

EVALUATION STUDY OF RISK ASSESSMENT PROCEDURES FOR SMALL-SCALE CHEMICAL FACTORIES IN JORDAN

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An evaluation study was conducted on Risk Assessment Procedures implemented in eleven small-scale chemical factories in Jordan. The assessments failed to reduce number of minor incidents occurring within the working site area in four factories. All incidents are directly or indirectly caused by human behaviour. Therefore, understanding the human factor and human behaviour is an important issue. It is quit hard to change the human behaviour over night to meet all the obligations from a simple worker with limited skills. The implementation of ISO 9001 or 9002 contributed indirectly in reducing the number of minor incidents in these chemical factories. The foreign Risk Assessment Expert did not take into account the socio-economical and human behaviour factors when conducting the Risk Assessment Procedure on these factories. It is crucial to look at the effect of the environment and human behaviour within the framework of socio-economical issue before conducting an assessment. There are also several important issues should be taken into consideration, such as: a) The level of education of the working staff, b) The Job stability and satisfaction, c) low wages, d) The character and behaviour of the daily worker. The key for a successful implementation of a Risk Assessment in a factory is to build up a two-way communication between the top management and the simple worker to fulfil his needs and provide him with sense of security and job stability.

KEYWORDS: Risk Assessment, Risk Management, Human Behaviour, Minor Incidents, ISO 9000.

INTRODUCTION

Jordan is a developing country located in the East Mediterranean Region. It has a unique history of stragglng to build up a stable economy to cope with the huge increase of population due to the wars in the Middle East (1948 and 1967), the Gulf War in 1990 and political instability in the region, which created huge pressure on socio-economical levels because the country has very limited resources. Also, Jordan has a wide variety of cultures, traditions and religions among its population. The labour union law was established in 1953 and was modified several times during 1960, 1972 and 1974. That was due to the increase in the industrial growth and to cope with the new developments in labour rights issues.

Before the Risk Assessment Procedure is conducted, it is highly important to understand the nature of people that we are dealing with. It is definitely true that the result of a Risk Assessment for two identical plants in two different locations is different, (for example, one in Europe and another in the Middle East). The assessment is not just ticking off boxes in an instruction sheet or investigating the sources for human health risks.

An ideal risk assessment method which would suit all organizations does not exist, as each organization possesses its own unique characteristics^[1]. However, the requirements for an ideal risk assessment method have been studied by several researcher^[2,3,4]. A method

should be complete in its coverage of all necessary components, and to perform a risk analysis and risk management at the same time.

Risk Assessment is not new and in simple words it is an action we take as individuals, almost in every working day. As individuals, we spontaneously analyse, assess and decide upon risky situations without thinking of the uncertainty of the outcomes. The technical development of Risk Assessment for human health and occupational standards started as early as 1930s. The US National Research Council (NRC) has established in 1983 all the work related to the systematic and quantitative approach to Risk Assessment. The NRC regarded the process of risk assessment as an activity conducted by the application of objective science and scientific principles, while risk management was viewed as a decision making process that 'entail (ed) considerations of political, social, economic and engineering information with risk-related information ... to develop, analyse, compare and select the appropriate regulatory response ... The selection necessarily requires the use of value judgments on such issues as the acceptability of risk and the reasonableness of the costs of control'^[5].

The main typical elements of Operational Risk Management (ORM) process can be summarized by the following steps^[6]:

1. Identify hazards:
 - a) Outline the major steps in the operation (operational analysis).
 - b) A preliminary hazard analysis is conducted by listing all of the hazards associated with each step in the operational analysis along with possible causes for those hazards.
2. Assess hazards:

For each hazard identified, the associated degree of risk in terms of probability and severity is determined.
3. Make risk decisions:

Developing risk control options. Start with the most serious risk and selection of controls that will reduce the risk to a minimum level. The communication with higher authority is necessary when assistance is needed to implement controls.
4. Implement Controls:

Engineering and administrative controls are to be implemented considered. These would include modification of equipment, standard operating procedures, work rotations, personal protective equipment, etc., that are also standard controls for chemical and physical hazards encountered in occupational settings.
5. Supervise:

Conduct follow-up evaluations of the controls to ensure they remain in place and have the desired effect. Monitor for changes that may require further operational risk management, and take corrective action when necessary.

From the previous five elements of the ORM, it is clear that the human factor has not been considered as a source of health risk. On the other hand, the major safety issue in the development of technological societies is the consideration of the human element as the source of, and contributor to, accidents^[7], and that all accidents in artificial systems are directly or indirectly caused by human behaviour. For those of us interested in genuine safety, and not just legally prompt cosmetic action, understanding the human factor and

human behaviour is unavoidable^[8]. There is a need to provide officials, professional safety managers and workers with a better understanding of the different categories of human behaviours and the performance-shaping factors behind these categories. A simulated model^[9] on human behaviour and human interactions was described based on three structured frameworks:

1. *Human error event frameworks* aim at representing human errors within the socio-technical and organizational context.
2. *Human behaviour frameworks* describe how individual human behaviour is modelled, with respect to the data and the boundary conditions due to the environmental and the organizational context, as represented in the previous framework.
3. *Human-machine interaction frameworks* account for the interaction between models of operator and plant and produce an overall simulation of a range of accident dynamics

From the presented frameworks, it is clear that human behaviour is the key element in constructing the simulated model.

Workers with limited skills represent high percentage of the working force in most of the small-scale chemical factories. Therefore, it is quit difficult to fulfil all the technical requirements to meet the entire obligation from a simple worker. It is necessary to use simplified procedures and construct an easy scheme to implement. For an Example, a UK scheme to help small firms control health risks from chemicals in the workplace has been developed by a working party set up by the UK Health and Safety Commissions Advisory Committee on Toxic Substances (ACTS). Two important criteria which were applied to the development of the toxicological basis for the scheme were firstly, the approach taken must be simple and transparent, such that it can be readily understood and consistently applied by small and medium sized enterprises and secondly, the best use should be made of any available hazard information^[10]. It is acknowledged that safety, health and environmental protection measures have become important and shall be initiated by the highest level of management of the company, and not be left to staff experts, but must be felt and appreciated by the company as a whole^[11]. To achieve this is as much a technical as an organizational task and it requires good communication. The human factor is a major element in safety.

From all of the above, it is crucial to look at the characteristic behaviour of the working labours with the frame of present environment and socio-economical issues before conducting an assessment. This evaluation study is trying to prove that human factor is an essential part of any successful assessment, and studying all characteristic behaviours which may lead to a better understanding of what we can call unique cultural behaviour inside the factory.

EVALUATION STUDY

This industrial evaluation study was conducted on a set of eleven factories working in the field ranging from chemical production to chemical mixing and packaging. The working force ranges from 80 up to 120. The factories are located in different industrial areas in the Greater Amman Municipality. All the selected factories have obtained either ISO 9001 or 9002 for more than one year before carrying out the Risk Assessment. The Risk Assessment Procedures were done through foreign agencies. Most of these factories have primitive and simple safety scheme implemented inside the factory's premises.

From the results of the study, it was noticed that the Risk Assessment Procedures for four out of eleven factories failed to reduce the number of accidents which can be classified as minor incidents occurring in the working location. Table 1 illustrates the number of incidents for the eleven factories before and after conducting the Risk Assessment. It shows that there was a clear drop in number of both minor and major incidents after obtaining either ISO 9001 or 9002. This may be due to restrictions implemented on workers, and limiting their access to certain departments which minimize contact and friction with other employees. Also, the creation of Job Description helped to identify the activities of each worker within a group of workers. Also, Table 1 shows that after conducting the Risk Assessment the drop in number of minor incidents what was not up to expectation.

Table 1. Evaluation results of the factories before and after conducting risk assessment procedures.

Implementation process	Minor incidents	Major incidents
Before obtaining the ISO 9001/9002	105	7
After obtaining the ISO 9001/9002 and before conducting the risk assessment	59	4
After conducting the risk assessment	33	1

Figure 1 shows clearly without any doubt that increase in number of minor incidents is directly related to increase in the percentage of workers with limited skills within the working force of the factory. Also, Figure 2 compares the change in the number of minor incidents after implementing the ISO 9000 and the Risk assessments methods. Figure 3 concludes that there are four factories failed to reduce minor incidents more than 50% of the its total number of incidents recorded.

DISCUSSION OF THE EVALUATION OUTCOMES

Based on the collected information on the eleven factories and by looking at the managerial scheme inside each factory, it can easily be noticed that these factories can be divided into two different types of managerial systems: Seven of these factories implement modern management systems where as Four factories apply classical management systems. The modern management systems open direct lines among all different working levels of the working force in the factories through controlled communication channels. An evaluation scheme is implemented for each worker to monitor his personal activity, performance and productivity. This concludes that before conducting any Risk Assessment, it is important to have a full picture of the management system implemented. This will help in building up faith in the assessment procedure and that it is not just a extra pile of paper work for the staff.

The four factories were the assessment failed to reduced the minor incidents use classical management systems. It is noticed that the factories employees more than 35% of workers with limited skills on daily paid basis which create the sense of job instability for the workers. Also

they lack training opportunities to improve their working capabilities. Also most of these workers have low wages which reflects heavily on their performance and work commitment. Several recommendations were given to these factories to promote the concept of safety culture. The implementation of these recommendations has further reduced minor incidents in the first six months of implementation. These recommendations were:

- 1) Set-up of several controlled short breaks during the working day for the workers to do their private activities such as; doing prayers, having snacks, smoking, and drinking coffee and tea.
- 2) Install facilities to listen for traditional music in the working area.
- 3) The use of a simplified coding scheme to identify hazard chemicals, chemicals handling and storage procedures.
- 4) The use of clear signs for dangerous locations.
- 5) Minimize the paperwork used for documentations by labours with limited skills.
- 6) Set up social activities one every month between the management and the working staff.
- 7) Promote the idea of salary bonus for best worker of the month for those of low wages, especially for workers with limited skills. This is to encourage work commitment and job stability.

FUTURE TRENDS OF RISK ASSESSMENTS

There are several future trends of Risk Assessment should be taken into consideration. These trends be can summarized in the following points:

- a) The concept of damage as primarily being limited to the risk to human and occasionally ecological health needs to be broadened to include a range of economic and social considerations.
- b) It important to understand the cultural behaviour of workers inside the factory because the worker behaviour is a reflection of this safety culture. Also, to examine the regular activities for the simple worker during a normal working day.
- c) The implementation of a simple coding system and installing signs in dangerous locations. Then making easy access for information when needed, and minimizing the paperwork among large percentage of workers with limited skills.
- d) The assessments must allow for multiple exposure pathways, inter-media transfers of pollutants together with secondary environmental effects, as well as assessments that draw into the decision making framework technical, health, economic, social and other issues. Environmental quality standards for substances in air, water, soil, biota and foods will have to be developed in a manner that ensures internal consistency and coherence^[12].
- e) Risk Assessment needs to take greater attention on what may cause minor risks that could lead indirectly to major incidents. In most occasions major incidents occur from minor ones.
- f) Involving the top management into the Risk Assessment process will definitely help in verifying what kind of risk the worker is exposed to. Also, it is important to open channels with all the parties involved in the Risk Assessment specially between the top management, the operational personnel in charge, and the Risk Assessment Expert.

- g) The challenge in the coming years will be to embed the use of science in risk assessment and risk management within a socio-political framework, and to subsume within the decision making process the nature of things and the nature of man. This is not to diminish the status or role of scientists and of experts in environmental decision making^[13].

CONCLUSIONS

The chemical industries in Jordan have limited experience in the issues of security and labour safety. Therefore implementing procedures and instructions as listed in the manuals is not always a successful way in conducting Health Risk Assessment. It is important to take into consideration the management system implemented inside the selected factory for the assessment. It is highly crucial to build up confidence and faith from both sides: the management and the simple worker so that the proposed safety system and modifications will be definitely fruitful, and not just an extra pile of paper work.

The foreign Risk Assessment Expert usually misses out such a vital matter when carrying out human health assessment. It is quit hard to change the human behaviour over night to meet all the obligations from a simple worker. The assessor should always keep in his mind that conducting an assessment will not be necessarily the same for the same factory in a different location. Complicated and long list of procedures are not necessary the best way to implement Risk Management. A simple scheme of procedure may prove more fruitful and easy to implement by simple workers inside the factory. Not every program or scheme implemented in Developed Countries can be easily implemented in Developing Countries. Verifying all the obstacles is an important step before implementing an assessment procedure. We teach the baby to crawl first, stand up and then walk.

Human behaviour is the main issue to be included in any assessment conducted not only cultural behaviour, but also behaviour based on the sense of job instability and security. Also it is important to implement Operational Risk Management parallel with risk assessment methods when dealing with minor incidents in small factories with high percentage of workers with limited capabilities and where the availability of training programs is limited and expensive.

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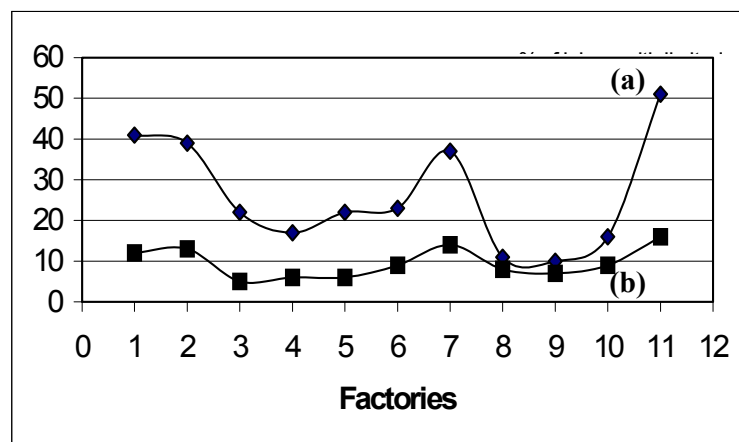


Figure 1. The relationship between the percentage of labour with limited skills (a) and the number of minor incidents (b)

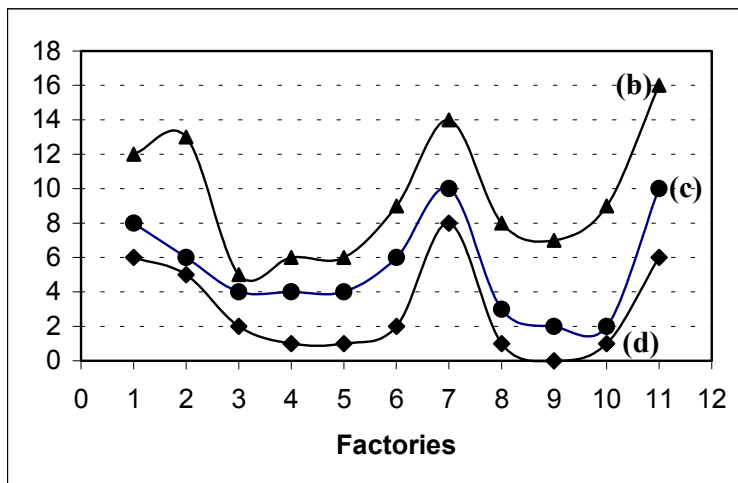


Figure 2. The change in number of minor incidents (b), after implementing ISO 9000 (c), and after conducting risk assessment method (d)

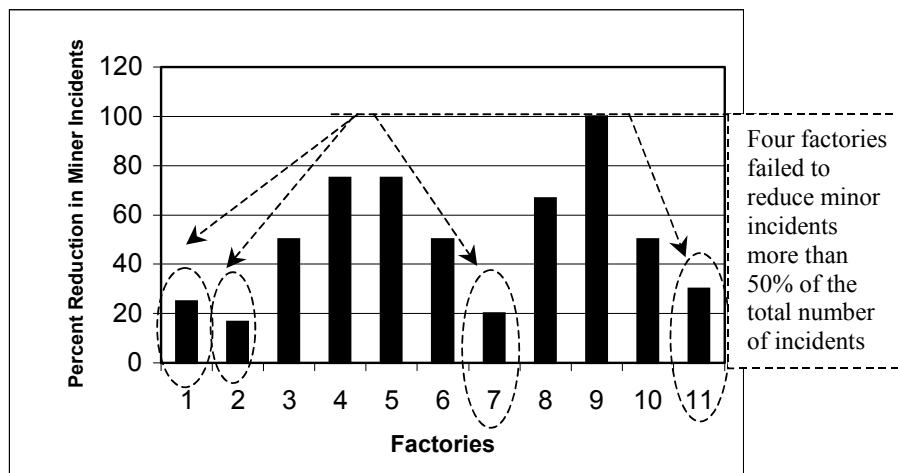


Figure 3. Percentage of reduction in minor incidents in each chemical factory