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INTEGRATED MANAGEMENT SYSTEM PROPOSED FOR MANUFACTURING COMPANIES IN MEXICO

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ABSTRACT

Due to the globalization of the markets, the implementation and maintenance of a formal management system have become a common practice to control the processes and even to condition the closure of commercial contracts. Thus, companies have adopted one or more management systems. However, to align different management systems with the business strategy might result problematic, forcing companies to face the need to have a unique management system. This research paper intends to analyze the presence or absence of key elements of an integrated management system that may consider areas such as quality, environment, safety and occupational health in the manufacturing industries in México. The objective of this research is to propose an integrated management system for the Mexican manufacturing companies. In order to obtain a valid model was applied an exploratory and confirmatory factorial analysis that was conducted using software such as SPSS and LISREL.

Keywords: *Quality management system, environmental management system, occupational safety and health management system, factorial analysis*

1. Introduction

Due to the globalization of the markets, the implementation and maintenance of a formal management system have become a common practice to control the processes and even to condition the closure of commercial contracts. Actually, the globalization forces the companies to employ adequately their resources to compete and remain on the market.

Shah (2003) indicates that the senior management divides its time to control all the synergies existent and prioritize the activities base on the necessities of the background. Therefore, the management takes a leading role for the permanence of the companies.

In order to achieve the control in the organizations, the management should be focus in the key processes and the creation of parameters to indicate its performance (Mairani, 2007).

If the results of the control are similar to the goals established by the company, the senior management must conserve the internal practices that allow that achievement.

Moreover, the beginning of the commercial activities and the closure of contracts by customers have demanded the presentation of international certificates to endorse the efforts to maintain quality, respect for the environment and occupational health in the organization.

Actually, there are national and international quality management system models. Some models recognized are the Total Quality Management (Camisón *et al*, 2007) and Kaizen (Imai, 1998). There are even proposals of national quality awards; among the highest awards are Deming Prize from Japan, Malcom Baldrige Award from United States, European Quality Award and National Quality Award (Cantú, 2006).

Internationally, the International Organization for Standardization (ISO) has published the ISO 9000 family which addresses various aspects of quality management. The ISO 9001:2008 sets out the requirements of a quality management system and is the only standard in the family that can be certified (ISO, 2014a).

Regarding to the environmental management, in México there is a Industria Limpia (Clean Industry) Certificate since 1997, which recognizes the commitment with the society in terms of environment preservation through environmental audits (Procuraduría Federal de Protección al Ambiente, 2014). ISO had developed the international standard ISO14001:2004 that is focused on the environmental management and can be certified too (ISO, 2014b).

On the other hand, in 1999 a group of national agencies of standardization from all the world proposed an occupational health and safety management voluntary based on the British standard BS8800, which aims to eliminate the confusion in the work centers due this type of different standards and the reduction of the accidents through the prevention and control of workplace hazard (LRQA, 2009).

Wilkinson and Dale (1999) comment that operate separate management systems covering quality, environment and security and ensure that they will be aligned with the strategy of the organization may be problematic.

Traditionally, the Mexican companies have implemented quality management systems and have faced the difficulty of integrating other systems like the ones focused on quality, environment, safety and occupational health. Similarly, the maintenance of individual management systems represents a high cost and their fulfillment generates uncertainty in personal. Such, the presence of a model able to integrate all management systems mentioned above is required to allow the organizations to realize only one effort to achieve total control on their activities.

Therefore, this research paper intends to analyze the presence or absence of key elements to propose an integrated management system that may consider areas such as quality, environment, occupational health and safety in the manufacturing industries in México.

2. Research

The management systems considered are:

- Quality Management System (QMS). A QMS is conformed by the systems and processes necessary to the company to achieve quality and the actions to measure the performance in accordance with customer requirements (Mairani, 2007). The standard considered for this management system is ISO9001.
- Environmental Management System (EMS). The EMS are management systems design for structure the efforts to protect the company´s environment to accomplish the current regulations (Strasser, 2008) and is employed to control the activities, products and processes that cause or may cause an environmental impact, trying to minimize it (Piñeiro. 2002). For this kind of management system, the certifications considered are ISO 14001 and Industria Limpia (Clean industry), which is a certificate given in México by the Procuraduría Federal de Protección al Ambiente (PROFEPA) through the Programa Nacional de Auditoría Ambiental (National Program of Environmental Auditory).
- Occupational Health and Safety Management System (OHSM). The OHSM is a structure to guide, measure and evaluate the security performance (Schaechtel, 1997), which allows to control the risks and improve the performance of the companies (Arkins, 2003). OHSAS 180001 is the standard considered in this area.

For the definition of the complex variable denoted as Integrated Management System was generated a construct (see Figure 1).

Following, the constructs for each management system are shown (see Tables 1,2 and 3).

Using the constructs, a questionnaire is designed. This instrument consists in 41 questions using a 5 points Likert scale. The reliability of the survey instrument was confirmed with an alpha Cronbach of 0.9542. A survey is conducted among 42 manufacturing companies across Mexico with at least one management system certified. The person in charge of the respective management system answers the assessment instrument.

3. Factorial analysis

This research employs both the exploratory factorial analysis and the confirmatory factorial analysis to determine the attributes that integrate the management systems studied.

3.1 Exploratory Factorial Analysis

With the aid of SPSS software and the results of the survey, the components analysis is realized for each management system studied to determine the principal factors which variance value is greater than 1.0 (see Table 4).

Other way to reduce the factors is doing the sedimentation chart. Generally, the stroke has a distinctive interruption between the slope generated by the higher values and a fading related with the rest of the factors. Generally, the highest point of the slope shows the quantity of significant factors (Malhotra, 1997). The graphics was obtained with the MINITAB software for the quality management system, environmental and occupational health and safety (Figure 2).

Both procedures conclude the same, must be considered four factors for the quality management system and three factors for the environmental management system and the occupational health and safety management system. Then, using the software SSPS the orthogonal rotation matrixes of the components selected are obtained for the quality management system (see Table 5), environmental (see Table 6) and occupational health and safety (see Table 7).

The orthogonal rotation gives as a result not correlated factors. The extraction method used was the Principal Components Analysis (PCA). The procedure varimax was used as the rotation method, which is the most employed. The interpretation is realized identifying the variables with high load in the same factor (Malhotra, 1997). Such are obtained the factors (see Table 8, 9 and 10) with its variables for each management system studied.

With the SPSS was realized a run with different kind of extraction methods (unweighted least squares, generalized least squares, maximum likelihood, principal axis factoring, alpha factoring, image factoring) to verify the initial results obtained by the application of PCA. The analysis was realized with two rotation methods, which are varimax and oblimin.

The exploratory factorial analysis confirmed the results obtained by the PCA for each kind of system.

3.2 Confirmatory Factorial Analysis

The regression techniques as well as the path analysis are types of structured equation models that analyze the causal and not causal relationships between the variables considered in the constructs (Casas, 2002). It is necessarily to develop a measurement for the construct that validate the relationship between itself and its indicators. Considering the information of the exploratory factorial analysis, the main factors for each management system were validated using the confirmatory factorial analysis. The Root Mean Square Error of Approximation (RMSEA) calculated for each system is less than 0.08 (recommended value) and the Tucker-Lewis index is higher than 0.90 (recommended value) (see Table 11).

The quality management system model considers the following variables:

- Customer focus (e.client). Key component that determines the customer requirements and its impact on the company policy and objectives, and influences in the procedures and the quality improvement.
- Quality management (g.calida). Component that includes the planning, measurement and the quality auditory, as well as its registers, and influences in the procedures of the system.
- Procedures (procedim). Component that comprises the manufacturing and quality procedures and influences in the improvement of the quality system.
- Improvement (mejora). It is the variable resultant from the procedures and considers the corrective and preventive actions.

The variables that were determined for the environmental management system model are defined as:

- Environmental focus (e. ambient). Factor that considers the environmental aspects and impacts, the policy and environmental objectives, and also the system planning.
- Environmental management (g. ambient). This factor includes the measurement of the environmental impacts, auditory and the system documentation.
- Continuous improvement (mejora). Factor that consists in the environmental emergency training and response and the corrective and preventive actions.

The variables of the occupational health and safety management system model are:

- Occupational health and safety focus (e. seguri). Factor that contemplate the risk assessment and control, the emergency preparation and response, and the corrective and preventive actions.
- Occupational health and safety management (g. seguri). This factor considers the occupational health and safety policy and the documentation of the system.
- Continuous improvement (mejora). Factor that includes planning, audits, and training.

The models mentioned before were tested by the covariance matrix and each model was estimated using a maximum likelihood criterion.

4. Structural Equation Model

All the variables mentioned in section 3.2 define the model of the integrated management system. Using LISREL was obtained the structural equation modeling of the integrated management system (see Figure 3).

5. Conclusions

The survey was conducted among 42 manufacturing companies across México with at least one management system certified. The 34% of the companies belongs to the state of Puebla while the 25% and 9.4% comes from the states of Tamaulipas and Tlaxcala respectively. In terms of the business sector the automotive, metal-mechanical and chemical result the most representative ones.

Regarding the exploratory factorial analysis and based on the results generated by the software SPSS, the principal components of each system studied were calculated, which were confirmed employing different extraction methods (unweighted least squares, unweighted least-squares, maximum likelihood, principal axis factoring, among others) and with the two principal methods of rotation (varimax and oblimin).

Related to the Quality Management System, the four indicators found: customer focus, quality management, procedures and continuous improvement show a mix of the Deming cycle and the requirements of the International Standard ISO9000:2008 (see Figure 4).

The Environmental Management System with its three indicators: environmental focus, environmental management and continuous improvement denote a parallel approach to the one proposed by the International Standard ISO14001:2004 (see Figure 5).

For the Occupational Health and Safety Management System was found three indicators: occupational health and safety focus and management, and the continuous improvement give a similar scenario as the Mexican Norm IMNC NMX-SAST-001-IMNC-2000 (see Figure 6).

Finally, the integrated management system considers ten indicators that includes the three management systems considered in this research (see Figure 7).

This research shows the presence of key elements in the quality, environment, occupational health and safety management systems to propose an integrated management system for the manufacturing industries in México that may consider those areas.

6. Suggestions for future studies

For future researches, it is suggested to create more structural equations models employing other estimation methods and different correlations matrix, also to consider other productive sectors.

Also, the system integration can be by pairs, i.e., quality and environment, quality and occupational health and safety and so on.

Moreover it is proposed to develop a non-recursive model for each management system studied an d the integral management system.

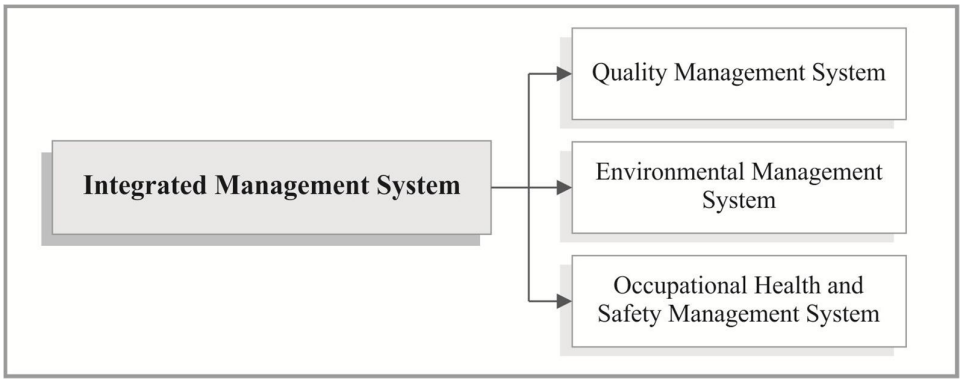

Figure 1: Integrated Management System construct

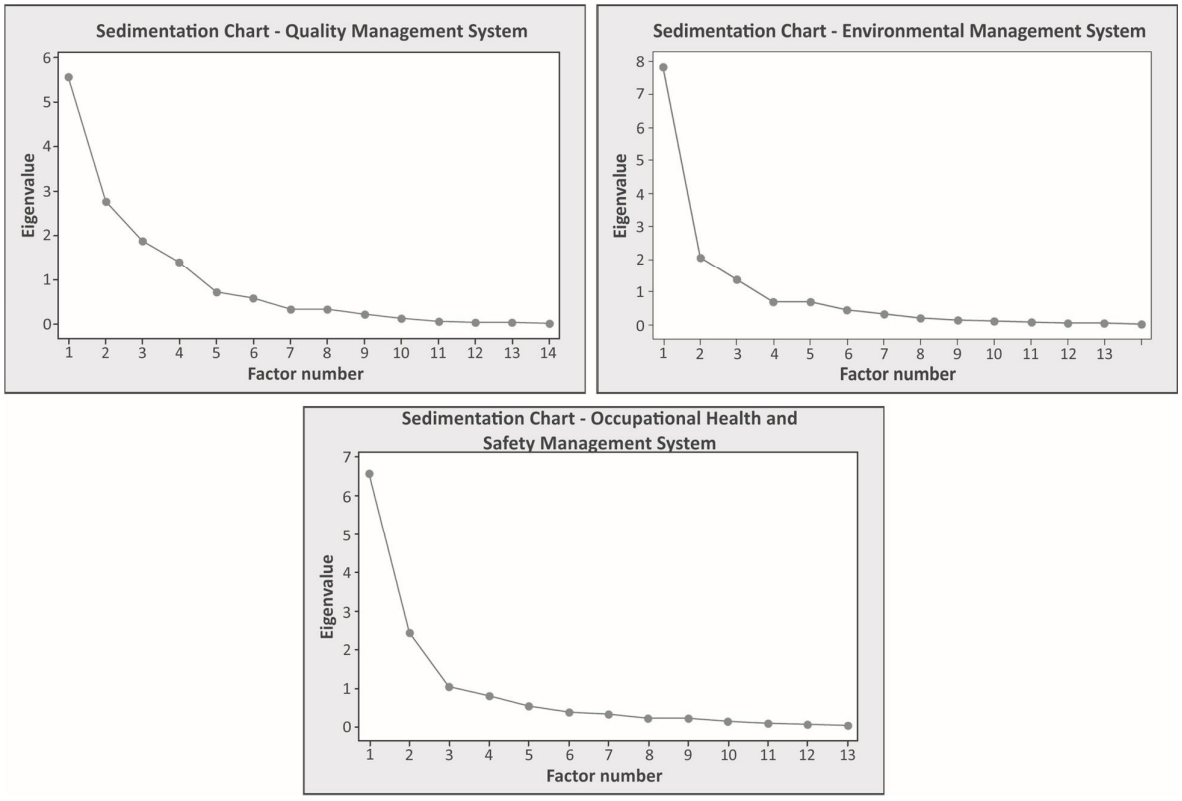

Figure 2: Sedimentation chart of each management system

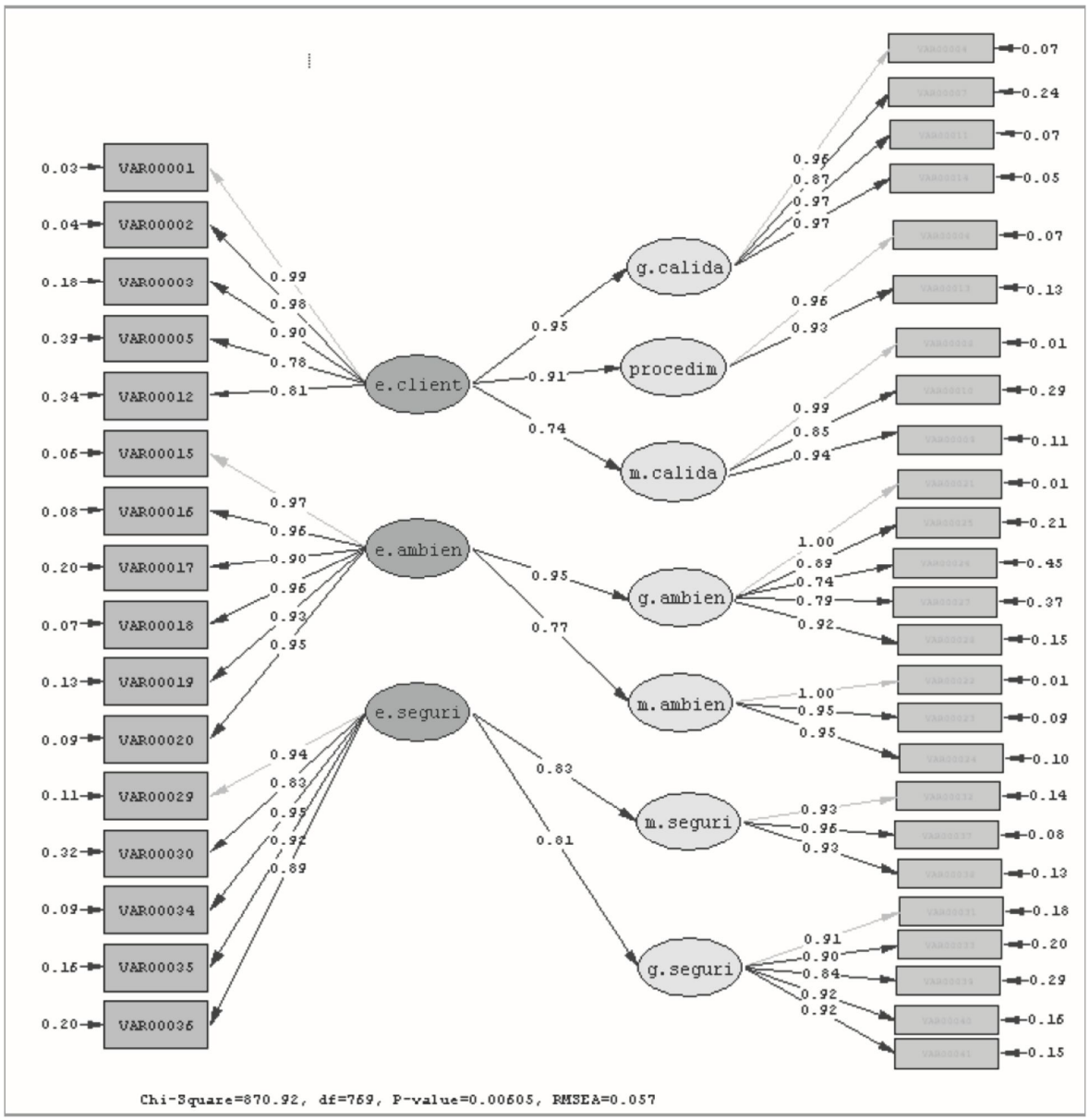

Figure 3: Structural Equation Modeling of the Integrated Management System

Figure 4: The conceptual model of the quality management proposed for the manufacturing companies based in México

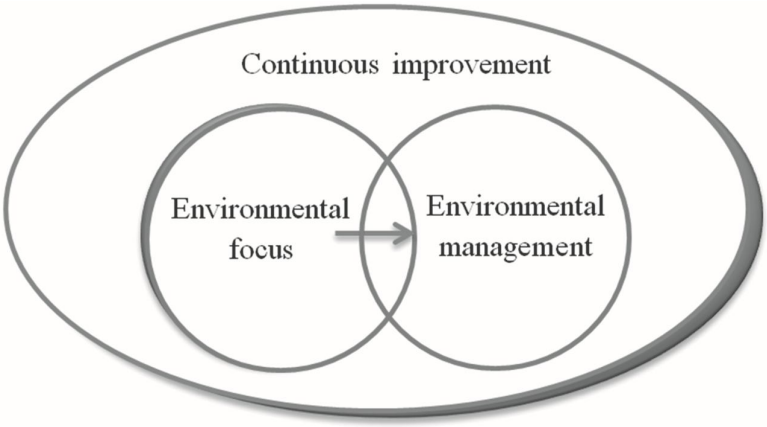

Figure 5: The conceptual model of the environmental management proposed for the manufacturing companies based in México.

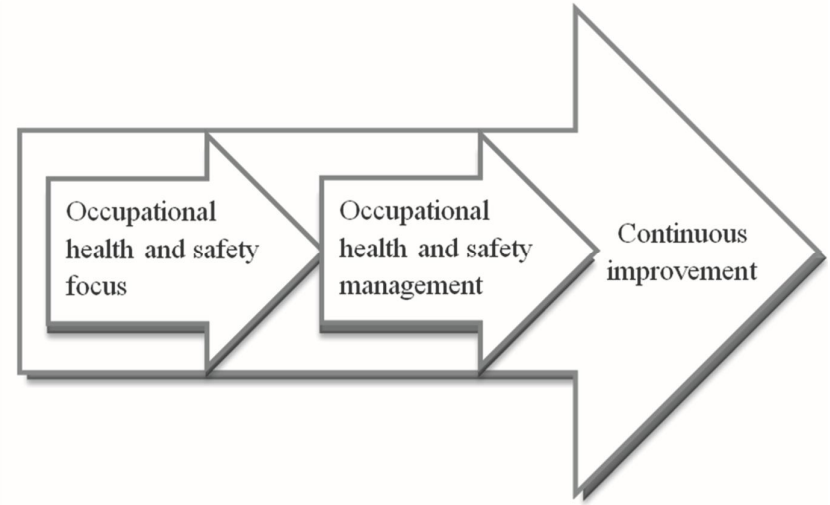

Figure 6: The conceptual model of the occupational health and safety management proposed for the manufacturing companies based in México

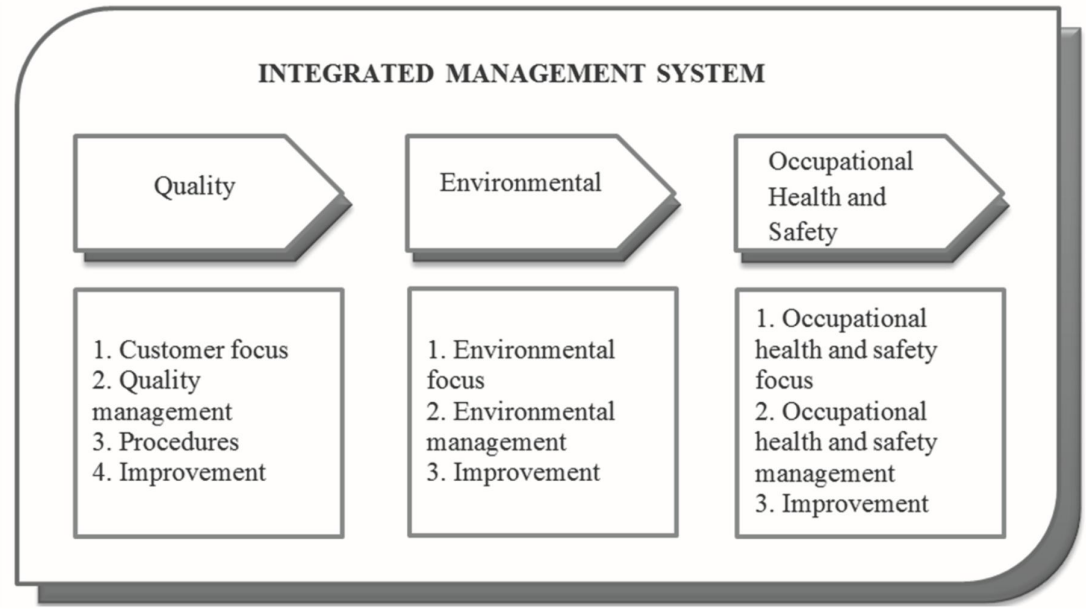

Figure 7: The conceptual model of the Integrated Management System proposed to the manufacturing organizations in México

Levels		
1	2	3
Quality Management System	Customer	Requirements (VAR00001)
	Management	Quality Policy (VAR00002)
		Quality Objectives (VAR00003)
		Quality Planning (VAR00004)
	Process	Administrative (VAR00005)
		Product Realization (VAR00006)
		Measurement (VAR00007)
	Improvement	Corrective Actions (VAR00008)
		Preventive Actions (VAR00009)
		Nonconforming product (VAR00010)
		Audits (VAR00011)
	Documentation	Quality Manual (VAR00012)
		Procedures (VAR00013)
		Registers (VAR00014)

Table 1: Quality management system construct

Levels		
1	2	3
Environmental Management System	Environmental	Environmental aspects (VAR00015)
		Environmental impact (VAR00016)
		Federal regulation(VAR00017)
	Management	Environmental Policy (VAR00018)
		Environmental Objectives (VAR00019)
		Planning (VAR00020)
	Process	Environmental impact measurement(VAR00021)
		Emergency Preparedness and Response (VAR00022)
	Improvement	Corrective Actions (VAR00023)
		Preventive Actions (VAR00024)
		Audits (VAR00025)
	Documentation	Environmental Manual (VAR00026)
		Procedures (VAR00027)
		Registers (VAR00028)

Table 2: Environmental management system construct

Levels		
1	2	3
Occupational Health and Safety Management System	Risks	Assessment (VAR00029)
		Control (VAR00030)
	Management	Occupational Health and Safety Policy (VAR00031)
		Planning (VAR00032)
		Inspection (VAR00033)
	Process	Emergency preparation and response (VAR00034)
	Improvement	Corrective Actions (VAR00035)
		Preventive Actions (VAR00036)
		Audits (VAR00037)
		Education and training (VAR00038)
	Documentation	Occupational Health and Safety Manual (VAR00039)
		Procedures (VAR00040)
		Registers (VAR00041)

Table 3: Occupational health and safety system construct

Management System	Factor	Variance
Quality	1	5.565
	2	2.764
	3	1.874
	4	1.400
Environmental	1	7.822
	2	2.048
	3	1.360
Occupational Health and Safety	1	6.578
	2	2.440
	3	1.037

Table 4: Components to consider for each management system

	Component			
	1	2	3	4
Requirements (VAR00001)	.896	-.044	.097	.236
Quality Policy (VAR00002)	.944	-.001	-.030	-.131
Quality Objectives (VAR00003)	.966	.187	.062	.038
Quality Planning (VAR00004)	-.040	.835	.265	.268
Administrative (VAR00005)	.530	.493	.165	.166
Product Realization (VAR00006)	.045	.052	.067	.902
Measurement (VAR00007)	-.078	.788	.109	-.066
Corrective Actions (VAR00008)	.017	.135	.956	.073
Preventive Actions (VAR00009)	-.047	.190	.933	.105
Nonconforming product (VAR00010)	.659	.126	.702	-.018
Audits (VAR00011)	.471	.695	.247	.297
Quality Manual (VAR00012)	.593	-.260	-.023	.516
Procedures (VAR00013)	.032	.336	.082	.827
Registers (VAR00014)	.527	.533	.184	.521

Table 5: Orthogonal rotation matrix of the components for the quality management system

	Component		
	1	2	3
Environmental aspects (VAR00015)	.875	.271	.175
Environmental impact (VAR00016)	.861	.148	.130
Federal regulation(VAR00017)	.759	.152	-.028
Environmental Policy (VAR00018)	.873	.202	.200
Environmental Objectives (VAR00019)	.752	.282	.202
Planning (VAR00020)	.692	.456	.303
Environmental impact measurement(VAR00021)	.598	.624	.335
Emergency Preparedness and Response (VAR00022)	.134	.181	.939
Corrective Actions (VAR00023)	.198	.307	.878
Preventive Actions (VAR00024)	.130	.109	.930
Audits (VAR00025)	.363	.565	.442
Environmental Manual (VAR00026)	.192	.887	.090
Procedures (VAR00027)	.184	.871	.178
Registers (VAR00028)	.366	.769	.239

Table 6: Orthogonal rotation matrix of the components for the environmental management system

	Component		
	1	2	3
Assessment (VAR00029)	.919	.123	.079
Control (VAR00030)	.806	.279	-.218
Occupational Health and Safety Policy (VAR00031)	.170	.762	.313
Planning (VAR00032)	.144	.334	.830
Inspection (VAR00033)	.270	.702	.237
Emergency preparation and response (VAR00034)	.853	.191	.295
Corrective Actions (VAR00035)	.865	.157	.221
Preventive Actions (VAR00036)	.790	.039	.396
Audits (VAR00037)	.232	.434	.743
Education and training (VAR00038)	.151	.433	.763
Occupational Health and Safety Manual (VAR00039)	.001	.820	.172
Procedures (VAR00040)	.139	.815	.294
Registers (VAR00041)	.249	.797	.232

Table 7: Orthogonal rotation matrix of the components for the occupational health and safety management system

Factor	Variable
1	Customer requirement (VAR00001)
	Quality Policy (VAR00002)
	Quality Objectives (VAR00003)
	Administrative procedure (VAR00005)
	Quality Manual (VAR00012)
2	Quality Planning (VAR00004)
	Measurement (VAR00007)
	Audits (VAR00011)
	Quality Registers (VAR00014)
3	Corrective Actions (VAR00008)
	Preventive Actions (VAR00009)
	Nonconforming product (VAR00010)
4	Product Realization (VAR00006)
	Procedures (VAR00013)

Table 8: Quality Management System factors and its variables

Factor	Variable
1	Environmental aspects (VAR00015)
	Environmental impact (VAR00016)
	Federal regulation(VAR00017)
	Environmental Policy (VAR00018)
	Environmental Objectives (VAR00019)
	Planning (VAR00020)
2	Environmental impact measurement(VAR00021)
	Audits (VAR00025)
	Environmental Manual (VAR00026)
	Procedures (VAR00027)
	Registers (VAR00028)
3	Emergency Preparedness and Response (VAR00022)
	Corrective Actions (VAR00023)
	Preventive Actions (VAR00024)

Table 9: Environmental Management System factors and its variables

Factor	Variable
1	Assessment (VAR00029)
	Control (VAR00030)
	Emergency preparation and response (VAR00034)
	Corrective Actions (VAR00035)
	Preventive Actions (VAR00036)
2	Occupational Health and Safety Policy (VAR00031)
	Inspection (VAR00033)
	Occupational Health and Safety Manual (VAR00039)
	Procedures (VAR00040)
	Registers (VAR00041)
3	Planning (VAR00032)
	Audits (VAR00037)
	Education and training (VAR00038)

Table 10: Occupational Health and Safety Management System factors and its variables

Management System	RMSEA	Tucker-Lewis index
Quality	0.0613	0.993
Environmental	0.0211	0.998
Occupational Health and Safety	0.0439	0.991

Table 11: Results of the confirmatory factorial analysis

References

1. Arkins, P. (2003). Solving the Mystery: A summary of Ohsas 18000 & ISO/IEC JTC-1/SC31. *Professional Safety*, 13.
2. Camisón, C., Cruz., González, T. (2007). *Gestión de la Calidad: Conceptos, enfoques, Modelos y Sistemas.* Madrid: Pearson Educación, S.A.
3. Cantú, H. (2006). *Desarrollo de una cultura de calidad.* México: McGraw Hill Interamericana.
4. Casas, M. (2002). Los modelos de ecuaciones estructurales y su aplicación en el índice Europeo de Satisfacción del cliente. Retrieved March 19, 2010 from http://www.uv.es/asepuma/X/C29C.pdf
5. Imai, M. (1998). *Kaizen*. CECSA.
6. ISO. (2014a). ISO 9000 – Quality Management. Retrieved April 28, 2014 from http://www.iso.org/iso/home/standards/management-standards/iso_9000.htm
7. ISO. (2014b). ISO 14000 – Environmental management. Retrieved April 28, 2014 from http://www.iso.org/iso/home/standards/management-standards/iso14000.htm
8. Procuraduría Federal de Protección al Ambiente. Programa Nacional de Auditoría Ambiental. Retrieved May 2, 2014 from http://www.profepa.gob.mx/innovaportal/v/26/1/mx/programa_nacional_de_auditoria_ambiental.html
9. Mairani. (2007). No matter the plant size, quality management systems measure up. *Plant Engineering*, pp. 25-26.
10. Malhotra, N. (1997). *Investigación de Mercados*. México: Prentice Hall.
11. Piñeiro, M. (2002). Gestión Ambiental en Jealsa-Rianxeira, S.A. *Revista Galega de Economía*, 11 (2), pp. 1-16.
12. Schaechtel, D. (1997). How to build a safety management system. *Professional Safety*, 42 (8), pp. 22 - 23.
13. Shah, G.C. (2003). Strategic business elements of ISO9001:2000. *Hydrocarbon Processing*, pp. 109-110.
14. Strasser, K.A. (2008). Do voluntary corporate efforts improve environmental performance? : The empirical literature. *Boston College Environmental Affairs Law Review*, 35, pp. 533-555.
15. Wilkinson, G., and Dale, B.G. (1999). Integration of quality, environmental and health and safety management systems: an examination of the key issues. *Proceedings of the Institution of Mechanical Engineers*, 213 (Part B), pp. 275 - 283.