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

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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.


الملخص


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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),

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):

<table>
<thead>
<tr>
<th>No.</th>
<th>Clause / Sub clause</th>
<th>Reference to Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.1</td>
<td><strong>Understanding of organization and its context:</strong>&lt;br&gt;- The organization should define the internal and external issues risk factors that are relevant to the purpose of its scope and activities (EMS).</td>
</tr>
<tr>
<td>2</td>
<td>4.2</td>
<td>Understanding the needs and expectations of interested parties.</td>
</tr>
<tr>
<td>3</td>
<td>4.4</td>
<td>Management system and its processes (Environmental management system).</td>
</tr>
<tr>
<td>4</td>
<td>5.1</td>
<td><strong>Leadership and commitment:</strong>&lt;br&gt;- The top management shall practice and demonstrate its ability to lead the organization in implementing the EMS.&lt;br&gt;- The top management shall ensure that requirement of the standards.</td>
</tr>
<tr>
<td>5</td>
<td>5.2</td>
<td><strong>Policy:</strong> (Establishing EMS policy), including prevention of pollution.</td>
</tr>
<tr>
<td>6</td>
<td>6.1</td>
<td><strong>Actions to address risks and opportunities:</strong>&lt;br&gt;- The organization shall determine which risks and opportunities may affect its ability to achieve the intended results.&lt;br&gt;<strong>The objectives of this determination:</strong>&lt;br&gt;  - To ensure that the (EMS) can achieve its intended results&lt;br&gt;  - To enhance desirable effects&lt;br&gt;  - To prevent or reduce adverse effects&lt;br&gt;  - To achieve improvement</td>
</tr>
<tr>
<td>7</td>
<td>6.1.3</td>
<td><strong>Determination of compliance obligations (ISO 14001:2015):</strong>&lt;br&gt;  - 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.</td>
</tr>
<tr>
<td>8</td>
<td>7.0</td>
<td><strong>Support (Resources-People-Competence-Awareness-Infrastructure and Communication),</strong> to determine and provide necessary resources (risk is implicit whenever ‘suitable’ or ‘appropriate’ is mentioned).</td>
</tr>
<tr>
<td>9</td>
<td>8.1</td>
<td><strong>Operational planning and control:</strong>&lt;br&gt;  - The organization should plan, implement, maintain, and supervise the processes needed to meet the requirements.&lt;br&gt;  - For planning changes, their consequences are considered.</td>
</tr>
<tr>
<td>10</td>
<td>8.2</td>
<td><strong>Emergency preparedness and response:</strong>&lt;br&gt;  - The organization shall establish, implement, and maintain a process (es)</td>
</tr>
<tr>
<td>No.</td>
<td>Clause / Sub clause</td>
<td>Reference to Risk</td>
</tr>
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<td>-----</td>
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</tr>
<tr>
<td></td>
<td>9.1.1</td>
<td>Monitoring, measurement, analysis, and evaluation.</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>needed to prepare for and respond to potential emergency situations, as identified in sub-clause 6.1 relating to Actions to address risks.</td>
</tr>
</tbody>
</table>
| 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.
HMIS LABEL (Before modified)  
HMIS LABEL (After modified)

NFPA LABEL (Before modified)  
NFPA LABEL (After modified)

Releases to land  
Green color around number for corrosivity

Releases to water  
Yellow color around number for reactivity

Emissions to air  
Blue color around number for toxicity

Waste and by-products  
Red color around number for ignitability

The ranges from (0) indicating a minimal aspect to four (4) indicating the most hazardous aspect

Recyclable  
Non-Recyclable

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):

- 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:

<table>
<thead>
<tr>
<th>No.</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>CRM</td>
<td>Chemical Risk Management</td>
</tr>
<tr>
<td>2</td>
<td>EMS</td>
<td>Environmental management systems</td>
</tr>
<tr>
<td>3</td>
<td>HMIS</td>
<td>The Hazardous Materials Identification System</td>
</tr>
<tr>
<td>4</td>
<td>IMS</td>
<td>Integrated Management System</td>
</tr>
<tr>
<td>5</td>
<td>IRM</td>
<td>Integrated Risk Management</td>
</tr>
<tr>
<td>6</td>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>7</td>
<td>MS</td>
<td>Management System</td>
</tr>
<tr>
<td>8</td>
<td>NFPA</td>
<td>The National Fire Protection Association</td>
</tr>
<tr>
<td>9</td>
<td>NMS</td>
<td>New management standard</td>
</tr>
<tr>
<td>10</td>
<td>OH&amp;S</td>
<td>Occupational Health and Safety</td>
</tr>
<tr>
<td>11</td>
<td>RM</td>
<td>Risk Management</td>
</tr>
<tr>
<td>12</td>
<td>SDS</td>
<td>Safety Data Sheet</td>
</tr>
</tbody>
</table>

REFERENCE


International Organization for Standardization. Website: w.org/tc176fsc02/public .Accessed 27 Nov 2018

Osama, A. Waly.& others.


