Journal of Environmental Studies and Researches (2021), 11(2):277-288

Design Environmental Impacts Model of Chemicals in Integrated Management System (Case Study: in Chemicals Industry)

Osama, A. Waly [1], Mobarak H. Aly [1], Ezzat A. El-Fadaly[1], Mohamed A. EL-Dardiry [2]

1- Environmental Studies & Researches Institute University of Sadat City
2- Faculty of Engineering, Alexandria University

ABSTRACT

Determining a suitable work environment is a requirement in all new management system standards (ISO 9001:2015, ISO 14001:2015, and ISO 45001:2018). ISO 14001:2015 is an international standard that specifies the requirements of environmental management systems (EMS). This study assessed the influence of top management commitment, applications of compliance, operational control, monitoring, measurements, resource management, as well as improvements as critical factors on successful implementation and the operation of the ISO 14001:2015 **(Kymal et al., 2015; Waly, 2017).** It helps to establish management of the system that helps to create such a system to minimum impact on the environment **(U.S. EPA 2019; NOAA 2019; SCP/RAC 2019)**. Integration of the environmental management system into the organization's processes can enhance its ability to operate more effectively and efficiently, through the sharing of processes and resources **(ISO 14001:2015)**. The chemical industry must be able to identify and measure its environmental impacts and demonstrate continuous improvement. This requires an environmental management strategy to manage and minimize impacts on the environment. This study focuses on developing an environmental impact visual model (pictograms) in the chemicals industry to investigate the most important environmental parameters and their importance in order to mitigate environmental impacts.

Key words: work environment; EMS- ISO 9001:215- ISO 14001:2015- ISO 45001:2018- chemical industries- integration of the environment- environmental impacts.

الملخص

تحديد بيئة العمل المناسبة هو مطلب في جميع مواصفات الإدارة الحديثة (أيزو ٢٠١٥:٩٠٠١ – أيزو٢٠١٥:١٤٠٠١ و أيزو ٢٠١٨:٤٥٠٠١) ، يجب على المنظمة الأخذ في الاعتبار العوامل المناسبة مثل البيئة والصحة وقواعد وإرشادات السلامة، بالإضافة لاستخدام معدات الحماية.

- مواصفة الأيزو ٢٠١٥:١٤٠٠١ والخاصة بنظام إدارة البيئة تساعد في منع التلوث في صناعة المواد الكيميائية. حيث تساعد هذه المواصفة على إنشاء نظام إدارة بيئية للمساعدة في منع التلوث من صناعة المواد الكيميائية. دمج نظام الإدارة البيئية في عمليات المنظمة يساعد في تعزيز قدرة المؤسسة على العمل بشكل أكثر فاعلية وكفاءة من خلال مشاركة العمليات والموارد. يجب أن تكون صناعة المواد الكيميائية قادرة على تحديد وقياس آثارها البيئية وإظهار التحسين المستمر. وهذا يتطلب استراتيجية إدارة بيئية لإدارة وتقليل التأثيرات على البيئة. تعتمد هذه الدراسة على فهم متطلبات المخاطر في مواصفة الأيزو ٢٠١٥:١٤٠٠١ (تم دراسة عدد ١٢ مُتطلب بالمواصفة). تركز هذه الدراسة على تطوير نموذج مرئي للتأثيرات البيئية (الصور التوضيحية) في صناعة المواد الكيميائية للتعرف على أهم التأثيرات البيئية في صناعة المواد الكيميائية (تلوث الهواء–تلوث الماء–تلوث التربة–المخلفات الصلبة) من أجل التخفيف من الآثار البيئية لها.

الكلمات الدالة : بيئة العمل - أيزو ٢٠١٥:٩٠٠١- أيزو ٢٠١٥:١٤٠٠١ –أيزو ٢٠١٨:٤٥٠٠١ – صناعة المواد الكيميائية - دمج نظام الإدارة البيئية والتأثيرات البيئية.

1. INTRODUCTION

Environmental management, as part of a management system that seeks to provide organizations with an outline to protect the environment and respond to changing environmental conditions **(ISO 14001:2015)**.

In today's competitive environment, there is a growing number of standards for management systems that contribute to sustainable development (Nadae et al. 2019), where the challenge for organizations is to integrate them into one effective and efficient system.

Literature approached different aspects concerning the relationship between the organizations and the environment. This very important relation was clearly formalized through environmental standards development that defined EMS structure (Ionescu, 2000, 2005; Kit-Fai et al., 2002; Melnyk et al., 2003; MacDonald, 2005; Rowland-Jones and Cresser, 2005; Lupu et al., 2006, 2012; Fortunski, 2008; Perotto et al., 2008; Herghiligiu and Lupu 2015; Tambovceva, 2010, Waly, 2017 and so on).

ISO 14001 applies to any organization that wishes to improve and demonstrate its environmental performance to others through the presence of a certified EMS (Singh 2009, p.1); the new version is ISO 14001:2015.

The list of potential benefits of pollution prevention can be very long and include also **(**U.S. EPA 2019; NOAA 2019; SCP/RAC 2019).

Aspects would be things within the company's control that directly or indirectly cause those impacts. Environmental systems such as an internal waste minimization program can be informal or can be formal and standardized, such as ISO 14001 (Kahraman and Baig, 2010).

The first step in managing the environmental impacts (risks) involves identifying all the chemicals that are used, handled, stored, or generated in your workplace in consultation with workers. The identity of chemicals in the workplace can usually be determined by looking at SDS and the label**.**

Where the nature of the hazard is very serious, or chemical processes are complex, it may be necessary to obtain more detailed information from chemical suppliers, two of the most common labeling systems are:

1. The National Fire Protection Association (NFPA) (www.nfpa.org),
2. The Hazardous Materials Identification System (HMIS).

These systems provide a number of keys to indicate the relative hazard of the material in the areas of health, flammability, and reactivity. The number system is from "0" for no hazards to "4" for extreme hazards. (Safe Work Australia, 2011a).

2. MATERIALS AND METHODS

The main purpose of the study is:

The main purpose of this study is to develop an environmental impact visual model (pictograms) in chemicals, industry to investigate the most important environmental parameters and their importance in order to mitigate environmental impacts in Chemical Risk Management (CRM) Based on requirements of environmental management systems (ISO 14001:2015) within the Chemical Manufacturing Industry by:

i. Identify ISO 14001:2015 Risk (aspects) requirements (where and how risk-based thinking will be applied) (Table 1 and Figure 1).
ii. Identify and control the more important environmental aspects influencing the organization system:
    a. Emissions to air.
    b. Releases to water.
    c. Releases to land.
    d. Waste and/or by-products.
iii. Establishing chemical risk Models Identify integrated chemical risk and environmental aspects.

3. RESULTS AND DISCUSSION

According to **clause 6.1.2** in ISO 14001:2015, Chemical Manufacturing Industry is required to conduct identification of environmental requirements Risk (aspects) from its operations according to (ISO 14001:2015), **(Table 1 and Figure 1).**

Table 1: Where and how risk-based thinking will be applied in **(ISO 14001:2015):**

No.	Clause / Sub clause	**Reference to Risk**
1	4.1	**Understanding of organization and its context:** -The organization should define the internal and external issues risk factors that are relevant to the purpose of its scope and activities (EMS).
2	4.2	Understanding the needs and expectations of interested parties**.**
3	4.4	Management system and its processes (Environmental management system).
4	5.1	**Leadership and commitment:** -The top management shall practice and demonstrate its ability to lead the organization in implementing the EMS. -The top management shall ensure that requirement of the standards.
5	5.2	**Policy**: (Establishing EMS policy), including prevention of pollution.
6	6.1	**Actions to address risks and opportunities:** -The organization shall determine which risks and opportunities may affect its ability to achieve the intended results. **The objectives of this determination:** - To ensure that the (EMS) can achieve its intended results - To enhance desirable effects - To prevent or reduce adverse effects - To achieve improvement
7	6.1.3	**Determination of compliance obligations (ISO 14001:2015):** - Organizations have to identify and have access to up-to-date information, the applicable legal and other requirements. Organizations also have to take these requirements into account when establishing, implementing, maintaining, and continually improving their management system.
8	7.0	**Support (Resources-People-Competence-Awareness-Infrastructure and Communication),** to determine and provide necessary resources (risk is implicit whenever ‘suitable’ or ‘appropriate’ is mentioned).
9	8.1	**Operational planning and control:** - The organization should plan, implement, maintain, and supervise the processes needed to meet the requirements. - For planning changes, their consequences are considered.
10	8.2	**Emergency preparedness and response:** - The organization shall establish, implement, and maintain a process (es)

No.	Clause / Sub clause	**Reference to Risk**
		needed to prepare for and respond to potential emergency situations, as identified in sub-clause 6.1 relating to Actions to address risks.
11	9.1.1	Monitoring, measurement, analysis, and evaluation.
12	10.2	**Nonconformity and corrective action:** In a situation where there is non-conformity, the organization should update the risks identified during the planning stage if necessary; React with nonconformity and, as applicable (Taking action to control and correct it.

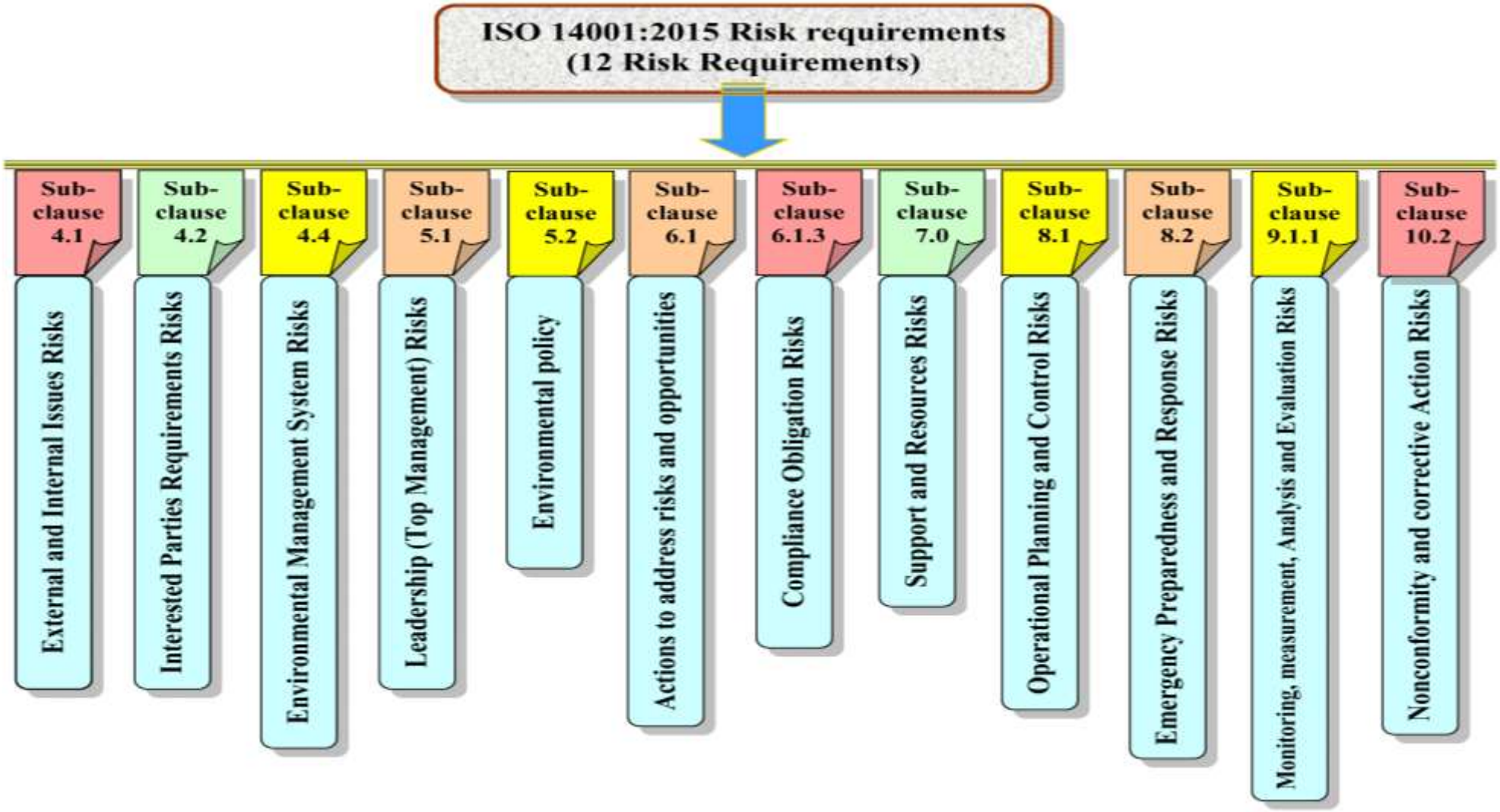

Figure 1: ISO 14001:2015 Risk requirements (By the authors)

We suggest creating a modification Model to Chemicals Labels (HMIS LABEL and NFPA LABEL) as follows:

1. In the case of **HMIS LABEL** by creating a square shape surrounding it.
2. In the case of **NFPA LABEL** by creating a rhombus shape surrounding it, that each of them contains four sides indicated that:
    1) Each side colored by color (different 4 colors) is related to the environmental medium in which the chemicals are released, whether it is on the ground (Green color) or air (Light blue color) water (Orange color) as well as the effect of Waste and by-products (Black color) on the environment in which it is discharged.

    2) A number shall be placed on each side are related to the degree effect of the environmental aspect of the environment in which it is released; that ranges from (0) indicating a minimal aspect of four (4) indicating the most hazardous aspect.

    3) The color around each number provides a key to indicate the type of hazardous characteristics as follows:
        - Red color for ignitability,
        - Green color for corrosivity,
        - Yellow color for reactivity, and
        - Blue color for toxicity.

Our Model (pictogram) introduced a new classification and labeling system for hazardous chemicals. The pictogram is changed in line with the United Nations Globally Harmonized System **(Figure 2)**.

The purpose of using these pictograms is to visually alert those who come in contact with hazardous chemicals of the risks they may be exposed to and their need to take precautionary steps to protect themselves from harm.

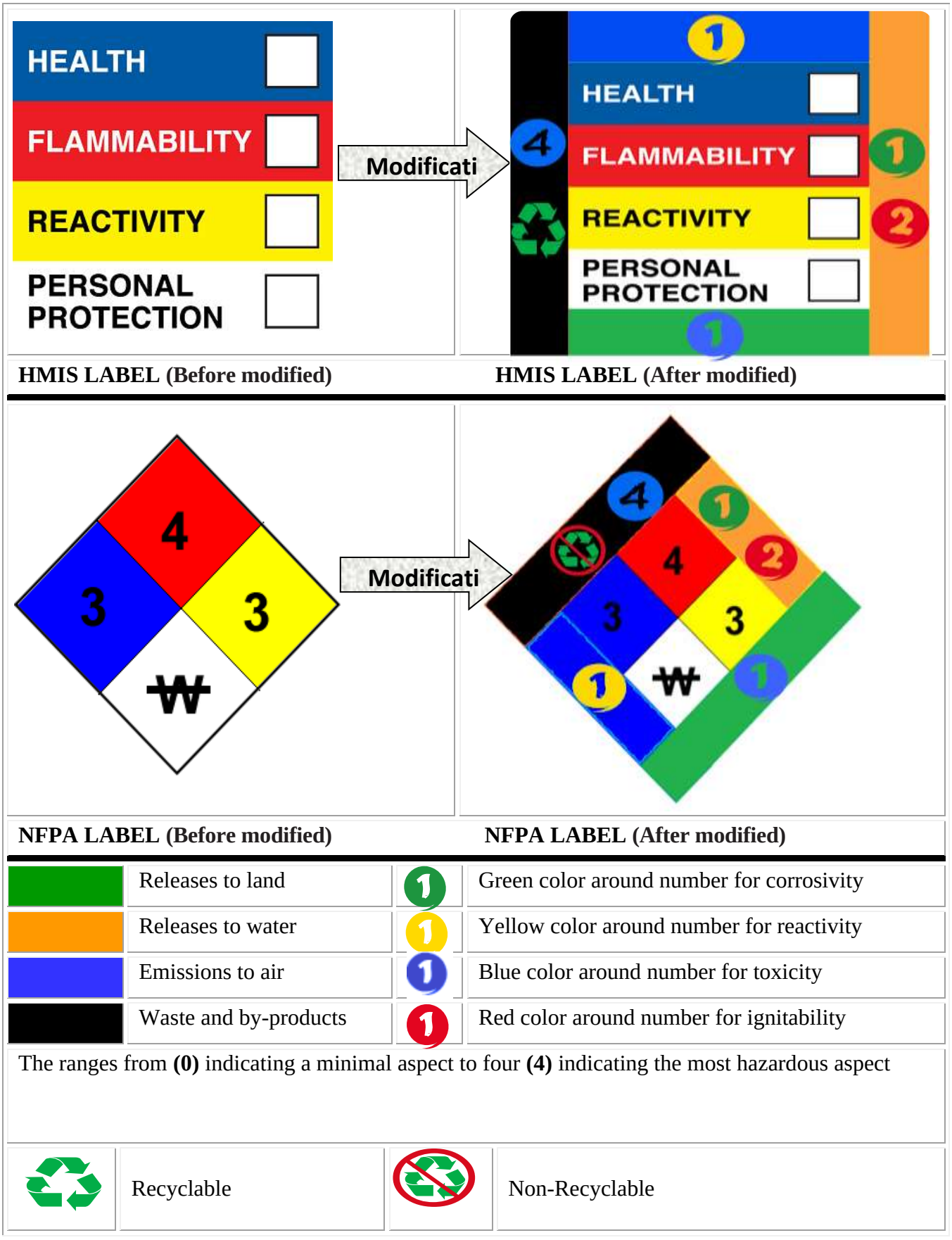

Figure 2: Suggestion a modification Model to Chemicals Labels **(By the authors)**

4- BENEFITS OF APPLYING THE NEW MODIFIED ASPECT MODEL:

The output of static analysis illustrated in **(figure 3):**

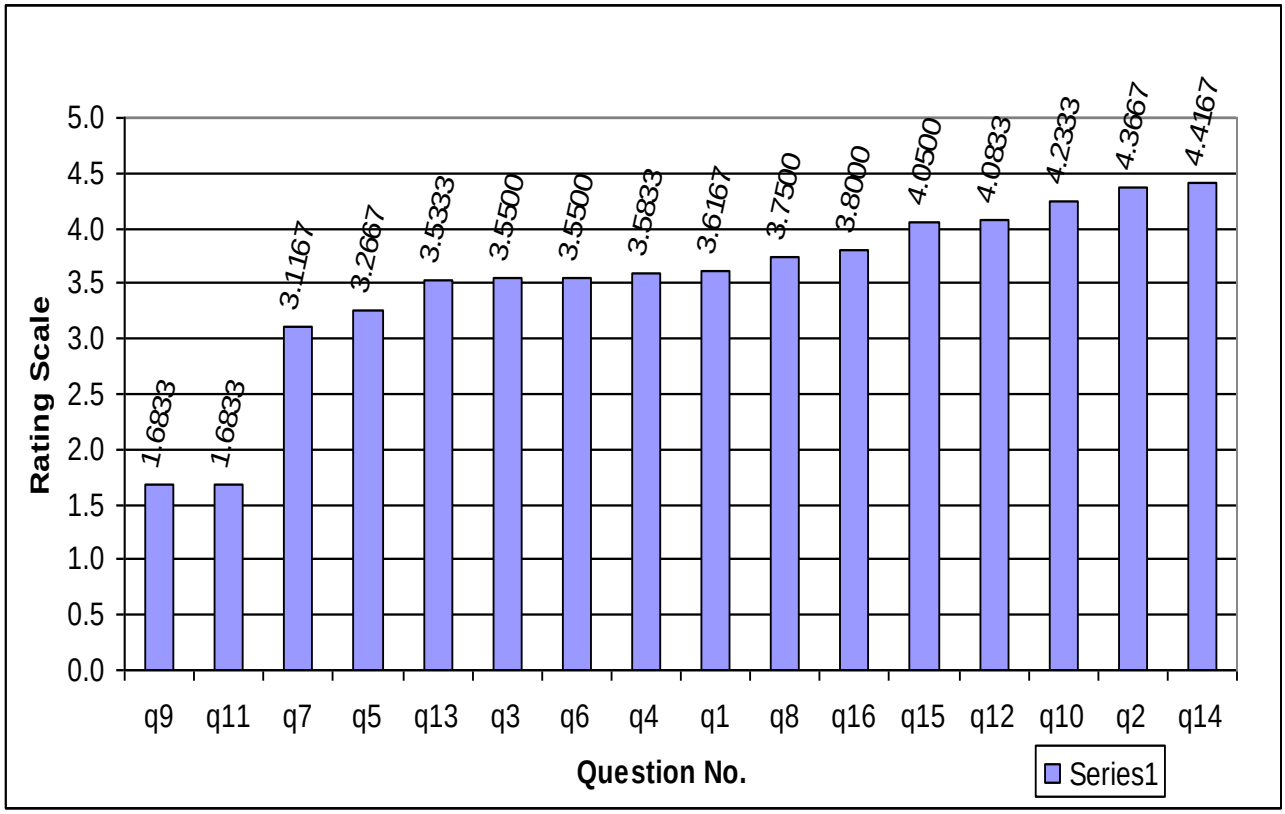

Figure 3: Benefits of applying the new aspect Model

- The statistical analysis of the benefits of applying the new aspect Model has shown the questions No. 14, 2, 10, 12, 15, 16, 8 and 1, are more effective when applying the new aspect Model.

a. (q14) Easily determine the environmental impact of chemicals in the different emitted environment
b. (q2) More comprehensive information about the use of chemicals in the workplace
c. (q10) Ease of risk assessment of chemicals
d. (q12) Easily communicate with risks
e. (q15) Compliance with law
f. (q16) Reducing the frequency and the severity of the incident
g. (q8) Good risk management
h. (q1) Better management of the environment

4. CONCLUSIONS AND RECOMMENDATIONS:

4.1. *Conclusions*

The results of the study show that the application of a visual model of environmental impacts (pictograms) in the chemical industry helps to easily verify the most important environmental factors in order to mitigate the environmental impacts.

4.2. *Recommendations*

1. The researcher recommends the importance and necessity of applying a visual model of environmental impacts (pictograms) in the chemical industry to easily verify the most important environmental factors and their importance in order to mitigate environmental impacts.
2. The researcher recommends the importance and necessity of placing this model in the safety data sheet (SDS) for chemicals, to be available in the workplace and training the staff for easy identification of its various environmental impacts.

6- List of abbreviations (Table 2):

Table 2: List of abbreviations:

No.	Abbreviation	Description
1	CRM	Chemical Risk Management
2	EMS	Environmental management systems
٣	HMIS	The Hazardous Materials Identification System
4	IMS	Integrated Management System
5	IRM	Integrated Risk Management
٦	ISO	International Organization for Standardization
٧	MS	Management System
٨	NFPA	The National Fire Protection Association
٩	NMS	New management standard
١٠	OH&S	Occupational Health and Safety
١١	RM	Risk Management
١٢	SDS	Safety Data Sheet

REFERENCE

Rtunski, B. (2008). Does the environmental management standard ISO 14001 nulate sustainable development? An example from the energy sector in Poland. nagement of Environmental Quality: An International Journal, 19(2), 204–212.

Rghiligiu, I. V., Lupu, L.M. (2015). A theoretical framework regarding the vironmental management system as organizational complex process. In 7th European hibition of Creativity and Innovation, Iaşi Romania.

Interrnational Organization for Standardization. Website: w .orgjtc176fsc02/public .Accessed 27 Nov 2018

Interrnational Organization for Standardization. Website: https://www.iso. p/ui/#iso:std:iso:9001:ed-5:v1:en. Accessed 17 Feb 2020

Ionescu, C. (2000). Cum să contruim şi să implementam un sistem de management de mediu în conformitate cu ISO 14001. Bucharest: Economică.

Ionescu, C. (2005). Managementul mediului: ISO 14001: 2004, calea spre excelenţă. Bucharest: Economică

ISO 14001:2015 (2015). Environmental management systems – Requirements with guidance for use. Geneva: International Organization for Standardization.

ISO 45001:2018 (2018). Occupational health and safety management systems – Requirements with guidance for use. Geneva: International Organization for Standardization.

ISO 9001:2015 (2015). Quality management systems – requirements. Geneva: International Organization for Standardization.

ISO/IEC. (2018). ISO 31000, Risk management – Guidelines. Retrieved from ISO: https://www.iso.org/standard/65694.html. Accessed 12 Nov 2020

Kahraman, E., & Baig, A. (Eds.). (2010). Environmentalism: Environmental Strategies and Environmental Sustainability. Nova Science Publishers.

Kit-Fai, P., Ip-Kee, H., Lau, H. C. W., Hang-Wai, L., & Lewis, W. G. (2002). Development of an EMS planning framework for environmental management practices. The International Journal of Quality & Reliability Management, 19(6/7), 688–709.

Kymal, C., Gruska, G. F., & Reid, R. D. (2015). Integrated management systems: QMS, EMS, OHSMS, FSMS including aerospace, service, semiconductor/electronics, automotive, and food: Updated to the latest standard changes including ISO 9001:2015, ISO14001:2015, and ISO 45001:2016: Includes guidance on integrating corporate responsibility and sustainability. Milwaukee, Wisconsin: ASQ Quality Press.

MacDonald, J. P. (2005). Strategic sustainable development using the ISO 14001 Standard. Journal of Cleaner Production, 13631–643.

Melnyk, S. A., Sroufe, R. P., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. Journal of Operations Management, 21(3), 329–351.

Nadae, J., Carvalho, M.,&Vieira, D. (2019). Exploring the influence of environmental and standards in integrated management systems on economic performance of firms. Journal of Manufacturing Technology Management, 30(5), 840–861.

National Fire Protection Association (NFPA). Website :www.nfpa.org. Accessed 22 Oct 2020

Nations, U. (2011) .(Globally Harmonized System of Classification and Labeling of chemicals (GHS) .(Fourth revised edition. New York and Geneva.

NOAA (National Oceanic and Atmospheric Administration) website, Pollution Prevention Defined (in:) Federal Facility Pollution Prevention Planning Guide. https://www.labtrain.noaa.gov/default.htm. Accessed 28 Feb 2020.

Rowland-Jones, R., & Cresser, M. (2005). An evaluation of current environmental management systems as indicators of environmental performance. Management of Environmental Quality: An International Journal, 16(3), 211–219.

Safe Work Australia. (2011a). Labelling of Workplace Hazardous Chemicals: Code of Practice. Retrieved from http://safeworkaustralia.gov.au/AboutSafeWorkAustralia/WhatWeDo/Publications/Pages/labelling-hazardous-chemicals-COP.aspx. Accessed 2 Feb 2020.

SCP/RAC (The Regional Activity Centre for Sustainable Consumption and Production) website, Cleaner production: http://www.cprac.org/en/sustainable/production/cleaner. Accessed 28 Feb 2019.

Singh, S., Rajor, A. G., & Rastogi, S. G. (2009). Establishing an Integrated Management System (ISO 9001, ISO 14001, OHSAS 18001) within Typical Manufacturing Industry.

The United States Department of Labor website: OSHA Hazard Communication. Website: http://www.osha.gov/dsg/hazcom/index.html. Accessed 11 Nov 2020

Website. (U.S. EPA. (United States Environmental Protection Agency https://www.epa.gov. Accessed 1 Mar 2019.

UNECE website: GHS Guide. Website: http://www.osha.gov/dsg/hazcom/ghs.html. Accessed 27 Nov 2020.

United Nations. Economic Commission for Europe. Secretariat. (2009). Globally Harmonized System of Classification and Labelling of Chemicals (GHS). United Nations Publications.

Waly, O. (2017). "Design a Model for Integrated Management System (IMS), Of (Quality, Environment, and Occupational Health & Safety) (A case study In Industry)". (Unpublished Master thesis). Environmental Studies & Research Institute, Sadat City university. Sadat City, Egypt. pp. 57-64.