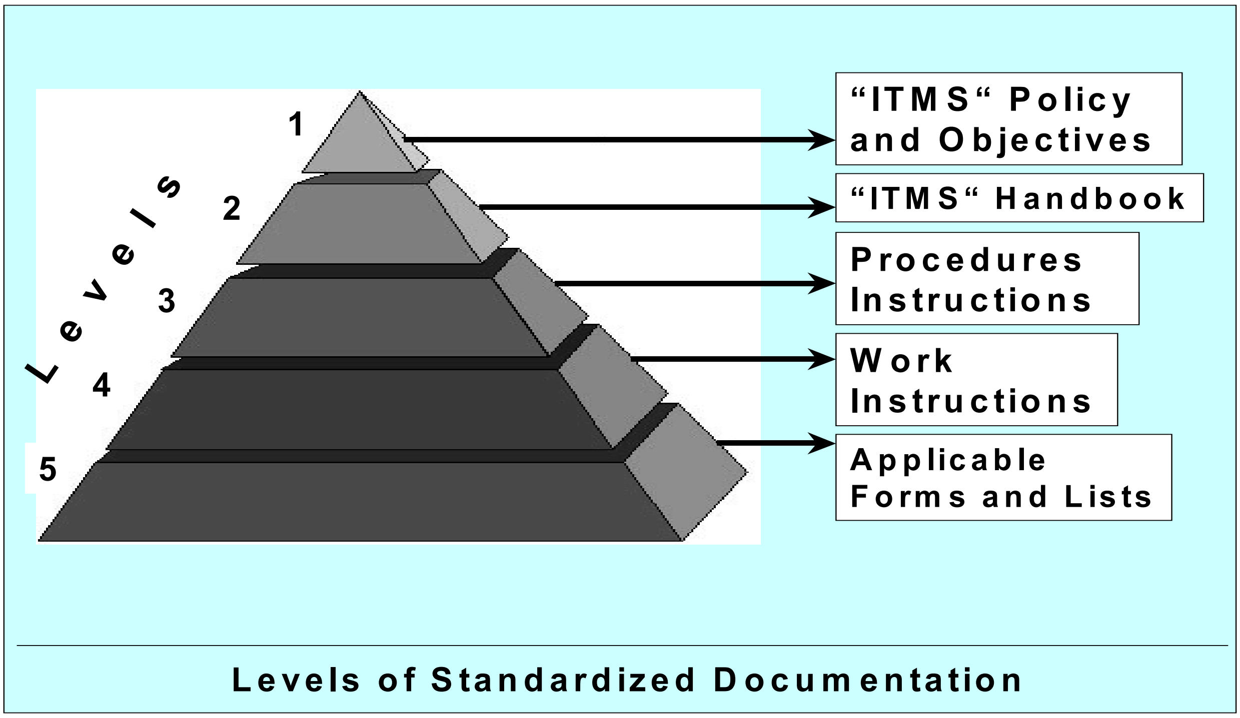


Figure 9.6 *A Consideration of a Pyramid of SD Levels*

The handbook could be divided into several banded documents or parts, each one describing one main subject, such as banded documents about each one of four management functions, QMS, EMS, OH&S-MS, external parties, financial, costs, marketing, and other concerned subjects. It describes primarily, which achievements the organization should target, the range of details and responsibilities and the role of each unit and department, which technical elements should be demonstrated and unified and what would be done to determine their management systems to be integrated, describing the kinds of integration, constitution process, implementation, successful operation, continual improvement, define motives, describing know-how, and common technical elements.

The handbook contains all brochures to be provided to workforce, customers, suppliers, contractors, agencies or any other concerned stakeholders. The "ITMS" handbook consists of all documents concerned to the external sides of NS, IS, GR and other organizations, it contains detailed description of four or five levels.
Briefly, it contains the following sections:

1. Preface of the integrated technical management systems.
2. Objectives description and needs.
3. Type, size, departments, goal and identification of the organization, product and service types, statistical information and data, workforce data (number of workers, experiences, places, etc.), related social and economic data, equipment and instrument data (type, size, number, location, productivity, age, etc.), customer data (where, their classification, communication level, etc.), and any other external parties.
4. Needed management systems (QMS, EMS, OH&H-MS, FMS, MMS, RMS, TMS, HRMS, HMMS, etc.)
5. Specification of overall responsibilities and duties for every member of “ITMS” team, technicians (tester, inspector, auditor, recorder, etc.), responsibilities regarding hazardous substances, water and internal energy consumption, emergency services, training and learning, development rules, technology, equipments and devices, after sale services, materials control, an so on.
6. Description of operations, processes, strategic planning, design disciplines, internal and external communication, management review, continual improvement (methods and tools), after sale operations (delivery, benchmarking, maintenance and services), and other internal activities.
7. Appendixes of applicable forms and lists: lists of (NS, IS, GR, instructions, permits, laws, orders, reports, engineering specifications, etc.), essential documents (tables, photos, curves, catalogues, etc.) and description forms (equipments, jobs, operations, training course, programmes, etc.).
8. Documents of constitution process: banded document of five procedures descriptions, implementation descriptions, calculations, controlling processes, references and details of justifications and conclusions, inspection checklists, gaps filling process, “ITMS” auditing and evaluation, description of success concepts, kinds of integration, lists of technical elements, requirements, system hardware and software specification, programming and system personnel training requirements.

9.3.3.2 Procedures Instructions

The instructions of procedures are those dealing with five procedures of “ITMS” constitution that are described in details in chapter 6. It discusses how, why and what are the five constitution procedures of portioning, unification, integration & CIC, standardization and implementation, and explains how they are made and formed.

Therefore, the instructions here, are a sequence of orders given by an official integrated technical system in the form of activities, principles, statements and rules of the action. Consequently, they are a series of instructions designed and prepared by constitutor and other members of the team, the instruction to be followed according to former planning with assistance from top management and under experiences and skills

of team members, information and data, with helps from related departments, and all procedures should be standardized according to NS, IS and GR.
"ITMS" is to be executed by a series of tasks, steps, decisions, calculations, demonstrating technical elements and other undertaken processes.
The instructions will be enforced by technical cycle and special rules (as described in chapter 5) for making efficient constitution process, discussing the principles of connection between aspects, discovering and filling the gaps.
The procedures instructions could be defined, recorded and they are containing sheets for explanation steps and methods. In all cases the recorded procedures are usually called instructions because they define what should be done, where they happened and who does them. They are the contents of processes and sub-processes including specific characteristics described in sheets to give an overview of the process structure in the organization and contain responsibilities, process type specifications and internal tasks. The procedures instructions contain success concepts (technical compliance and balancing, equilibrium among RTA, PCT criteria, continual improvement, audit evaluation of integrated technical management systems (as explained in chapter 8), in order for higher success range.

9.3.3.3 Work Instructions

The third level is the work instructions. It is a form of information which is communicated in order to explain how an action, behaviour, method, or task is to be started and finished, how the work is to be executed and conducted.
The work instructions are to be formulated by implementer and workers on "ITMS" operation together with management responsible for departments including the workforce on production and service. They also include any related operation with the implementation procedure. They are usually be explained in documents as: how to install, operate and work, they concentrate on what workers do and with which level they perform their activities. Any process in an organization will need work instructions, therefore it is necessary to determine which instructions are needed for them for achieving an optimum level. Because in sight of technical integration, all operations in the organization have their vital roles on quality, environment and OH&S, therefore they should have specific attention in all stages, and in order for more successful technical integration, there should be high level and more detailed instructions of work.

9.3.3.4 Applicable Forms and Lists

The applicable forms and lists are those documents that describe and provide guidelines to users (constitutor, manager, implementer, technical staff and other technicians in departments) in order to constitute, implement and improve the "ITMS". They contain requirements and specifications of applicable forms and lists (tables, drawings, statistics, rules, tools, event records, constant measures, plans, instructions forms, production schedules, process maps and flow charts, description of activities, check lists for filling gaps and corrections, agencies instructions, authority or government orders, labels, codes, commonly needed forms, regulations, charts and tools). **Figure 9.7** gives us an overview of such list.

The applicable documents describe detailed information that be used in practice for integrated management systems operation. They provide a more corrected and measurable data to subject being processed, and provide more accurately actual data in an organization.

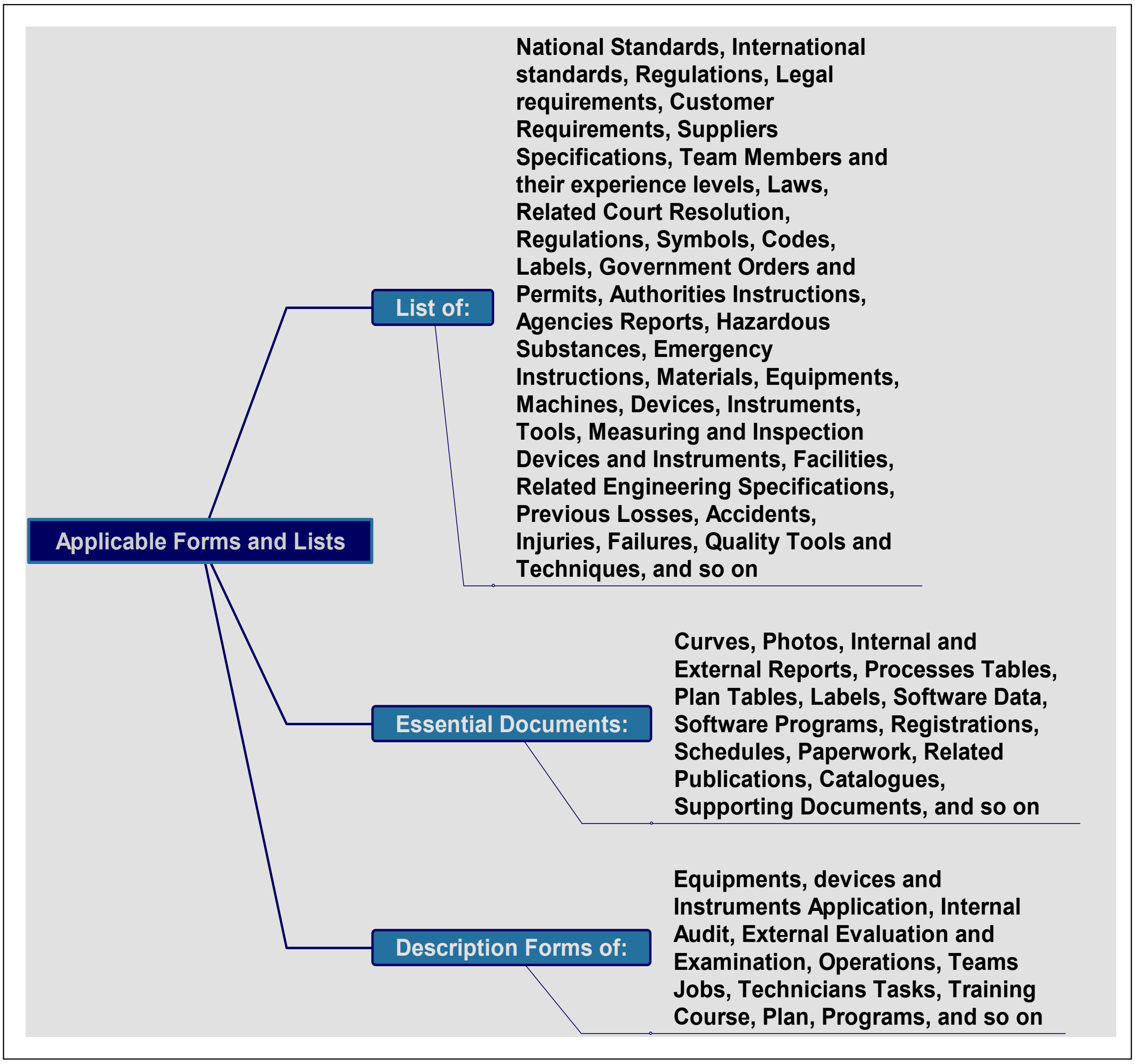


Figure 9.7 *Applicable Forms and Lists*

They contain list of NS, IS and GR, list of cooperating organizations and contractors, list of hazardous substances, packaging forms, transporting rules, list of significant environmental aspects, list of mechanical, chemical, biological materials, list of buildings, OH&S and environmental limitations, list of quality improvement tools, designing forms, photos, curves, drawings, maps and technical specifications sheets. The volume and types of above will depend on type and nature of the organization.

In addition for more efficient "ITMS" working, they contain records and historical archives of what are related to the three areas, as quality statistics, data, events, rules for accident prevention, test booklets, emergency manual, safety and ergonomic guidelines.

Chapter 10- The Benefits

Benefits are the sustainable goals which can be measured and quantified. They generate additional income, reduce costs, remove unnecessary processes and minimize efforts. Here, the same status is true about the benefits of integrated technical management systems for gaining additional results from the new established technical integration process with the same amount of efforts. They are to be delivered by the organization and be derived directly out of the "ITMS" strategy closer to its overall objectives and targets of high quality of products and services, stronger environmental aspects protection, and higher performance of occupational health and safety.

In all cases, the resulting benefits from the new system are used as organization’s advantages and are evaluated as a significant part of the overall benefit of the organization.

This chapter gives an overview about the several benefits of implementation and operation of an integrated technical management system of quality, environment and OH&S in operational processes, products and services by all types and sizes of organizations. It explains in brief, the overview of the reasons to constitute such a system, the motivations and its advantages. They are referred here in context of chapters and sections.

Most previous investigations have concentrated on certain benefits and specific situations, and regarded them for higher productivity, more flexibility and accountability, higher cost savings through demand and market forecasting, higher efficiency, lower time usage and less failure rates. "The benefits of the integration process are: cost saving, improved overall organizational productivity, removal of duplication of efforts, increased opportunity to use necessary, sufficient, and graded approaches across disciplines, and simplifies project planning process" [Waite, 1998, page 30]. Other studies state similar benefits. "The goals of integration are: minimizing inspection expenditure, combination of certification and auditing, cost saving, more flexibility, establishing an information basis unit" [Pischon, 1999, page 295- 296]. More investigations have showed likewise advantages. "Benefits of an integrated management system are: cost saving in certification, more efficient auditing of management systems, more efficient use of time, continuity in services and competitive edge" [Krueger, 1998, presentations].

Also the development of related systems together generates more benefits in cost reduction than if they were developed separately. “Development of a system, if developed simultaneously will yield greater total cost reduction than if each had been developed separately” [Graves, 2003, page 120].

Additionally, the integration between two or three management systems optimizes a mix of benefits that can play a vital role in realizing the principles of progress in any organization. "The advantages of integration of QMS and EMS are improvement in market position, savings of raw materials and costs, increase in workers’ motivation, simplification of procedures, and improvement of relation with authority and public" [Ebel, 2001, page 104]. Also, as seen from most investigations, there is a realization that cost reduction is more often the significant advantage from the integration process.

As depicted in **Figure 10.1**, the benefits are represented by two types: the first are those considered as common benefits, as briefly stated above and further elaborated on. The second type is the specific benefits that are derived from this thesis work under the constitution of “ITMS”.

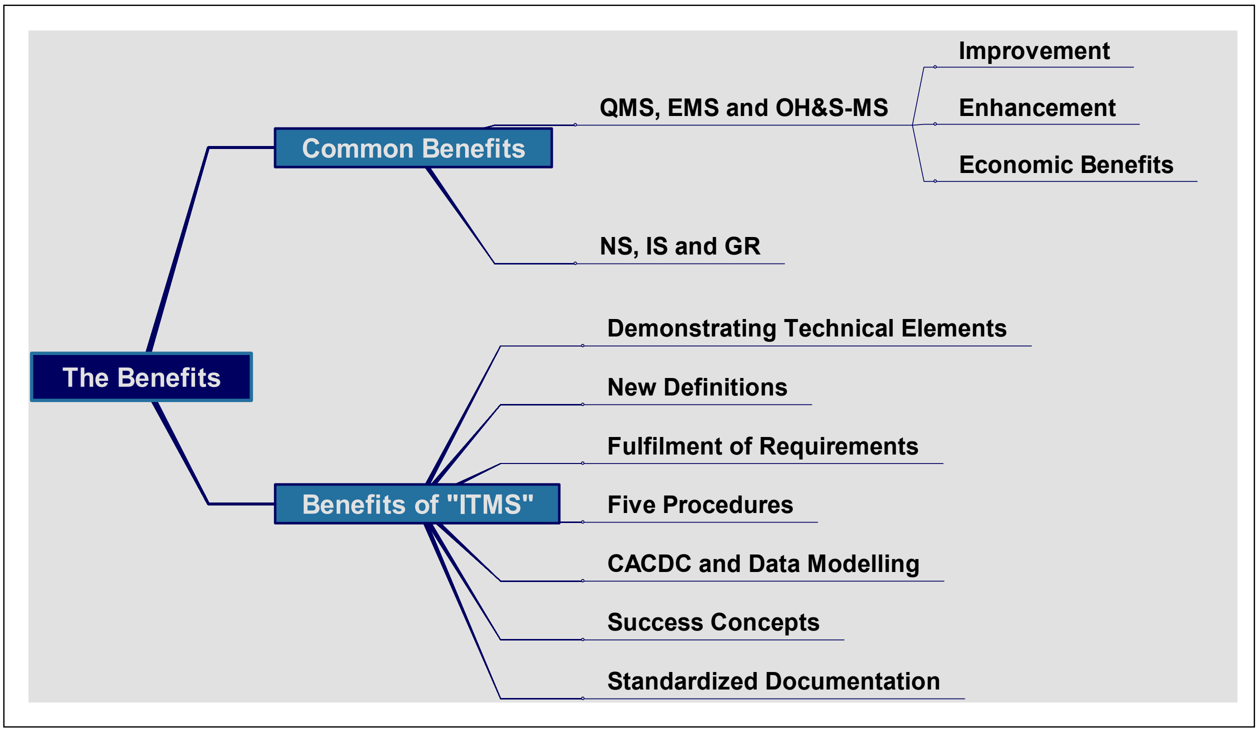


Figure10.1 *Benefits of Integrated Management Systems*

Common Benefits

Common benefits are those relating to outcomes from ordinary situation in designing and adapting management systems. They are benefits gained from implementing the three areas of quality, environment and OH&S and their unified policy.
Numbers of investigations have proved that it is impossible for any manufacturing organization and service industry to exist without quality, environment and OH&S issues and the benefits of their application, when transferred to an integrated management systems, would increase substantially. The benefits are explained in chapter 2.5 under "Comparable benefits between QMS, EMS and OH&S-MS"

In chapter 1.6 under "Motivations for an Integrated Technical Management System" the various motivations are considered to achieve the benefits of an integrated system. All these motivations described in the stated sections are the possible common benefits that can be obtained by constituting and implementing an integrated system.
Therefore the integrated management systems contain three types of benefits and they have to:

- improve - quality of products, operations and services, environmental aspects and surroundings protection, compliance with legal and regulatory requirements, control of defects and rapid correction, occupational health and work safety and relations with external parties.
- enhance - customers confidence and their satisfaction, pollution prevention and ability of resources conservation, continuous adherence to regulations, rules and laws.
- ensure - economic benefits by reducing operational costs, minimizing documentation, certification cost, training cost, saving time during operations, more efficient control on environmental aspects, accidents and risks, and prevention of costly mistakes by workforce. Also ensure removal of duplication of efforts in auditing, testing, inspection, documentation, recording, etc.

In chapter 3.4 in "Benefits of the NS, IS and GR", we see the positive outcomes of standards. Adhering to such standards leads to compatibility of various products, customer satisfaction, public safety and increased production efficiency. Furthermore, standardization hugely reduces losses caused due to undermining the critical elements to be considered for producing high quality goods, managing environmental preservation and handling OH&S aspects successfully.

Benefits of "ITMS"

These benefits are concerned with the outcome of this thesis work and are to be expected from constitution, implementation and operation of the "ITMS". It contains several benefits specific to this thesis work and are described as follows:

a) Demonstrating Technical Elements

Demonstrating the role of technical elements is useful in order to activate them in overall operational manufacturing and service industries. Here demonstrating means series of processes such as classifying them according to their faces (RTA, Technology, Engineering), discovering their range of importance, finding places which need the introduction of certain technical elements, bringing similar elements closer to each other as preface for unification, defining their lacks and gaps, discovering the places that do not use them or don't have them. Description of their vital role in making an organization active is explained in detail in chapter 1.4.3.
Such a demonstration of technical elements leads to a higher accuracy, efficiency and reliability in operations, and increases the assurance of environmental protection and occupational health and safety of the workforce. Intensive consideration to technical elements is required in most certification procedures. The most important factor of demonstrating technical elements is the use of technical elements in the unification, which is one of the five procedures to be followed for the constitution of "ITMS". Hence technical elements form the basis of this new management system constitution.

b) New Definitions

During this investigation on the technical integration process certain new forms of definitions were obtained in the context of their interrelation with each other. This interrelation is more clear through their application because they execute common goals and deal with similar issues of quality, environment and OH&S.
Such an interrelation can be understood by the important triangle relation of customer-organization-product as mentioned in chapter 2.1.4.
The new definitions come into effect only in context of the three areas, without their integration these new definitions have no meaning.
Therefore, these new definitions will add new power into the overall benefit by strengthening three areas objectives, and enable organizations to have a better understanding of several requirements that must be fulfilled.
These new definitions show a new direction for building new dimensions of requirements by NS and IS. In addition, it establishes a necessary situation for interested parties to change regulations, rules, laws and orders, and issue new ones in order to eas-

ily reach all goals of customers, organizations and products in a balanced level without any lacks and their specifications in terms of quality, environment and OH&S.

c) Fulfilment of Requirements

It is true that concentrating on one area (quality, environment or OH&S) will lead to the strengthening of that area towards its goal, but during processing of this single area, the other two areas may perhaps be neglected and their requirements will not be fulfilled as it is needed. On the other hand, its known clearly that several activities need to be performed in any operational process or service. There are requirements from each one of customers, national and international standards, workforce, public, agencies, authorities, government, other organizations, etc, as well as those concerned with high quality level, environmental media protection and OH&S performance.
The question here is: how could all this be achieved? And how to fulfill these requirements at the same time?
One way to do this is by the technical integration process. The constitution and implementation of an integrated technical management system assures this aim through achievement of all of them in the same place and at the same time.
As explained above the new definitions will give organizations the better understanding of several requirements concerning with input components of the constitution process and fulfilling them in a balanced level so as not to forget any one of them.
The “ITMS” is a single way to satisfy all these requirements without missing out any of the demands of organizations, customers, government, standards, agencies, society and so on. **Figure 10.2** shows the requirements that could be fulfilled by “ITMS”.

d) Five Procedures

In the technical integration constitution process, certain procedures must be achieved, such as portioning, unification, integration, standardization and implementation. All procedures have motivations for the “ITMS” constitution process as explained in chapter 6 under sections 6.3, 6.4.1, 6.5.2, 6.6.2 & 6.7.1, but at the same time each procedure holds some benefits towards objectives and targets of quality, environment and OH&S.
The main purpose of the portioning is to demonstrate vital role of all parts of operations, products and services and make them active in order to improve quality, environment and OH&S in their working and outcome. Deep portioning and higher number of portions leads to a more clear situation, and this helps extensively in gaining the objectives and targets because large number of portions will include tasks of quality, environment and OH&S.

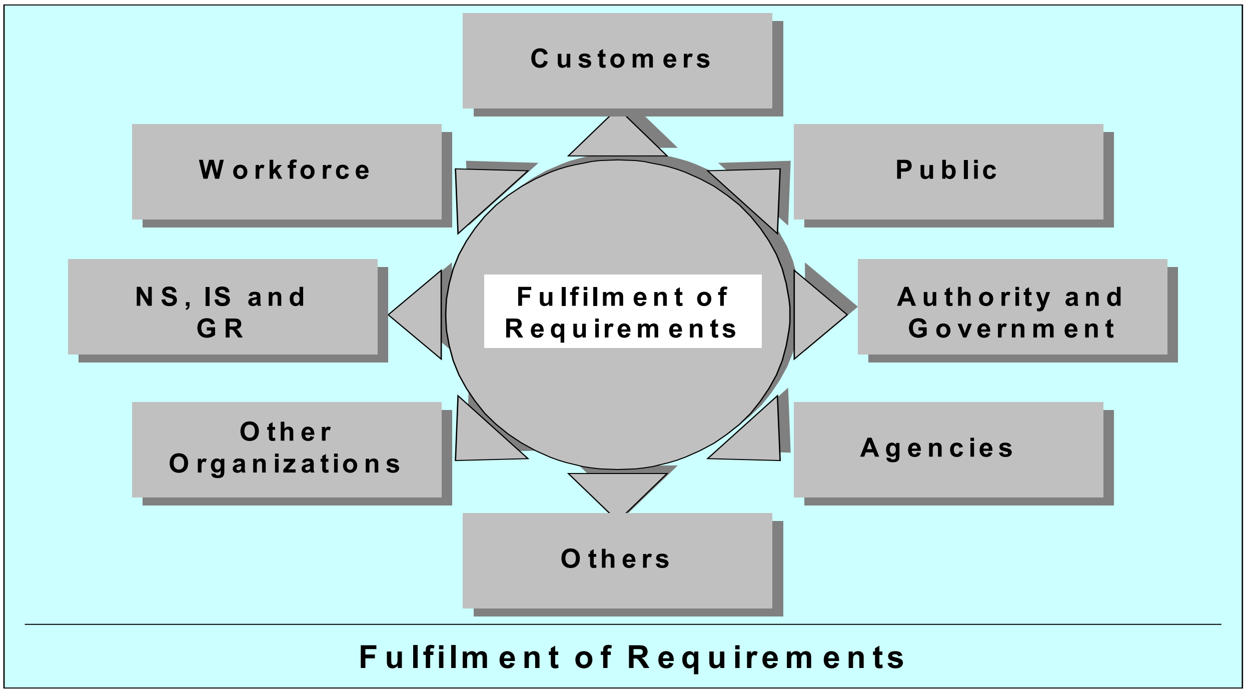


Figure 10.2 *Fulfilment of Requirements by "ITMS"*

The portioning helps in rapidly discovering RTA which need to be unified. By it, the continual improvement enters into every place and even smaller portions are not neglected. It helps to discover lacks or gaps in order to fill them. Also, better standardization could be performed because portioning will exhibit all parts to be standardized.
Under organizational structures, the jobs and duties of workforce will be more clear and professional, and the members will be more able in their coordination about various issues of quality, environment and OH&S.
The unification and CIC function will reduce the volume, cost and efforts, and under them additional loads can be removed, risks minimized, hazards and accidents reduced and exchange of information between departments becomes more active. The CIC function of the integration procedure will make technicians gain more skills and training in subjects about the three areas.

The standardization results standardized operations, products and services according to NS, IS and GR and problems can be easily solved. It transmits all benefits of standards and regulations into the operations and products, and it verifies higher quality, more environmental protection, and increase in occupational health and safety. And the standardization gives a stronger ability for solving problems, design and stability, and ensure that the standards will enter into all organization's tasks.

e) CACDC and Data Modelling

The computer-aided collection data centre has many benefits. Through an established CACDC, the standards could be imposed in overall operations and manufactured products, because it streams and distributes NS, IS and GR to where they are needed.

It makes rapid distribution, transformation and movement of the actual data and information inside and outside an organization, received and provided just in time with effective cost, higher quality and safety. Another benefit is that it makes effective formal connection between the centre and ISO, NSO, agencies, government, associations and institutes, and also between customer's ideas and requirements with the team of "ITMS", and it helps to make decisions as well, i.e. decisions should be taken just in time needed for various operations and during events.

The other benefits of data modelling are that it shows all details about operational manufacturing, products and services, and about attributes and parameters of quality, and detailed environmental aspects and ecology, risks, accidents and hazard identification. It also provides finer details of portions, and indicates failures, weak points and gaps.
It provides a transactional mechanism to control revised information and stores overall information of integrated technical management systems.

f) Success Concepts

Success concepts are active tools used for achieving the integrated technical management systems as explained in chapter 8, and they lead to series of benefits for the organization. Adapting technical compliance and balancing, facilitates organizations to follow national and international standards, regulations codes, laws, rules and guidance. The concepts assure the compliance between all attributes relating to organizational, operational, products and external structures. As an example here of a product, that its attributes must be in compliance with each other such as size, volume, nature, composition, compound, colours, viscosity, resistance, packaging shape, measures, etc. because without this, the product will be of low quality and would lead to adverse impacts on environment and OH&S performance.

Adapting equilibrium among RTA gives further benefits, i.e., it makes that all requirements are in conformance with each other during their application in operations and products. This conformity is a provision for success of the application of all clauses of international standards, because it could not be possible to achieve conformity between some and leaving out some others. The equilibrium makes three areas to be in a higher level in all departments, and it makes the integration stronger and assists in a more successful degree of implementation.

PCT as a success concept, as described in chapter 8.2.3.3, demonstrates and analyzes its faces of performance-cost-time to provide more benefits. Its adaptation helps to achieve higher quality and service level, and enables organizations to effectively manage and optimize time and cost. It leads to higher degree of standardization and robust processes. Additionally, it leads to obtain the actual demands by customers, society and public.

g) Standardized Documentation

The establishment of a standardized documentation is beneficial for the organization in various ways as explained in chapter 9.3.1 because it contains details of QMS, EMS and OH&S-MS and description of technical elements that are necessary for any organization working towards the goal of having the precise three areas. The SD provides the basis of effective work performance and developing methods. It gives a clear framework of operations and product specifications, scope of training, and provides answers and solutions of real problems. Also it explains installation and needed maintenance, instructions of procedures, applicable forms and lists, and basis of auditing the systems and its evaluation.

SD clarifies duties of every member, and defines their responsibility levels and helps their actions to be performed accurately and removes any confusion in the technical integration. It works as a source of details regarding all management systems and contains all necessary standards and general regulations.

Chapter- 11 Conclusions and Outlook

Today organizations of the manufacturing business and service sector are facing higher quality requirements. Additionally, the standards for environmental protection, regulations for occupational health, workforce and public safety have become more stringent. Due to the permanent increase in manufacturing products and energy consumption, most industries, manufacturers, distributors, vendors, suppliers, customers and consumers require higher level of quality, stronger environmental protection and increased occupational health and safety (OH&S) performance. This fact makes it necessary to design an integrated management system that meets all these requirements and that complies at the same time with national and international standards, regulations, rules, laws, guidance, and so on.

Current literatures have investigated and shown several developments about integrated management systems, many of which reach their specific goals. Some imperfections still remain, as most publications do not focus on the technical elements, which are very important in every organisation. And some of them tried to integrate two management systems instead of three. Moreover, they did not portion the organization's tasks and there were only vague descriptions of the constitution process of an integrated management system. Also there was no attempt for establishment of a computer-aided collection data centre and data modelling, nor was there a provision of a framework for constitution of integrated systems and most studies used old versions of standards.

Because of these problems, this thesis work intends to remove these lacks by constituting a standardized integrated technical management system of quality, environment and OH&S called "ITMS". This is achieved through connecting three main aspects of customer, organization and products, demonstrating and activating the huge roles of technical elements and giving the same level of attention to all. The work presents five procedures for "ITMS" constitution process under the guidance of ISO 9001:2000, ISO 14001:2003 standards, and OHSAS 18001:1999, ISO 16949:2002 and EFQM-Model. Establishing a computer-aided collection data centre, data modelling and standardized documentation are assistance tools for this purpose.

Thus, here the goal of this thesis is constitution and implementation of an integrated technical management system of quality, environment and OH&S and its effective operation inside all places in any organization of all types and sizes. Here, the core part for this process is the technical elements. Activating technical elements in the organization, classified them under related activities, technologies and engineering basics, will guarantee the higher quality goals for production, products, services, environmental protection, occupational health and safety of workforce and external public.

Also, the framework of the integrated technical management systems can be conceptualized from four main groups. They are the internal and external participants that describe who are to be introduced into the process, input and output components that explain what needs to be inserted into the system and what results can be obtained, kinds of technical integration that can be followed, and finally the general columns that refer to the pillars of the technical integration constitution process.

First step in the introduction of integrated technical management systems is the portioning of an organization into four structures: organizational structures, operational structures, products structures and external structures, which represents the entire tasks and duties of an organization. And also each of the four structures can be further portioned into smaller parts.

The unification is the following procedure that occurs between technical elements. It unifies related technical activities having common or similar actions, and combines using or handling of technology in favour of achieving common goals of quality, environment and occupational health and safety. Also it unifies engineering basics like process designing and process calculation for manufacturing of a product while keeping up with the issues of the quality, environment, and occupational health and safety.

The integration as a procedure, is carried out on management systems of unified technical elements by bringing all processes, operations and workforce together and integrating them to constitute one structure and equating their functions as a combined band. Integration is accurately applied by a series function of coordination-intersection-combination of the respective management systems of quality, environment, and occupational health and safety.

The procedure of standardization is carried out by the imposition of standards and regulations in integrated technical management systems and every aspect like the workforce, duties, equipments, etc. of the organization. Standardization also takes place under the assistance of tools like modification, arrangement, calibration, etc.

Finally the practical function of application of integrated technical management systems is done by implementation procedure and its execution into all structures and their smaller portions. In this way a higher degree of integration could be achieved.

In application of integration in an organization and their departments there are some suitable kinds like total and partial integration, vertical and horizontal integration, etc. which can be introduced as per the suitability of the location.

An organization produces goods but acts as customer who receives raw materials or semi-products. The customer is user and consumer of products in sight of quality, whereas in sight of environment he represents aspects of water, air and soil that could be polluted and in sight of OH&S he is a worker on equipments who could be affected by accidents. The product is a result of an operational manufacturing or service in sight of quality, and can be an environmental change in sight of environment, but in sight of OH&S, the product's implication is transformed to performance level of occupational health and safety.
Thus, the definitions have interrelation in sight of quality, environment and OH&S and they change their meanings according to the task being performed by them. Discovered here in the wake of this study, in the context of integrated technical management systems is that the interrelations in the definitions of customer-organization-product have a deeper and wider meaning interchangeable concerning to quality, environment and occupational health and safety, as compared to a single management system.

This thesis professes some considerations and special rules that must be considered for effectiveness of integrated technical management systems constitution. A comparison between a project execution and "ITMS" constitution gives a clear idea on how to plan and constitute an integrated management system. Technical cycle among quality, environment and OH&S makes easier understanding of the operation of "ITMS". A set of special rules are necessary for effective constitution, precise implementation and minimizing any drawbacks.
These rules state that every small part or portion in any operation or product has an essential role in the overall integration process, without which, the complete integration is not possible and objectives and targets are not completely fulfilled. In any operational manufacturing or products there is a mutual dependence of all parts with each other and a small part with the whole.
Complete integration can be successfully achieved by removal of any gap if existing in any operation or product by complete "ITMS" implementation and here the total integration is equal to the sum of all partial integration in four structures, their smaller portions and organization's department.

There are no specific national or international standards and regulations for designing an integrated management system, but there are calls by them to make unification and integration. This thesis referred to many requirements of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999 that demand or call for unifying and integrating management systems namely quality, environment and OH&S. Quite a few of their clauses are presented. The same thing stands true for ISO 16949:2002 and EFQM-Model.

According to above, the thesis gives a detailed framework of an internationally usable "ITMS" model as a basis for the constitution of an integrated technical management system for any type and size of an organization.

Efficient management of integrated technical management systems is due to many factors. An organizational structure needs to be established and makes position of "ITMS" clearly in the organization and designates a specific team of "ITMS" to manage, direct and maintain all its issues and tasks.
An information management system must be set up because of the importance of data and information and their vital roles in managing "ITMS". A computer-aided collection data centre is a suitable way for handling and circulating data and information inside organization's department and with related external parties. The thesis describes all variations of networking in each type and size of organizations. Data modelling is necessary for showing more details of the four structures and products, and for finding any drawbacks.
The standardized documentation (SD) is another requirement needed in order to manage documentation of "ITMS". SD provides references of management systems, specific instructions, description of operations and technical activities, instructions of all procedures, and execution of all works, and provides application forms, lists of all standards and regulations, essential documents and other description forms.

This thesis also illustrates how constitution of "ITMS" can be performed in an enhanced way with the aid of success concepts, auditing and evaluation. Technical compliance and balance is a success concept that issues the suitability conditions between all portions of four structures in order to be compatible with each other and at the same time to be in accordance to the standards, and be compliant with customer needs with other requirements and it is also useful to show the possibilities of compatibility between the portions. Similarly, the equilibrium among related technical activities leads to making or producing of equivalent objects or status between articles of quality, environment and operational health and safety. It helps us to remove nonconformity between their operations.

The criteria of performance-cost-time which represented connection between three important roles of performance of "ITMS" operation, cost of "ITMS" constitution and time of "ITMS" implementation. A balance between these three criteria will give more power to the integration process. Auditing checks and reviews of all the activities and processes, records, information, statistics and events regarding the "ITMS" performance. The auditing helps the purpose of meeting goals, finding gaps, finding drawbacks or any mistakes happening during operation of the integrated technical management system, and observing the correct working of the success concepts.

Continual improvement is what makes most organization successful by continuously checking and correcting any drawbacks in the system. The Plan-Do-Check-Act (PDCA) cycle is one of the most useful tools for effective continual improvement. Evaluation gives the idea as to what level of success has been reached in comparison to the planned level. Evaluation shows the quality of "ITMS" in each part and portion and highlights any existing gaps. Any of success concepts, auditing process and continual improvement achievement are evaluated in order to bring about the necessary changes wherever required.

This thesis describes the benefits under two kinds, first those that are estimated as common benefits and generated by an integrated management system, which are proved in many previous investigations and cases. Second are the benefits related to efforts of this thesis work and assessed as specific benefits. They are concerned with subjects of internal processes and their outcomes give complete set of advantages to be derived from the application of "ITMS".

The outlook of standardized integrated technical management systems is to interpret and respond to the current situation and the expectations of the future. "ITMS" identifies and removes the existing drawbacks or lacks in organizations by successful integration and implementation.

It is realized that technical elements will be expanding due to developments in technology and this will generate a new situation that brings more load on the organization. Similarly maximizing of required quality goals, environmental protection and OH&S form further duties for the organizations. On this basis the technical elements are expected to play a larger role each day. To resolve this complexity the planning of continuous demonstration of all technical elements is preferred. Therefore demonstrating them is expected to balance this growth.

Because of increasing qualitative and quantitative sets of requirements relating to (customer, workforce, public), (quality, environment, OH&S), (products, operations, energy and service) and (technical elements), there is a need for the right attitude to determine the necessary actions to respond to this situation for problem solving and continuous improvement. There is a need to foresee into the future and think of a strategy to work with the ongoing developments to meet these requirements. The "ITMS" provides the necessary solution for all these requirements.

Many national and international standards and general regulations have been changed in the last decade, as the old versions have been changed from 1994 to 2000 (ISO 9000), from 1996 to 2003 (ISO14000), from 1999 to 2002 (ISO/TS 16949), from 1989 to 2005 Forum (EFQM) in order to make worldwide business more competitive and compliant to the latest developments.
Therefore, in future, it could be predicted that "ITMS" will develop the need for interested parties to bring about changes in the standards and regulations and issue new ones to achieve continuous changes of requirements of the customers, products and

services in balancing with the developed technical elements and according to objectives and targets of high level of quality, environmental protection and OH&S performance.

Appendix (A)

Unified Policy

A.1:

The following is an example of a unified policy for integrated technical management systems suitable for mechanical, chemical and electrical manufacturing firms.

We consider that our activities are more important with:

[Quality, Environmental Protection, and Occupational Health & Safety]

We are obligated in our operational manner to provide high standards of quality, environmental protection, and occupational health & safety to all our employees, customers, visitors, contractors and general public.

We recognize quality, environmental protection, and occupational health & safety performance as key factors within our business.

For this purpose we will

1. use the national and international standards, public and legal requirements, and general regulations as minimum criterion.
2. encourage the responsibility of all our workforce.
3. review and monitor our own performance regularly.
4. use highly experienced teams to achieve our goals and objectives.
5. ensure the availability of all necessary resources to make compliance with this “ITMS” policy.

Date: 00.00.0000

Signed by
Chief Executive Officer

A.2:

The following is an example of a unified policy for integrated technical management systems suitable for service organizations such as logistic, transportation, hazardous substances storage, packaging and handling of products.

Our
QUALITY, ENVIRONMENT AND OH&S POLICY

✓ our
basic task is to enhance constantly our customer satisfaction and requirements and to provide the best possible value through efficient, reliable and advanced technology.

✓ our
integrated technical management systems show evidence of high quality, environmental protection and occupational health & safety for our workers, customers and external clients.

✓ our
quality as leader of our logistic services is secured strongly by our continual improvement.

✓ our
awareness of our tamwork performance is crucial to maintain our worldwide security.

✓ our
training programmes for our workers are the key to achieve our goals.

✓ our
responsibility is revealed in compliance with national and international standards, regulations, laws, rules, codes and overall requirements.

Date: 00.00.0000

Signed
MANAGING DIRECTOR

A.3:
The following is an example of a unified policy for integrated technical management systems suitable for industry and service organizations.

(X): is the name of the firm

The management of **(X)** firm aims a high quality level, a large scale environmental protection and effective occupational health & safety.

<u>Firm **(X)** guarantees to meet all:</u>

- standards of quality.
- standards of environmental protection.
- general regulations of occupational health & safety for workers and clients.

<u>Because **(X)**'s strategy is based on continuous actions for :</u>

- striving for quality, services and environmental protection.
- strict observation of all regulations, instructions, laws, codes and orders concerning occupational health & safety for any internal and external party.
- offering good prices, in-time with safe delivery and satisfaction.
- efficient use of raw materials, energy and waste products.
- communication with the customers.

Date: 00.00.0000

Signed	Signed	Signed
Director of Department	Manager	Managing Director

Appendix (B)

“ITMS” Applicability

B.1:

The following table shows a classification of organizations of manufacturing, production and service industries and public sectors that can apply the “ITMS” in their tasks and operations.

Manufacturing and Production Sectors			
01	Agricultural production	15	Leather and leather products
02	Clothes and textile products	16	Lumber and wood products
03	Chemicals and allied products	17	Metal mining
04	Coal Mining	18	Miscellaneous manufacturing industries
05	Concrete, clay and glass products	19	Non-metallic minerals, except fuels
06	Electronic and other electrical equipments	20	Oil and gas extraction
07	Fabricated metal products	21	Paper and ally products
08	Food products	22	Petroleum and coal products
09	Forestry	23	Primary metal industries
10	Furniture and fixtures	24	Printing and publishing
11	General building contractors	25	Rubber and plastics products
12	General construction, except buildings	26	Special trade contractors
13	Industrial machinery and equipment	27	Tobacco products
14	Instruments, clocks, optical goods	28	Transportation equipment
Service Sectors			
29	Accessories and goods stores	39	Equipment repair services
30	Agricultural services	40	Food stores
31	Automotive service stations	41	Health services
32	Business services	42	Hotels and residence places
33	Building materials supplies	43	Passenger transits
34	Communications	44	Pipelines (gas, water, chemical…)
35	Eating and drinking places	45	Real estate services
36	Educational services	46	Security
37	Electric, gas and sanitary services	47	Transportation of goods
38	Engineering & management services	48	Warehousing of products
Public Sectors			
49	Administration of human resources	53	Housing and reconstruction
50	Administration of economics	54	Justice and legislative
51	Environmental quality and health	55	Local and regional governments
52	Finance, taxation and monetary	56	Public establishments

Table B.1 *Types of Organizations*

B.2:

The following table shows the types of engineering sciences where "ITMS" can be applicable in their technical elements.

Engineering Sciences	What they do	Technical Elements
Aeronautical	Design, manufacturing, operation and maintenance of air vehicles, such as aircrafts and helicopters	Designing, manufacturing, development and maintenance
Aerospace	Aviation, space exploration, missiles development	Designing, development, missile test and supervision
Agricultural	Food production processes and machinery	Systems design for soil and water resources, machinery and farm structures
Architectural	Design of concerned with building issues as space, environment, light, sound, sight, etc.	Designing, planning, calculation and improvement
Biomechanics	Fluid mechanics and medical issues	Designing deformation systems
Biomedical	Design medical equipment and materials as diagnosis devices, artificial materials, metal alloys, ceramics and human body	Designing, Instrumentation, application, measuring and developing
Chemical	Design plants and operations, chemical processes and materials	Designing, processing, mixing, coating, extruding, filtering, combusting and liquidating
Civil	Design and build buildings, bridges, construction of halls, dams, sanitary, stores, etc. used by the public	Designing, planning, constructing, executing and managing
Computer	Design and constitute hardware and software, and programming with the aid of computers	Designing, planning, calculation and developing
Construction	Plan, design and supervise buildings	Planning, designing, surveying, estimating and procuring
Electrical	Design electrical devices, power generating and distribution, stations and motors	Designing and working on producing electricity distribution, operating and controlling
Electronic	Design and production of electronics	Designing, developing, manufacturing and application
Engineering Management	Combine engineering and business, focus on research and development and operations	Planning, organizing, directing, controlling, developing, analyzing and modelling
Environmental	Design processes relating to environmental issues	Designing, testing, inspection, developing and controlling
Ergonomics and human factors	Study of human work and movement, systems, equipment, work environment, physiological and biomechanical aspects	Designing systems to make it fit between people, equipments, environment, systems and workplace
Fire protection	Design methods, instruments and alarming systems for fire control and protection in buildings and structures	Designing, planning and controlling

Geological	Work on recovery of earth's minerals	Designing, organizing, controlling, developing and discovering
Industrial	Help organizations to operate efficiently as industrial operations and integrating people, materials and energy in productive ways	Designing, operation, controlling and developing procedures
Logistic	Transport, storage, distribute and warehousing of raw materials and goods	Designing, directing, supervising and developing
Manufacturing	Design manufacturing operations and products	Designing, manufacturing, processing and controlling
Materials	Develop new materials to improve products	Designing, controlling, testing and developing
Mechanical	Design and develop all mechanical things as machines, equipments, instruments, production and service lines	Designing, operating, maintenance and management of machinery and production lines
Metallurgical	Focus on the processes relating to metals	Designing, processing and developing
Mining	Design processes relating to mining	Designing, controlling and developing
Naval	Design and operation of ships and marine craft	Designing, construction, operation and maintenance
Nuclear	Focus on the processes of nuclear power plants	Designing, construction and operation of nuclear reactors
Petroleum	Find oil and gas and design things like oil wells	Discovering, maintenance and controlling
Quality	Deals with the principles and practices of product and service quality assurance and quality control	Designing methods, continual improvement, controlling, documenting and conformance
Safety	Occupational health and safety of workers, materials, equipments and analysis of risks and hazards	Designing methods, controlling, application and analyzing
Software	Design and constitute software for computers	Designing and developing
Structural	Plan and design various structures	Designing and planning
Surveying	Determine correct locations for projects	Planning, determining locations and drawing
Systems	Know how to manage and ensure the standards, groups of resources and manufactured goods	Designing, managing and controlling resources
Traffic	Design of safe and efficient traffic systems	Designing, marking, modelling, controlling and networking traffic systems
Transport	Ensure the safe and efficient movement of people and goods	Designing, modelling and controlling transport movement
Urban Planning	Buildings and arrangements	Designing, planning, traffic flows and improvement

Table B.2 *Types of Engineering Sciences*

Appendix (C)

A Composed Framework for an Internationally Usable “ITMS”-Model

1 Scope

Any organization that intends to plan and design a management system and is concerned with the issues of quality of products and services, environmental protection and occupational health and safety issues must base its tasks and activities on the related international standards. ISO 9001:2000 specifies requirements for an effective quality management system that helps an organization to provide products and services that meet customers and applicable to regulatory requirements. ISO 14001:2003 specifies requirements for an environmental management system to implement, maintain and improve environmental protection, and the Occupational Health and Safety Assessment Series OHSAS 18001:1999 gives requirements for an occupational health and safety (OH&S) management system that enables an organization to control its OH&S risks and improve its performance.

2 Terms and Definitions

In order to make the content more understandable and to maintain this framework, the main concepts and terms are defined in the following:

- Policy: It is a unified strategy of integrated technical management systems which includes all three policies of quality, environment and occupational health and safety.
- Organization: It wishes to constitute or design an integrated technical management system for its tasks and activities related to the quality level of products and services, environmental protection activity and OH&S performance.
- Customer: who will receive the results of the integrated management systems
- Objectives and targets: overall objectives, goals and targets related to perform the high level quality, environmental aspects and surroundings protection, and successful occupational health and safety performance.
- Integrated technical management systems: It is the standardized technical integration process of QMS, EMS and OH&S-MS, it can be named as new system.
- Standards: These comprise of national and international standards.
- General regulations: regulations, rules, laws, codes, guidance, etc.
- Top management: the highest management responsible which could be represented by a managing director or executive general manager.

3 Management Systems

Consist of management systems of quality, environment, and occupational health and safety that are active in the organization.

4 General Requirements

The organization should establish, document, implement and maintain an integrated technical management systems in accordance with the requirements of ISO 9001:2000, 14001:2003 and OHSAS 18001:1999 and determine how they will fulfil these requirements, and continually improve effectiveness of the new system according to the standards and regulations.

5 Policy

The top management must define a documented, implemented and unified policy that must be communicated to workforce, understandable for them and available for the public, in order to ensure that it is appropriate to:

- quality purposes of the organization
- nature, scale and environmental impacts of its activities, products and services
- nature and scale of the organization’s OH&S risks

6 Planning

6.1 Setting up of Objectives and Targets

The organization should define, establish and maintain procedures for:

- quality objectives and other product requirements
- environmental objectives and targets for pollution prevention, at relevant functions and levels within an organization, and be compliant with legal and other environmental requirements
- ongoing identification of hazards, risk assessment with respect to the scope and the nature
- indicated participants of constitution process of the integrated technical management systems and determine input and output components

6.2 Addressing Significant Aspects

The organization must address significant aspects to its operation. Those help to obtain a higher level of quality, environmental protection, occupational health and safety performance and lead to continuous and effective improvement so that it complies with the requirements of related International Standards. For this purpose the organization must:

- identify the necessary processes for the quality management system, environmental management system and OH&S management system and their application throughout the organization
- determine its technical elements that should be unified
- determine the sequence and interaction of the different processes
- provide classification of quality failures, adverse impacts on the environmental elements and risks and hazardous materials
- ensure the availability of resources, data and information, tools, facilities and other supports and planned results

6.3 Identification of Resources

A responsible management should ensure and provide the resources (humans, machines, equipment and so on) to support integrated technical management systems in order to be constituted and then operated, with special regards to those resources and tools that are necessary to improve the integrated systems.

6.4 Identification of Needs and Critical Issues

In order to achieve more benefits and obtain objectives and targets the top management must assure that:

- entire planning of the constitution process and its implementation is carried out
- the completeness and accuracy of the management systems are preserved when changes are to be planned and then implemented
- customer requirements, general regulations, orders by authorities, instructions by agencies and associations are effectively satisfied and determined

6.5 Planning of Operational Processes

The organization must establish and maintain the planning of operational processes needed for the realization of objectives and targets. The output of this planning should be suitable for the organization’s application. This includes:

- necessary processes and resources needed in order to assure the achievement of objectives and targets and these must be supported by appropriate documentation
- requirements determination for verification, validation, monitoring, inspection, measurement, and test activities for products and operations

7 Organizing and Leading

7.1 Leadership Team

The top management must ensure that a leadership team of the integrated technical management systems is established and distributed according to professional standards to all levels of the organization. The leadership team manages controls and ensures that each member of the team has knowledge about quality, environment and occupational health and safety issues.

7.2 Roles and Responsibilities

The roles, responsibilities and authorities of the team members must be defined, documented and communicated in order to facilitate effective operation of the integrated technical management systems. The line of their communication must be clearly stated.

7.3 Management Representatives

The top management should appoint some members as specific management representatives who, irrespective of other responsibilities, must have tasks and authorities that include:

- assurance that all processes which are needed for the new system are established, implemented and maintained,
- reports of any information and disadvantage to the top management or other executive management that are related to the improvement of the quality, environmental protection progress, OH&S performance and any basic need for development and review

7.4 Internal Communication

The organization must ensure that appropriate communication process is established within all departments of the organization and it assures effective operation of the new system and a pertinent interconnection is maintained between the various levels and functions.

8 Operations and Procedures

8.1 Operational Control

The organization must identify and establish operations and activities which are associated with the performance of objectives and targets. The organization must also establish control of documentation procedure. The organization must:

- control overall operations of technical integration process related to the identifiable quality of products, environmental aspects and OH&S risks
- design workplace, installations, machinery, operating procedures and work organization
- improve the quality of its operations, products and services
- minimize the adverse impacts on the environmental surroundings, eliminate OH&S risks and accidents

8.2 Customers Focus

The organization must ensure and determine procedures in order to

- make sure that the quality requirements of customers are being met and their satisfaction are enhanced under the process of continuous improvement
- identify the significant environmental aspects of the organization’s activities, products or services that can interact with the environment
- identify the hazards and risks associated with the task issues which need to be addressed
- evaluate the statutory and regulatory requirements that must be adapted

8.3 Procedures and Implementation

The organization must plan, identify and establish procedures for the constitution process of the integrated technical management systems of quality, environment, and occupational health and safety, and also for implementation within organization’s departments. The organization must:

- find out the technical elements within the organization
- determine structures and their portioning
- find out the gaps in order to fill them
- identify the five procedures of the constitution process and act on them
- ensure the overall resources and tools needed
- achieve actions for implementation

8.4 External Relationship

The organization must determine and implement an effective arrangement of relations with associated external parties such as customers, public, agencies, authorities and other organizations.

8.5 Product Realization and Emergency Preparedness

The organization must plan and develop the processes needed for product realization by determining overall requirements and its goals. The organization must establish, plan and maintain procedures to identify potential emergency situations and potential accidents that can have impacts on the environment, health and safety of the staff.

9 Resource Management

9.1 Management of Human Resources

The organization must determine and provide the human resources necessary for achievement of work performance, product quality, environmental protection and an effective OH&S programme and to ensure that they are competent on the basis of appropriate education, training, skills and experiences.

9.2 Management of other Resources

The organization must determine and provide other resources needed as:

- infrastructure of building, workplace and associated utilities
- equipments, devices, networked computers, control rooms, methods to networked communication, offices and movement accessories, and any other necessary instruments

10 Data and Information

The organization must design, ensure and maintain information management systems to handle actual data and transfer information among the departments of the organization. This may include:

- the description of the core elements of integrated technical management systems and its interaction
- a network of computer-aided collection data for an effective circulating data
- the establishment of specific methods for data modelling
- to build a system related and connected with departments, responsible management, customers and other related external parties

11 Documentation

11.1 General

The organization must establish, implement and maintain integrated technical management system documentation by employing suitable media such as paper or electronic. This includes:

- documented statements of unified policy
- a handbook
- documented requirements of procedures instructions, work instructions and applicable forms
- documents needed for planning, operations, success concepts, auditing, continual improvement and evaluation

11.2 Handbook

The organization must establish, define and maintain a handbook which consists of:

- contents, preface, general description and needs
- needed management systems
- scope of the integrated technical management systems and details of requirements and application
- Description of procedures of the constitution process, description of levels of documentation

11.3 Control of Documents

The organization must establish and maintain procedures to control all necessary documents and data to approve documents for its adequacy prior to issue and review periodically and revised as necessary by authorized personnel.

11.4 Control of Records

The organization must establish and maintain procedures for the identification and control of records of all procedures and operations.

12 Audit and Evaluation

12.1 Monitoring and Performance Measuring

The organization must establish and maintain procedures for monitoring and performance measuring. This includes:

- monitor and measure the characteristics of the product, adverse environmental impacts, and occupational health and safety performance
- monitor the extent to which the objectives and targets of the integrated technical management systems are met
- measure and achieve technical compliance and balancing, equilibrium among technical related activities, and follow the Performance-Cost-Time (PCT) criteria

12.2 Analyzing and Handling Nonconformities

The organization must establish and maintain procedures to analyse and control nonconformities. This tends to:

- identify actual non-conformities and mitigate their impacts
- investigate and eliminate the causes of actual non-conformities in order to prevent recurrence
- investigate accidents, incidents and non-conformances and take actions to mitigate any arising consequences from accidents

12.3 System Audit Process

The organization must establish a specific system audit process and conduct periodic internal and external audits do determine if the integrated technical management system:

- conforms to planned and constitution arrangements
- conforms to the requirements of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999, and other related national and international standards, and general regulations
- is effectively implemented and maintained
- has been properly implemented and maintained
- meets the organization's policies, objectives and targets
- the operation results are reviewed, reported and documented

12.4 System Evaluation Process

The organization must establish a specific system evaluation process, and conduct an evaluation programme to determine the continuous suitability of the new system during constitution process, implementation and its operation. This means:

- evaluate overall constitution process, implementation and its continual improvement
- evaluate compliance of its operations with national and international standards, and general regulations
- evaluate compliance of organization’s quality requirements, applicable environmental legal requirements and occupational health and safety regulations

13 Management Review

13.1 General

The top management must make efforts to review the constituted, implemented and operated organization’s integrated technical management systems depending on the planned intervals in order to:

- ensure a suitable, adequate and permanent obtaining of effective activities of quality, environment and OH&S
- assess the possibilities and opportunities for its development

13.2 Review Input

The management review must contain input information on various concepts and components of integrated technical management systems. Such as:

- group feedbacks like feedback of customers, products and services, and other external feedbacks as authorities, agencies and public
- results of system audit process and system evaluation process
- product and service conformity and process performance

13.3 Review Output

The management review must contain output decisions and actions on various concepts and components of the new system. They are related to:

- promote the effectiveness of the integrated technical management systems and its operation
- required resources and support tools

14 Improvement

14.1 Continual Improvement

The organization must continuously improve the new system through:

- a unified policy
- overall objectives, targets and programmes
- audit and evaluation results
- an analysis of data and information
- a corrective and preventive action
- the use of methods and tools of continual improvement and decision-making

14.2 Corrective Action

The organization must take corrective actions to eliminate the causes of the non-conformities in order to prevent recurrence. Corrective action must be appropriate to increase effectiveness of the systems.
The documented procedures must be established to define the:

- review of non-conformities at all levels of requirements related to customers, products, and other external parties instructions and orders
- needed action for new systems operation
- review of corrective actions

14.3 Preventive Action

The organization must determine the action to eliminate the causes of potential non-conformities in order to prevent their occurrence. Preventive actions must be appropriate to the anticipated potential problems through constitution and operation of the integrated management systems.

The documented procedures must be established to define the:

- potential non-conformities and their causes
- needs of the implementation
- review of preventive actions

Appendix (D)

Common Elements of “ITMS” Framework

The following shows the elements of a composite framework for an internationally usable “ITMS” model with reference to the requirements of ISO 9001:2000, ISO 14001:2003 and OHSAS 18001:1999.

Nr.	“ITMS” Framework Elements	ISO 9001:2000 Clauses	ISO 14001:2003 Clauses	OHSAS 18001:1999 Clauses
1	**Scope**	1	1	1
2	**Terms and Definitions**	3	3	3
3	**Management Systems**	4	4	4
4	**General Requirements**	4.1	4.1	4.1
5	**Policy**	5.3	4.1	4.2
6	**Planning**			
	6.1 Setting up of Objectives and Targets	5.4.1	4.3.3	4.3.3
	6.2 Addressing Significant Aspects	4.1	4.3.1	4.3.1
	6.3 Identification of Resources	6.1	4.4.1	4.4.1
	6.4 Identification of Needs and Critical Issues	5.4.2/ 7.2.1	4.3.1	4.3.1
	6.5 Planning of Operational Processes	7.1	4.3.3	4.3.4
7	**Organizing and Leading**			
	7.1 Leadership Team	5.5	4.4.1.a	4.4.1.a
	7.2 Roles and Responsibilities	5.5.1	4.4.1	4.4.1
	7.3 Management Representatives	5.5.1	4.4.1.b	4.4.1.b
	7.4 Internal Communication	5.5.3/ 7.2.3	4.4.3	4.4.3
8	**Operations and Procedures**			
	8.1 Operational Control	7.2/ 7.3/ 7.4/ 7.5	4.4.6	4.4.6
	8.2 Customers Focus	5.2/ 7.2.1	4.3.1	4.4.1.a
	8.3 Procedures and Implementation	4.1.a.b.d.f	4.3.2/ 4.3.3.a	4.3.2/ 4.3.4.a
	8.4 External Relationship	7.2.3.b	4.4.3.b	4.3.2
	8.5 Product Realization and Emergency Preparedness	7.1	4.4.7	4.4.7
9	**Resource Management**			
	9.1 Management of Human Resources	6.2	4.4.1/ 4.4.2	4.4.1/ 4.4.2
	9.2 Management of other Resources	6.3/ 6.4	4.4.2.b	4.4.1
10	**Data and Information**	7.4.2/ 8.4	4.4.4.b	4.4.5/ 4.4.5.e
11	**Documentation**			
	11.1 General	4.2.1	4.4.4	4.4.4
	11.2 Handbook	4.2.2	4.4.4.b	4.4.4.a
	11.3 Control of Documents	4.2.3	4.4.5	4.4.5
	11.4 Control of Records	4.2.4	4.5.4	4.5.4
12	**Audit and Evaluation**			
	12.1 Monitoring and Performance Measuring	8.2	4.5.1	4.5.1
	12.2 Analyzing and Handling Nonconformities	8.3	4.5.3	4.5.3
	12.3 System Audit Process	8.2.2	4.5.5	4.5.4
	12.4 System Evaluation Process	7.5.2	4.5.2	4.5.2.d
13	**Management Review**			
	13.1 General	5.6.1	4.6	4.6
	13.2 Review Input	5.6.2	4.6	4.6
	13.3 Review Output	5.6.3	4.6	4.6
14	**Improvement**			
	14.1 Continual Improvement	8.5.1	4.5.3	4.5.2
	14.2 Corrective Action	8.5.2	4.5.3	4.5.2
	14.3 Preventive Action	8.5.3	4.5.3	4.5.2

Appendix (E)

Checklist of Gap Analysis of “ITMS” Framework

The following is the gap analysis checklist of the “ITMS” framework which makes it possible to identify easily the existing gaps, remove them and constitute a totally integrated system.

Nr.	“ITMS“ Framework Elements	Three Areas 3A		
		Quality	Environment	OH&S
		Yes or No	Yes or No	Yes or No
1	**Scope**			
2	**Terms and Definitions**			
3	**Management Systems**			
4	**General Requirements**			
5	**Policy**			
6	**Planning** 6.1 Setting up of Objectives and Targets 6.2 Addressing Significant Aspects 6.3 Identification of Resources 6.4 Identification of Needs and Critical Issues 6.5 Planning of Operational Processes			
7	**Organizing and Leading** 7.1 Leadership Team 7.2 Roles and Responsibilities 7.3 Management Representatives 7.4 Internal Communication			
8	**Operations and Procedures** 8.1 Operational Control 8.2 Customers Focus 8.3 Procedures and Implementation 8.4 External Relationship 8.5 Product Realization and Emergency Preparedness			
9	**Resource Management** 9.1 Management of Human Resources 9.2 Management of other Resources			
10	**Data and Information**			
11	**Documentation** 11.1 General 11.2 Handbook 11.3 Control of Documents 11.4 Control of Records			
12	**Audit and Evaluation** 12.1 Monitoring and Performance Measuring 12.2 Analyzing and Handling Nonconformities 12.3 System Audit Process 12.4 System Evaluation Process			
13	**Management Review** 13.1 General 13.2 Review Input 13.3 Review Output			
14	**Improvement** 14.1 Continual Improvement 14.2 Corrective Action 14.3 Preventive Action			

Appendix (F)

PDCA for “ITMS” Framework

The continual improvement of an internationally usable “ITMS” model could be performed by PDCA cycle. Here, the PDCA faces are distributed in 14 elements of the framework. **Figure F.1** shows the distribution of all elements on the four faces of the cycle.

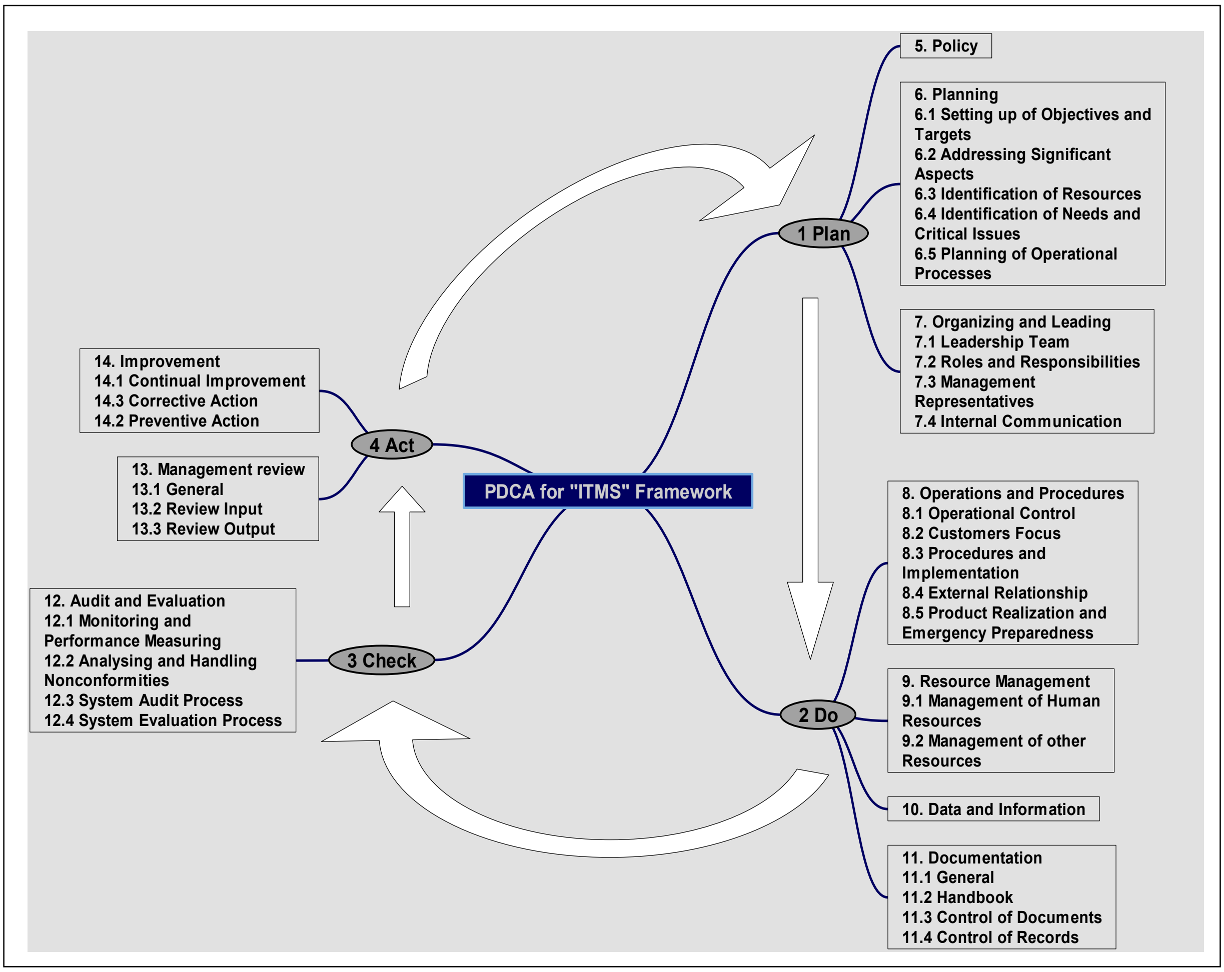


Figure F.1 *PDCA for "ITMS" Framework*

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