Occupational Safety and Health Performance Measurement Model

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master's Degree in Engineering Management

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DELARATION

I declare that this work is the result of my own investigation and that it has not already been accepted in substance for any degree, nor is being currently submitted for any degree.

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DEDICATION

This work is dedicated to my father,

who had the faith to raise me

on high virtue and morality.

ACKNOWELDGMENT

I would like to acknowledge the patience and guidance of Prof. Saad Suliman, the Thesis Supervisor, during all phases of this research.

Secondly, I would like to appreciate the support provided by all team of Occupational Safety Section in Ministry of Labour which made this study feasible. Also I would like to thank the group of experts who spent their valuable time to participate in the survey and their contribution to this research.

ABSTRACT (ENGLISH)

The International requirements and local demands of occupational safety and health standards generate a high pressure on the governments to develop their own enforcement systems in order to monitor the compliance of business owners with the legal requirements of such standards. A huge debate exists on the best way to evaluate workplaces in this field using risk assessment.

Decisions made by government inspectors are subjective in most cases. The experience and the knowledge of an inspector have the biggest influence on these decisions for each case. This situation causes a lot of conflict between the decisions taken by a single safety inspector for different cases that have the same circumstances. Also these conflicts occur between different inspectors that face the same case in different places. Fairness, consistency and transparency of the decisions are required by the society as this will shape the level of community trust of the inspectorate.

The thesis reviewed the existing models to evaluate OSH performance, studied the current situation of Bahrain OSH inspection system and developed a policy and a model to help OSH inspectors to evaluate OSH performance of workplaces.

The developed model consists of two parts; one is a descriptive part that explained the steps that should be followed by OSH inspectors for each situation. The other is a numerical part which utilizes a designed scale system to evaluate workplaces by a single measure based on the current OSH regulations in the Kingdom of Bahrain. All regulations were sub-classified into a number of attributes that describe each one of them. Three different types of approaches were used. One is the Average Weights Model by creating relative weights for each attribute depending on the results of the preference expressed by a questionnaire. It targeted a sample of manufacturing and construction companies. The other approach is creating a relative weight for the same attributes by using the Analytic Hierarchy Process (AHP) method. The AHP utilized a questionnaire targeted 15 OSH experts. One extra approach was added by finding an average between the weights calculated by Average

Weights and AHP. The weights resulted used to evaluate the overall performance by a simple rating system.

The developed model attempts to assist the OSH enforcement body inspectors in determining the suitable legal action as stated by law. Moreover, it pursues to minimize the failure that may be caused by human interference due to lack of experience or knowledge as it will depend on a numerical scoring scale set to measure the level of risk exists in the workplace rather than depending on judgment of the inspector himself.

Twenty inspection cases were selected, from the latest inspections done by the Occupational Safety Section (OSS) in Ministry of labour, in order to carry out the validation of the model. All approaches were applied to the cases to find the overall OSH score. The final decisions found were compared to the decisions recorded previously by the OSH inspectors. The results show that the AHP model has more acceptable, consistent scores and decisions. The resulted model may be considered as a sort of a leading indicator.

ABSTRACT (ARABIC)

ملخص البحث

عنوان الأطروحة : "نموذج لقياس أداء السلامة والصحة المهنية في مواقع العمل"

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شكلت المتطلبات الدولية والمحلية في مجال السلامة والصحة المهنية ضغطاً على الحكومات مما أدى إلى سعيها إلى تأسيس نظم خاصة بها للتفتيش والرقابة على مدى التزام أصحاب الأعمال بالمتطلبات القانونية لتوفير وسائل السلامة والصحة المهنية وتأمين بيئة العمل.

ودوماً ما كانت القرارات التي يتخذها مفتش السلامة والصحة المهنية التابع للحكومة بالقرارت الشخصية وغير الموضوعية، فالمعرفة في مجال السلامة والصحة المهنية وخبرة المفتش الشخصية تلعب دوراً كبيراً في طبيعة هذه القرارات. وذلك ما سبب الكثير من التضارب والاختلاف بين القرارات التي يتخذها المفتش بشأن الحالات المختلفة التي يواجهها أثناء عمله والتي غالباً ما تتسم بظروف متشابهة، ومن ناحية أخرى يحدث هذا الاختلاف في حالة قيام أكثر من مفتش بتقييم موقع عمل واحد أو مواقع عمل متعددة. وتجدر الإشارة هنا إلى أن العدالة والمساواة والشفافية مطلب مهم من قبل المجتمع وسوق العمل حيث أن ذلك يؤثر بشكل مباشر على ثقة الناس بجهاز التفتيش الحكومي.

وتراجع هذه الدراسة نماذج قياس أداء السلامة والصحة المهنية في مواقع العمل، كما تناقش الوضع الحالي لنظام الرقابة والتفتيش على إجراءات السلامة والصحة المهنية في مملكة البحرين. وفي هذا الخصوص تقترح الدراسة وضع سياسة وطنية للرقابة على التزام الشركات باشتراطات السلامة والصحة المهنية بالإضافة إلى اعتماد نموذج قياس بغرض الإسهام في مساعدة مفتشي جهاز السلامة والصحة المهنية على قياس مستوى الأداء في مواقع العمل الصناعية والإنشائية.

ويتكون النموذج المقترح من قسمين أساسيين، القسم الأول هو نموذج وصفي يتناول الإجراءات الواجب اتباعها من قبل مفتش السلامة والصحة المهنية عند القيام بعمليات التفتيش. أما القسم الآخر فيمثل نموذجاً يعتمد على أوزان رقمية تدخل في عملية القياس، وقد ربطت هذه الأوزان بتشريعات السلامة والصحة المهنية المطبقة في مملكة البحرين كعوامل أساسية

مؤثرة في مستوى السلامة والصحة المهنية في موقع العمل بينما جرى تقسيم المواد القانونية ضمن هذه التشريعات إلى مجموعات حسب موضوع المادة لتمثل العوامل الفرعية المؤثرة على مستوى السلامة والصحة المهنية في موقع العمل.

وبهدف وضع أوزان واقعية للعوامل الأساسية والفرعية جرى استخدام ثلاث طرق حسابية، الطريقة الأولى تمثلت في استخلاص الأوزان باستخدام المعدل الحسابي (Average Weights Model) وذلك عن طريق حساب المعدل الحسابي الناجم عن آراء مجموعة من المؤسسات المتأثرة بهذا النظام في قطاع الصناعة وقطاع التشييد والبناء من خلال استبيان وزع عليها. الطريقة الثانية استخدمت عملية التحليل الهيكلي (Analytic Hierarchy Process) لإيجاد الأوزان المطلوبة للعوامل الأساسية والفرعية حيث اعتمدت هذه الطريقة على مدخلات من قبل خمسة عشر خبيراً في مجال السلامة والصحة المهنية. أما الطريقة الثالثة فكانت إيجاد المعدل الحسابي للأوزان المحتسبة من خلال الطريقتين السابقتين.

ويهدف النموذج المقترح إلى دعم جهاز الرقابة الوطني المختص بالسلامة والصحة المهنية (قسم السلامة المهنية بوزارة العمل) في تحديد الإجراء القانوني المناسب، كما يسعى إلى تقليل الأخطاء في عملية قياس أداء السلامة والصحة المهنية في مواقع العمل الناجمة عن نقص الخبرة أو المعرفة بالنسبة للمفتش، وذلك من خلال الاعتماد على التقييم الرقمي لموقع العمل بدل رأي المفتش فقط.

وللتحقق من صحة نموذج القياس جرى اختيار عشرين موقعاً للعمل تم تفتيشها مؤخراً من قبل قسم السلامة المهنية في وزارة العمل حيث جرى استخدام نتائج الزيارة كمدخلات للنموذج وحساب المعدل الخاص بمستوى السلامة والصحة المهنية. وقارنت الدراسة بين القرارات التي حددها النموذج والقرارات التي اتخذها مفتشو السلامة حيث اتضح من خلال ذلك بأن نموذج القياس المستند إلى الأوزان المحسوبة من خلال نظام التحليل الهيكلي تعد أكثر قبولاً وواقعية. وتأمل الدراسة أن يسهم هذا النموذج في تطوير إجراءات تفتيش السلامة والصحة المهنية على المستوى الوطني.

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ABBREVIATIONS

ACOP	Approved Code of Practice
AHP	Analytic Hierarchy Process
AWM	Average Weighted Model
BBS	Behavior Based Safety
EPS	Enforcement Policy Statement
HSAWA	Health and Safety at Work Act
HSE	Health and Safety Executive
ILO	International Labour Organization
MOC	Management of Change
MOL	Ministry of Labour
NEBOSH	The National Examination Board for Occupational Safety and Health
OSH	Occupational Safety and Health
OSS	Occupational Safety Section
PPE	Personal Protection Equipment
SIO	Social Insurance Organization

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

"One who acknowledges the danger can later smile and talk about it cheerfully"

An interpretation for the I-Ching[1] Hexagram 51

The history of Occupational safety and health (OSH) has its roots back to 3000 BC The ancient Chinese, 2500 BC, recognized the risk of losses and they tried to manage this situation by placing one sixth of their harvest to this issue on each boat traveling to the market. The history showed that the ancient Egyptians, 1600 BC, described the negative consequences of breathing the fumes coming out from melting silver or gold (Stephans, 2004).

Our interest here is the development of occupational safety and health (OSH) legislation and the development of the enforcement activities during the last two centuries. The history of OSH legislations goes back to industrial revolution in the early of 19th century. However, a number of major incidents, that caused fatalities or major injuries that led to disability, raised the need of protection against working place hazards. Regulating working conditions probably appeared for the first time in Great Britain in 1726 (Key dates in Working Conditions, Factory Acts in Great Britain). These regulations aimed just to control the employment of women and children in plantations. At that time there were no sorts of enforcement entities or inspectorates. The enforcement or administration of such laws was given to the local judicial bodies. So a number of legislations came to regulate different aspects of working conditions but without sufficient enforcement.

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[1] The ***I Ching*** also known as the ***Book of Changes*** is one of the oldest of the Chinese classic texts. Its origins trace back to the 3rd millennium BC.

First attempts to formulate a labour inspection was by using volunteers to visit textile factories or plantations to check the protection measures taken by the owners and the working hours for women and children (Ruiz, 1998). Later on in 1850 when the Factory Act was amended in Britain, it introduced for the first time the concept of appointing inspectors of coal mines, it also set their powers and duties. In 1876, the state of Massachusetts, in northeastern of United State, instituted the first governmental-sponsored factory inspection program (Morrison, 2007). While in Great Britain the forming of a central inspectorate was in 1878 by releasing the Factory and Workshop Act. From that time the inspectorate developed progressively and in parallel with social and economic evolution (Ruiz, 1998).

After the First World War, states started to consider many functions and how to organize and manage them on national level such as interior or home affairs, legal affairs, health etc.. One of these functions is the labour administration so the concept of establishing a ministry or a department of labour began to be one of the core government roles. The functions of such departments were varied from country to another but in general they covered the issues of manpower training and employment, contracts, wages, safety and working conditions and the enforcement and inspection (ILO, Labour Administration (A training manual for labour officers), 1971).

Objectives of the Thesis

The aim of the thesis is to develop an evaluation model for occupational safety and health performance for various premises. The model will assist the enforcement body OSH inspectors to determine the suitable legal action for each inspection case as stated by law. It also will minimize the failure that may be caused by human interfere due to lack of experience, knowledge or power.

The model is intended to:

- Promote enforcement consistency in the enforcement decision making process by setting a standard evaluation criterion.

- Promote proportionality and targeting workplaces by the level of risk available.
- Build a framework for making enforcement decisions transparent by adopting and publishing an enforcement policy that allow all stakeholders to be aware about the decision making criteria,
- To ensure that decisions makers are accountable for them; the OSH inspector and the top management of the OSH inspectorate will be responsible for any wrong evaluation to a workplace which may endanger the life of the workers or impose any losses to the employers.
- Help experienced inspectors to assess their decisions in complex cases, as evaluating workplaces in terms of OHS depends on many factors and deals with a number of conditions which make it difficult to the inspector to decide about the level of risk of the whole workplace. This model will allow peer review of enforcement action between the decisions taken by OSH inspector for similar circumstances.
- Guide less experienced and trainee inspectors in making enforcement decisions by allowing them to follow standard steps and method to decide upon any case.
- Enable managers and supervisors to review the decision making process and their inspectors' enforcement actions.
- Help other authorities such as the Public Prosecutor or the judges to be aware of the reasons behind prosecuting somebody for the failure of complying with OSH rules and regulations.
- Simplify the benchmarking process between establishments in the field of OSH.
- Allow the enforcement body to design inspection programs based on the existing level of risk rather than just doing blitz inspection.
- Develop the monitoring criteria by using scientific measures that will be available for all and based on existing experiments.

Research Methodology

The research involved the following steps:

1. Critical literature review for models used to measure the OSH performance of workplaces. It also covered the policies and models used by different inspectorate.
2. Revision and discussion of the strengths and weaknesses of the current OSH framework in Bahrain.
3. Development of a model for OSH performance measurement based on the review and the needs of Bahrain.
4. Gathering data by conducting a structured survey designed to determine the impact of each OSH Ministerial Orders on the safety and health performance of a workplace.
5. Analyzing the collected data using Average Weights Model, Analytic Hierarchy Process (AHP) model and a model resulted from the average of the weights calculated from each mentioned model. This step is in order to find a relative weight of selected items that have an effect on OSH performance of a workplace.
6. Validate the model through testing on real examples of workplaces inspection activities and compare the results with existing previous inspections.
7. Providing conclusion and recommendations.

CHAPTER 2

LITERATURE REVIEW OF OSH MEASUREMENTS MODELS

CHAPTER 2

LITERATURE REVIEW OF OSH MEASUREMENTS MODELS

Safety Measurement

The problem of safety measurement is confronted by the problem of standardization. Many researchers, (Bu-Khamsin, 1999), (Suddle, 2009) & (Giovanis, 2010), stated that still there is no term of definition of safety which is accepted universally.

The notation "safety" has many definitions. Referring to Cambridge dictionary, 'Safety' is described as 'the state in which or a place where you are safe and not in danger or risk'. However, safety has been defined also as 'the relative protection from exposure to hazards', 'no accidents', 'the opposite of hazard' while the hazard is something that can cause harm, 'the appropriate handling of a substance or carrying out of an action with the view to efface the possibility of causing an injury or damage' (Giovanis, 2010), 'the conservation of human life and its effectiveness, and the prevention of damage to items as per mission needs (Bu-Khamsin, 1999).

Because of the various definitions that are given to the notion of "safety", it is difficult to give one-way definition to safety measurement (Giovanis, 2010). So, along the past decades researchers did not agree on a single way to measure safety performance. Could the safety be measured by just counting the number of accidents, the size of losses and damages resulted or to the way that all workers perceive or acknowledge safety?

Measurement as defined by Stevens (1951) is the assignment of numeral to objects or events according to rules (Bu-Khamsin, 1999). Or it is the comparison process among the existing objects or the natural qualities of incidents (Giovanis, 2010). The problem is how to convert the safety performance to a single numerical measure that states the situation of safety in a workplace. A lot of literature discussed the importance of performance safety measurement as any measure used by science. Safety

measurement will assist to locate and identify problem areas. It also can be used for trend comparison or to describe the current state of a company. Knowing what is happening in terms of safety, helps for predicting future problems and hence prevents accidents that may cause harm to people or any kind of losses to properties. Moreover, safety measurement can be used as a decision making tool. For example, to decide about the allocation of suitable resources in order to rectify problematic OSH areas or the establishment of long term preventive controls by the management. Evaluation of efforts or programs reserved to improve safety performance cannot be done without a measuring tool.

There are many attempts to classify occupational safety measurements or indicators. However, researchers agreed on two main classifications despite the different naming. OSH measurements can be classified into leading indicators (prospective) and lagging indicators (retrospective). In other words, indicators that depend on pre-incidents data and indicators depend on post-incidents data.

Lagging Indicators

The lagging indicators refer to the measurement tools that use post incidents data or the data resulted from occupational accidents, injuries or losses occurred in the workplace. The incidence rate, the incident frequency rate or the severity rate are examples of this category of indicators. For example the American Occupational Safety & Health Administration (OSHA) which is a part of USA Department of Labour uses the incident frequency rate which can be calculated based on the following formula:

$$\text{Incident Frequency Rate} = \frac{\textit{No. of incidents lead to absence} \times 200{,}000}{\textit{Total hours worked by all employees during the year}} \qquad (1)$$

The 200,000 hours in the formula represent the equivalent of 100 employees working 40 hours per week, 50 weeks per year as used by OSHA.

The normal risk assessment, which defined as an evaluation of risk in terms of severity and probability, is a tool that uses accidents data to evaluate the likelihood of occurrence and severity.

Risk assessment usually uses a two dimension matrix, see Table 1, one axis contains the probability segregations and the other axis holds the severity. The risk evaluated as the multiplication of probability and consequences (severity).

Table 1 - One Type of Risk Assessment Matrices

Probability \ Severity	Negligible	Marginal	Critical	Catastrophic
Frequent				
Probable				
Remote				
Improbable				

Low Risk Medium Risk High Risk Source: (Donoghue, 2001)

The probability can be classified quantitatively or qualitatively as shown in Table 2:

Table 2 – Quantitative and Qualitative Classification for Probability of Occurrence

Qualitative	Quantitative
Frequent	$f > 10^{-1}$
Probable	$10^{-1} > f > 10^{-2}$
Remote	$10^{-2} > f > 10^{-3}$
Improbable	$f < 10^{-3}$

Source: (Donoghue, 2001)

Where 10^{-1} represents one accident in 10 shifts.

While the severity can be described in the same manner as shown in Table 3:

Table 3 - Quantitative and Qualitative Classification for Severity

Qualitative	Quantitative (Cost $)	Quantitative (Injury)
Catastrophic	$C > 10^6$	Lead to fatality or disability
Critical	$10^6 > C > 10^5$	Lead to major injury
Marginal	$10^5 > C > 10^4$	Lead to minor injury
Negligible	$C < 10^4$	First aid injury or not

Source: (Donoghue, 2001)

Where C is the monetary cost of an accident.

There are different ways to define the risk matrix. It can be extended or reduced depending on the application.

Despite the wide use of lagging (retrospective) indicators in the industry, they have a number of disadvantages. Depending on accidents data only to evaluate the risk or safety performance is considered as a measurement of failure rather than success. Also it is a sort of frustration and does not give any praise.

The lack of data about accidents is the most critical area. Accidents data should be collected over a long period of time or from a large group of similar conditions to be approved statistically (Giovanis, 2010). Many establishments collect data regarding the accidents, injuries or damages happened under their scope. However, this data totally depends on the user as each organization has its definition for reported accidents rather than investigation techniques and special procedures. The investigation normally comes out with direct causes and little of root causes which can be rectified to improve the situation. From the other hand, recording the root causes of each accident reported is not an easy task for an organization as it requires professional investigation teams and strong data infrastructure. One extra reason is that investigators and reporters of accidents will face the problem of recording multi-causality of accidents and deciding about the cause that has more effect on an accident than other causes. Moreover, reported accidents are rarely compared to different events that disturb the production in a workplace. Some organizations will get a long period of time before having a reported accident which really does not show the real

situation of safety and health performance. The rewarding schemes for reporting or non-reporting accidents applied by some companies are another reason for the lack of accidents data. Some organizations depend on appraising the lapse of the time without occurrence of a lost time accident (LTA). The LTA is considered when a worker gets an injury that causes absence from work. This type of schemes may lead to hide the exact number of accidents occurred. Mangers or supervisors do not want to be pointed out for breaking an achievement recorded by the company. Some other companies reward on reporting accidents, this will cause an over-reporting situation as a lot of accidents will be reported to without necessity. Another reason that may cause the under-reporting, which is not reporting serious accidents by workers or supervisors, is the reluctance of management because of the blame culture in the organization or being afraid from facing sanctions either from company or local authorities.

Reported accidents may show vague condition also. For example, when a sub-contractor reports an injury to a social insurance organization, usually the sub-contractor will not state the exact workplace that may get involved directly to the accident because of poor safety conditions. Likewise, the company involved in the accident will not record it as the worker harmed does not belong to it.

Accidents rates or data do not allow the evaluator to include the current efforts taken by management to improve the safety and health conditions in the workplace, as they consider only the consequences of the accidents. Also, management will not be able to evaluate the effectiveness of applying new measures or systems to improve the safety conditions unless they wait till collecting sufficient data. Here is the point; it is not accepted to put human being under experiments through subjecting them to a new system or improved machinery just to proof that the system is safe. Similarly, for reliability science, devices or electronic equipment could pass through a reliability experiment or an overload test. However this type of experiments could not be carried out involving people.

So the ordinary risk assessment matrices are always criticized for their subjectivity and relying on the estimation of likelihood and severity that depend on judges rather than valid data (Cox, 2008).

Leading Indicators

The second classification of OSH performance indicators is the leading (prospective) indicators. These types of indicators depend on pre-incident data such inspection data, surveys, audits, sampling workers' behaviour or corrective action achieved.

Inspections usually address the work process and consider aspects of working activities and compare them with a set of predetermined standards, while the audits subject the whole working system to a closer examination. Both inspection and audits require the comparison with predetermined standards, without it they will be considered as only observing or looking.

Inspection and audits are powerful tools to monitor unsafe acts and conditions in a workplace. They have some advantages as they can provide direct and clear picture of the current situation of the workplace. They can discover the mistakes and problems that may lead to accidents or damages before they occur. Normally, both are accepted as administrative tools. The disadvantages are the requirement of experience and knowledge for the person who carries out the inspection or audit. Inspection or audits may lose their importance with frequent repetition.

Another type of leading indicators is the monitoring of safe and unsafe behaviour of workers. This tool is the key element of behaviour-based safety programs (BBS). It depends on recording of random samples of workers acts while working and compare it with predetermined behaviors. This method requires time to come out with a conclusion, high expenditure and special expertise. Similarly, using of questionnaires, as a sort of leading indicators, to measure the safety culture of workers or to test how the management acknowledge safety. Questionnaires should be clear and do not create misunderstanding in order to get the best result. However, repeating questionnaires during the same year may cause the exhaustion of workers.

Table 4 below shows the summery of the advantages and disadvantages for the lagging and leading OSH indicators.

Table 4 – Advantages and Disadvantages of Leading and Lagging Indicators

Type	Indicator	Advantages	Disadvantages
Lagging	Incident Rate	Understandable Single measurement indicator	Unreliable post incident data. Measurement of failure. No root causes analysis.
Lagging	Risk Assessment Matrix	Easy to use Risk evaluation and prioritization	Subjective. No consideration of multi-causality.
Leading	Inspections Audits	Provide direct and clear picture about OSH situation Early discovering of dangerous conditions	Requirement of knowledge and experience. Losing importance with frequent repetition.
Leading	Monitoring of Behaviors	Early discovering of problems to take actions	Time requirement to reach results. Costly. Requirement of special expertise.
Leading	Questionnaires	Measuring OSH perception	Improper design of questionnaire will lead to wrong results. Cause workers exhaustion with frequent repetition.

Measuring Safety Performance

Literature, (Ahmad, Gibb, & McCaffer, 1998), (Baig, 2001) & (Giovanis, 2010), contains a lot about characteristics of sufficient OSH measurements. The OSH measure should show the current performance level. Also it should be able to locate and identify problem areas and predict future accidents and problems. Many papers, (Ahmad, Gibb, & McCaffer, 1998), (Cuny & Lejeune, 1999), (Acikalin, 2009) & (Suddle, 2009), discussed how safety performance could be measured by a single indicator.

Using a single indicator to measure OSH performance has many advantages. For example, it is powerful in monitoring the improvement of a system. It also allows comparing between different sites or workplaces by the same measure. A single indicator can be easily understood and communicated. Moreover, it will be a powerful tool for decision making.

Cuny and Lejeune (1999) discussed modeling of severity. The authors argued to use a continuous scale to measure the severity by using the number of days lost for each accident rather than using discrete one. Then they suggested carrying out a statistical test to find the mean and standard deviation of the log normal fit of the distribution. The model suggested by the authors was intelligent. However, it needs more than 20 records for each category in order to be applied correctly. The reason behind it is that depending on the Central-Limit Theory applied to Normal Distribution model (Cuny & Lejeune, 1999). Also it considered as a lagging indicator.

Bu-Khamsin (1999) designed a safety performance Evaluation computer program tool for contractors. He referred to the literature to identify the main important factors that affect safety performance of contractors, and then he classified them to 20 main factors and 85 sub-factors. The model utilized a dimensional weighting approach based on multiple criteria for measuring contractor safety performance (Bu-Khamsin, 1999). A survey was conducted to determine the weight assigned for each factor and sub-factor. The weights were determined as a result of the preference expressed by the contractors. Twenty five construction companies replied to the survey from the construction industry in the eastern province of Saudi Arabia. Then a simple weighted

sum of all ratings is used by a PC program where the user can enter the evaluation done to the company and get out the final score.

The survey carried out used a scale of (4: very high, 3: high, 2: moderate, 1: little and 0: no impact) to rate the importance of each sub-factor. The mean impacts for each sub-factor were calculated and then the relative weights were calculated with respect to each group by using Equation 2 (Bu-Khamsin, 1999).

$$W_{ij} = \frac{SFMI_{ij}}{\sum_{j=1}^{m} SFMI_{ij}} \qquad (2)$$

Where; W_{ij} : the weight of the sub factor that is associated with the main factor.
$SFMI_{ij}$: The mean impact of the sub factor j that is associated with the main factor i.
m: number of sub-factors.

The mean impacts of the main factors were found by calculating the average of the mean impact of the relative sub-factor, see Equation 3, and the relative weight of the main factors found by using Equation 4.

$$MFMI_i = \frac{\sum_{j=1}^{m} SFMI_{ij}}{M_i} \qquad (3)$$

Where;

$MFMI_i$: the mean impact of the main factor i.

M_i : the number of the sub factors in the main factor i.

$$MF_i = \frac{MFMI_i}{\sum_{i=1}^{n} MFMI_i} \qquad (4)$$

Where;

MF_i : The weight of the main factor i.

$MFMI_i$: The mean impact of the main factor i.

n : Number of main factors

The tool created by BuKamsin is very simple tool to understand. Also it provided a systematic, structured approach for OSH evaluation.

Keren (2003) wrote a research regarding modeling safety performance. The research discussed how to evaluate safety performance within the facilities, among different number of facilities and across a whole type of industry. The aim was to develop a

model to evaluate the safety performance that will be independent from users' opinion and give a sort of standardization. The writer created an index-aided model to measure safety performance of an organization using the science of multi-disciplinary decision making. For illustration she used the Analytic Hierarchy Process (AHP) method (Keren, 2003). The writer suggested a hierarchy scheme for OSH performance as the one used by the Management of Change (MOC) practice (Keren, 2003), notice Figure 1. She segregated the problem in a number of layers, and then conducted a survey involving a panel of experts including six members to determine the relative importance of each attribute. Using AHP analysis, the writer determined relative weights for each factor and sub-factor. Then she designed an evaluation form to measure OSH performance of workplaces. The overall performance rate is calculated by using simple weighted sum of all factors. More about AHP is detailed in Chapter 4.

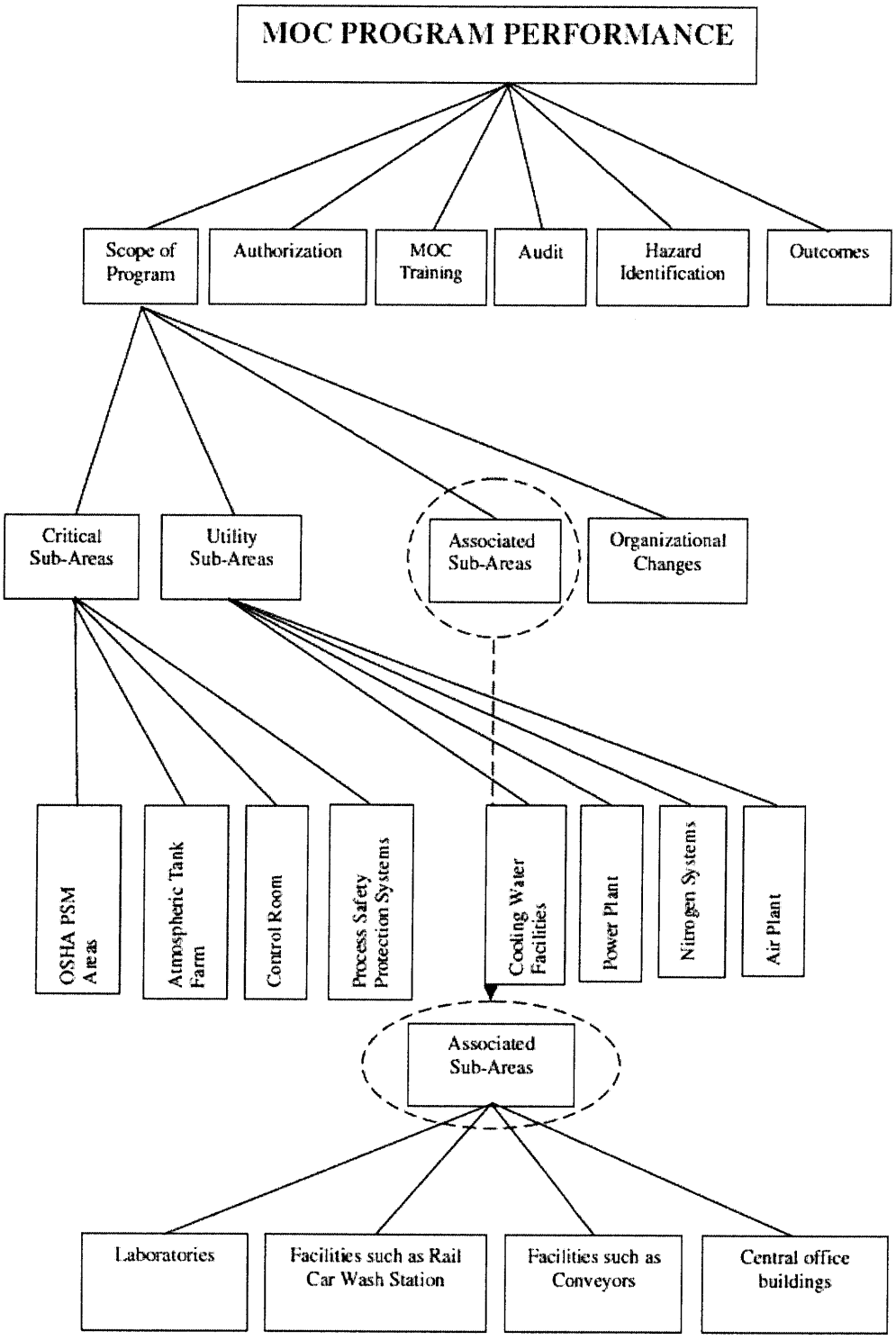


Figure 1 – Part of the Hierarchy Suggested by Keren

Acikalin (2009) attempted to combine both risk assessment using accidents data and the evaluation of safety management in one model. He suggested that each organization shall carry out two types of risk assessment, one using accidents data and the other by evaluating management efforts (Acikalin, 2009). He referred to the literature to determine the elements of safety management areas and sub-areas as shown in Table 5.

Table 5 – Suggested Weight for OSH Audit Areas

	Audit Area	Weight (ψ_i)
A	Organization and Personal	0.12
B	Identification and evaluation of major hazards	0.26
C	Operational Control	0.12
D	Management of Change	0.23
E	Planning for emergencies	0.14
F	Monitoring performance	0.07
G	Audit and Review	0.06

Source: (Acikalin, 2009)

Each Area has a number of sub-areas. The effectiveness of audit area E_A can be calculated from the given scores for each relative sub-area by using Equation 5. The writer used a simple scale (0-3) to evaluate the sub areas.

$$E_A = \frac{Sum\ of\ Points\ of\ Audit\ Area}{Max\ Available\ Points} \times 100\% \qquad (5)$$

The Safety Management evaluation is calculated by a simple weighted sum:

$$E_{SMS} = \sum_{i=A}^{G} \Psi_i E_i \qquad (6)$$

E_{SMS} : The effectiveness of safety management system.

Ψ_i: The relative weight factor of OSH area according to Table 5.

E_i: The effectiveness for OSH audit area *i*.

Then Acikalin suggested converting the E_{SMS} rate to a factor using a linear logarithmic formula shown in Equation 7. The Management factor, as named by the author will be combined with the risk assessment factor as shown in Equation 8.

$$MF(E_{SMS}) = 10^{\left[\frac{E_{SMS}-70}{30}\times 0.1\right]} \qquad (7)$$

Where;

$MF(E_{SMS})$: The management risk factor.

$$R = R_{gen} .MF(E_{SMS}) \qquad (8)$$

Where;

R : The total risk factor.

R_{gen}: The risk factor using accidents data.

The method states that the change of any of them will affect the overall measure. As the effectiveness of the management goes down the total risk of the establishment will increase. The model showed very convenient way to combine leading and lagging indicators. However, in the absence of accident data this method will not be applicable.

Inspectorate Work

Around the world Occupational Safety and Health became an essential part of labour legislations. A number of major events that happened during the last century such as Aberfan Disaster, United kingdom 1966, or Piper Alfa, California 1988, have contributed directly to the development of OSH frame work and legislations. It contributed also to the development of inspection systems. The essential function of the inspectorate is to decide about the compliance of an employer with legal OSH requirements either by planned inspections or investigations at workplace. According to the International Labour Organization (ILO) (ILO, Labour Administration (A training manual for labour officers), 1971) the purpose of labour inspection should be as follows:

1. To secure the enforcement of legal provisions relating to conditions of work.

2. To supply technical information to employers and workers and to advise them in order to comply with legal requirements.
3. Improvement of laws and regulations by addressing the areas that are not covered by OSH legislations.
4. Working towards the improvement of the working environment.
5. Protection of workers while engaged in their work.

A study prepared by Habib (2007) for the ILO came with a result that some countries in the Arab Region have serious deficiencies in OSH mechanisms and performance. The study covered all OSH inspection systems in 18 Arab countries. It discussed multiple areas related to managing OSH on national level as the existing OSH legislations, the role of enforcement, the compensation systems and the national policies and programs. The study showed that the inspection system have similar situation in most countries as the type of inspection carried out, the power of inspectors or the actions taken by the inspectors to secure the compliance of employers. It does not show that any of the Arab countries is taking a special policy or procedure to determine the level of compliance of inspected workplaces or selecting the suitable legal actions. The entire jobs are done by inspectors and depend on their knowledge and experience (Habib, 2007).

The general survey, carried out by ILO in 2009 concerning the application of occupational safety and health convention in the member states of ILO, appraised a number of steps taken by various countries around the world (ILO, General survey concerning OSH conventions, 2009). However, it does not show that there is a special procedure taken by the selected inspectorate regarding the method of measuring safety performance for an inspected workplace.

Another report written by (Arrigo, Casale, & Fasani, 2011) titled "A Guide to Selected Labour Inspection System" presented 43 inspection systems around the world. The report contains details about the main OSH laws and the authorities responsible for carrying out OSH inspection. It showed that most of inspection systems depend on fact finding and give the inspectors an area of discretion to decide

upon the suitable legal actions. Few inspection systems depend on prioritizing the inspection programs based on the level of existing risk.

However, this is not the case of United Kingdom OSH inspection system where the Health and Safety Executives (HSE) initiated an Enforcement Policy Statement (EPS) and an Enforcement Management Model (EMM).

OSH Framework in UK

The contemporary era of OSH in UK is a result of Roben's Report (Hughes & Ferrett, 2004). The report was published in 1972 by Lord Roben who was asked by the Government to review the provisions made for health and safety at work. His conclusion led to the birth of Health and Safety at Work Act (HSAWA), 1974. The Act describes the general duties of employers and employees. It also defines the relationship between the different OSH authorities, such as the Health and Safety Executive and the Health and Safety Commission, and the industry.

UK framework consists of three different OSH legal resources described below (Hughes & Ferrett, 2004):

- Regulations: a set of standards or procedures which comes under the umbrella of the HSAWA. They are directly approved by the local authority.
- Approved Code of Practice (ACOP): a document intended to give more details on the requirement of the regulation.
- Guidance: a document that covers technical aspect of health and safety at work but not considered as law. It can show the best practices to achieve better compliance with the Law or a regulation.

Enforcement Policy Statement

Aiming to control and manage its enforcement bodies' activities and decisions, the HSE designed an "Enforcement Policy Statement" (EPS). The EPS sets out the general principles and approach which the health and safety enforcing authorities are expected to follow.

According to the EPS the purpose of the enforcement will be as follows (HSE, Enforcement Policy Statement):

- To ensure that employers or their representatives, who are the duty holders, will take action to deal immediately with serious risks;
- To promote and achieve sustained compliance with the law;
- To ensure that duty holders who breach health and safety requirements, and directors or managers who fail in their responsibilities, may be held to account, which may include bringing alleged offenders before the courts.

It also describes the tools that shall be used by the enforcement bodies as:

- Verbal or written advice or warning.
- Issue improvement notices.
- Issue prohibition notices.
- Withdraw governmental approval or licenses.
- Issue prosecution notices.

The EPS mentions the enforcement principles, which shall be the main objective for each enforcing authority. The principles cover a number of subjects which are proportionality, targeting, consistency, transparency and accountability.

Proportionality means that relating the enforcement action to the risk. For instance, an inspector could not start with issuing a prohibition notice for minor violations such as non-providing a First aid box, or use only the verbal notice while the existing risk will lead to fatality such as working at height without using safety belt.

Targeting defines the level of attention that must be given to premises that generate high risk to individuals from their business activities. The most important object in this policy is assuring the consistency of enforcement action. Consistency means, according to EPS, taking similar approach in similar circumstances to achieve similar ends. In other worlds, companies have similar risks or conduct similar breaches to the law shall be treated in similar manner. The EPS states clearly that consistency is not an easy task and it enables the authorities to decide upon their procedures and policy in decision making. However, they oblige each one to have a written policy in this regard.

Accountability refers to the liability and responsibility for the decision taken by the inspector. The Policy ensures that the OSH inspectors are accountable for their decisions. Finally transparency covers the duty of the enforcement body to provide the duty holders all the necessary information regarding what is expected from them. The authority should make clarify also its actions and procedures for the public.

Enforcement Management Model

The Enforcement Management Model (EMM) is a framework which helps inspectors to make enforcement decisions in line with the EPS mentioned above. It provides inspectors with a systematic procedure for making consistent enforcement decisions. Moreover, EMM helps managers monitor the fairness and consistency of inspectors' enforcement decisions, and it assists less experienced inspectors in making enforcement decisions. EMM also assists duty holders who may be affected by enforcement decisions in their understanding of the principles followed by inspectors when deciding on a particular course of action (HSE, Enforcement Management Model, 2005).

OSH Inspectors are expected to apply the principles of the EMM in all their regulatory actions. However, they are asked to record the outcomes formally by EMM in the circumstances of investigation of fatalities or to review decisions. The EMM intended to provide a framework for improving consistency as the EPS stated as well

as transparency. The EMM is subjected to a formal review every three years just to ensure its robustness and validity.

According to the HSE the EMM intends to:

- Promote enforcement consistency by confirming the parameters, and the relationships between the many variables, in the enforcement decision making process;
- Promote proportionality and targeting by confirming the risk based criteria against which decisions are made;
- Be a framework for making enforcement decisions transparent, and for ensuring that those who make decisions are accountable for them; and
- Help experienced inspectors assess their decisions in complex cases, allow peer review of enforcement action, and be used to guide less experienced and trainee inspectors in making enforcement decisions.

The EMM created a simple procedure to be followed by OSH inspectors. During inspection, the OSH inspectors gather all relative data about the risk exist and control measure provided by the employers. A benchmarking is conducted by comparing the existing risk to one accepted by law. EMM does not enforce a quantitative assessment, inspectors use their knowledge and experience to convert the available information into the three well known risk elements which are the consequences (the nature of probable harm), the likelihood (probability of occurrence) and the extent (the number of workers affected). To determine the risk gap, EMM provide the inspectors with a risk assessment matrix, see Figure 2. The matrix is similar to normal ones used in ordinary risk assessment. On the vertical axis, the consequences and likelihood is plotted for the existing risk. The horizontal axis contains situation required by the law. After determining the risk gap, the inspector can decide upon the legal action shall be taken.

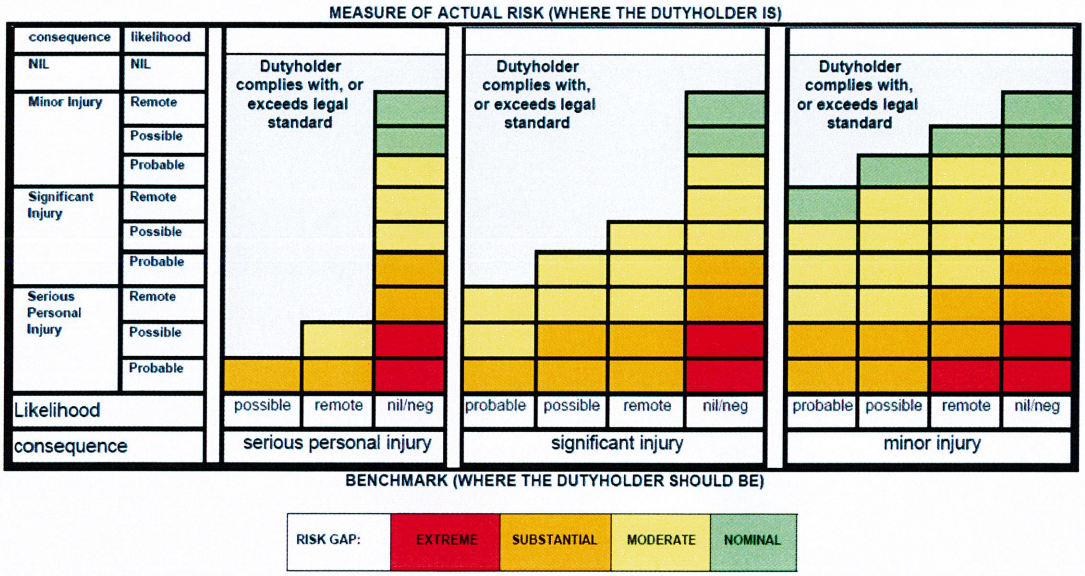


Figure 2 – Risk Gap Matrix Provided in EMM

The EPS and EMM subjected to a number of evaluations according to UK system. The latest published evaluation was carried by Greenstreet Berman, a consultancy agency, in 2006. The evaluation covered all affected parties such as employers, workers, inspectors and victims of occupational accidents. The evaluation concluded that the principles of EPS are vital aspect to achieve effective enforcement and sustained compliance amongst duty holders. However, most inspectors stated that the EPS and EMM had changed their approach while deciding about enforcement actions (HSE, Evaluation of EPS and Enforcement Action, 2006).

From the perspective of employers, the evaluation showed that EPS and EMM have achieved their target to promote proportionality, transparency and consistent enforcement decisions. The evaluation showed that only 25% of prosecutions were considered unfair (HSE, Evaluation of EPS and Enforcement Action, 2006).

UK OSH framework shows many positive areas. It helps OSH inspectors to take better decisions as it will unify the procedures and criteria. Also, it controls the area of discretion by guiding the inspectors in different circumstances.

Along with that, it is obvious that this framework depends on the knowledge and experience of inspectors. It also offers a huge database for inspectors as a reference to make comparisons for any situation they faced in reviewing existing risks. This will

reduce the time needed by less experienced inspector by evaluating the risk based on previous experience. The EMM depends on a 2-dimension risk assessment matrix, which may be more subjective than objective.

Conclusion

By the end of this chapter, it can be concluded that there is no single way to define the term "safety" as well as measuring safety performance. Different leading and lagging indicators are used to measure safety has their applications along with their pros and cons. Many methods were created to measure the safety performance. Although of their subjectivity and complexity, they may generate acceptable results that can reflect the situation of safety performance of a workplace.

Generally, safety inspectorates around the world are not interested in measuring safety performance rather than just using simple fact finding. They depend on human interaction to decide upon safety and health situation in a workplace. However, UK experience in using MMS was appreciated for its transparency and proportionality. It is one of the best practices used to guide safety inspectors in decision making.

CHAPTER 3

REVIEW OF OSH FRAMEWORK IN BAHRAIN

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OSH History in Bahrain

The development of OSH legislations in Bahrain associated with the industrial revolution during the early thirties of the last century, actually after the discovering of oil on the small island. The first labour law in Bahrain was introduced in 1957 (AlBanna, 2002). This law aimed to regulate the employment relationships between employers and workers. It contained many provisions regarding the terms and conditions, wages, working hours and disputes resolving. There was only one article related to OSH which was the article number (37). This article stated the duties of employers and employees in regard to the safety and health at work (The Labour Law of Bahrain 1957, 1957).

The first labour law did not deal with the enforcement of the law or establishing an inspectorate. The administration of that law was in hand of court at that time. Any affected worker should submit a complaint to the competent courts in order to be compensated. In fact, the only interest of OSH field was found in the Bahrain Petroleum Company (BAPCO) which is the first industrial body established in Bahrain. BAPCO recognized the importance of safety and health at work. The Management decided to widen the fire section to create "The Division of Safety and Fire". The division effectively started its jobs in 1954 (Taradah, 1992). In 1970, "Department of Labour" – named later "Ministry of Labour and Social Affairs" – established a safety unit. This unit was responsible only for carrying out safety awareness programs among the public. It had nothing to do with enforcement (Taradah, 1992).

OSH Enforcement Development

A long with the development in the world and after the independence of Bahrain in 1973, the country started seriously thinking of advancing the local administration. In 1975, the government of Bahrain established a number of local authorities to govern the country, one of them was Ministry of Labour and Social Affairs. "The Labour Law for the Private Sector" issued in 1976 by the Decree number 23 framed the new era for inspection system in Bahrain especially in the field of OSH. Labour Law, which still exists, consists of 20 chapters. Chapter 12 deals with safety and health at work. This chapter states the duties of employers and workers as well as the duties and powers of Ministry of Labour in that field. It gives the Ministry the power of imposing sanctions to the employers who failed to provide the necessary precaution to protect their workers from the hazards and risks raised from the working activities. Chapter 18 of the same law establishes the concept of labour inspection along with the power of the inspectors appointed for that function. It also appoints the Minister of Labour to regulate the operation and policy of labour inspection (MOL, 1985).

Under the umbrella of this law there are 20 ministerial orders issued to regulate OSH at workplaces. These orders covered the management of OSH on establishment level, operations safety, health and welfare and fire prevention. The ministerial orders are as follows (MOL, 1985):

1. Ministerial Order No. (7) – 1976 respecting the contents of the first aid box.
2. Ministerial Order No. (25) – 1976 respecting the compensation for employment accidents.
3. Ministerial Order No. (12) – 1977 concerning the organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding.
4. Ministerial Order No. (13) – 1977 the organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations.

5. Ministerial Order No. (14) – 1977 the organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment.
6. Ministerial Order No. (15) – 1977 the organization of services and precautionary measures necessary for the protection of workers during work from the hazards of dangerous machinery.
7. Ministerial Order No. (25) – 1977 the organization of services and precautionary measures necessary for the protection of workers in workplace.
8. Ministerial Order No. (26) – 1977 the organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines.
9. Ministerial Order No. (27) – 1977 the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery.
10. Ministerial Order No. (31) – 1977 provisions for the protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases.
11. Ministerial Order No. (32) – 1977 provisions for the protection of workers from the hazards of steam boilers, steam containers and receivers.
12. Ministerial Order No. (33) – 1977 provisions for the protection of workers from the hazards of electricity.
13. Ministerial Order No. (34) – 1977 provisions for the protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces.
14. Ministerial Order No. (3) – 1978 the organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work.
15. Ministerial Order No. (8) – 1978 prescribing the health and housing requirements for workers' housing accommodation.
16. Ministerial Order No. (6) – 2000 respect to organization of industrial safety measures in the establishment.
17. Ministerial Order No. (3) – 2001 with respect to periodical medical examination for workers susceptible to infection by vocational diseases.

18. Ministerial Order No. (12) – 2005 with respect to protection of workers during work from the hazards of fire in establishments
19. Ministerial Order No. (1) – 2006 with respect to procedures required for reporting occupational injuries and diseases.
20. Ministerial Order No. (24) – 2007 with respect to banning the employment of workers in the construction sector during the summer under the sun and in open areas between 12:00 noon and 04:00 PM.

Occupational Safety Section

Along with these dramatic developments in the country, Ministry of Labour and Social Affairs established the "Occupational Safety Section" (OSS) which followed the Labour Directorate. It consisted of limited number of engineers and specialists to carry out the main duties. In 1976, the ministerial order numbered (8) issued by the Minister of Labour stated the functions of OSS section as follows:

- Conduct periodical inspection for factories, establishments and various workplaces. The objective of visits is to provide both employers and workers with the necessary information and instructions to avoid work related hazards. Also these visits aim to enforce complying with OSH rules and regulations.
- Investigating complaints communicated to the section regarding OSH violations in workplaces.
- Organizing awareness activities to raise the preventive OSH culture among employers and workers.
- Registration of occupational accident notifications sent by the employers or workers themselves.
- Carry out occupational accident investigation.
- Be aware of the latest studies and researches in the field of OSH.

The ministerial order no. (28) for the year 1976 regulated the inspection function. This order stated the powers of labour inspectors as follows (MOL, 1985):

- To enter all places of work without previous notice during working hours whether at night or by day with the object of labour inspection therein and carry out an inquiry into the subject matter of inspection provided that this shall be carried out in accordance with the instructions conveyed to them by their supervisors.
- To examine the registers, papers, books and files or any other such documents of relevance to the workers in order to ensure their compliance with the requirements provided for in the Labour Law for the Private Sector and the Ministerial Orders issued for its implementation. The inspector may request the employer or his representative to give him access to all the above mentioned documents, and to draw his attention to the exhibiting of all the notices and statements provided for in the law.
- To obtain samples from the materials used and dealt with in the establishment in order to analyze them and to scrutinize the machines and the various fittings to ensure the existence of adequate and effective measures of safety and health to workers. The inspector shall have the power to issue the necessary instructions to introduce the urgent changes required for providing the requirements of protection from hazards of work and machinery and the means of protection against occupational diseases.
- To question the employer or his representative and the workers whether individually or in the presence of witness on any of the topics relative to the application of the provisions of the Labour Law for the Private Sector, and a conclusion may be reached in this light as to whether the requirements provided for in the aforementioned law and the Ministerial Orders governing its implementation are put into effect and to what extent.
- To consider with the employers and the workers, whether individually or collectively, the best ways to facilitate the application of the provisions of the law and the Ministerial Orders governing its implementation and to eliminate all the difficulties which obstruct the enforcement of the law, particularly with regard to any ignorance of the afore-mentioned provisions.

All the above mentioned powers comply with the international norms and standards.

Since that time Occupational Safety Section continued to do the same functions. Several changes had been made on its organizational chart over the last decade for the purposes of keeping in line with development of industry and labour market in Bahrain in terms of size and technology. Progressive developments were noticed in the enforcement body of OSH as ILO stated in its General Survey concerning OSH convention in 2009 (ILO, General survey concerning OSH conventions, 2009).

Organizational Chart of OSS

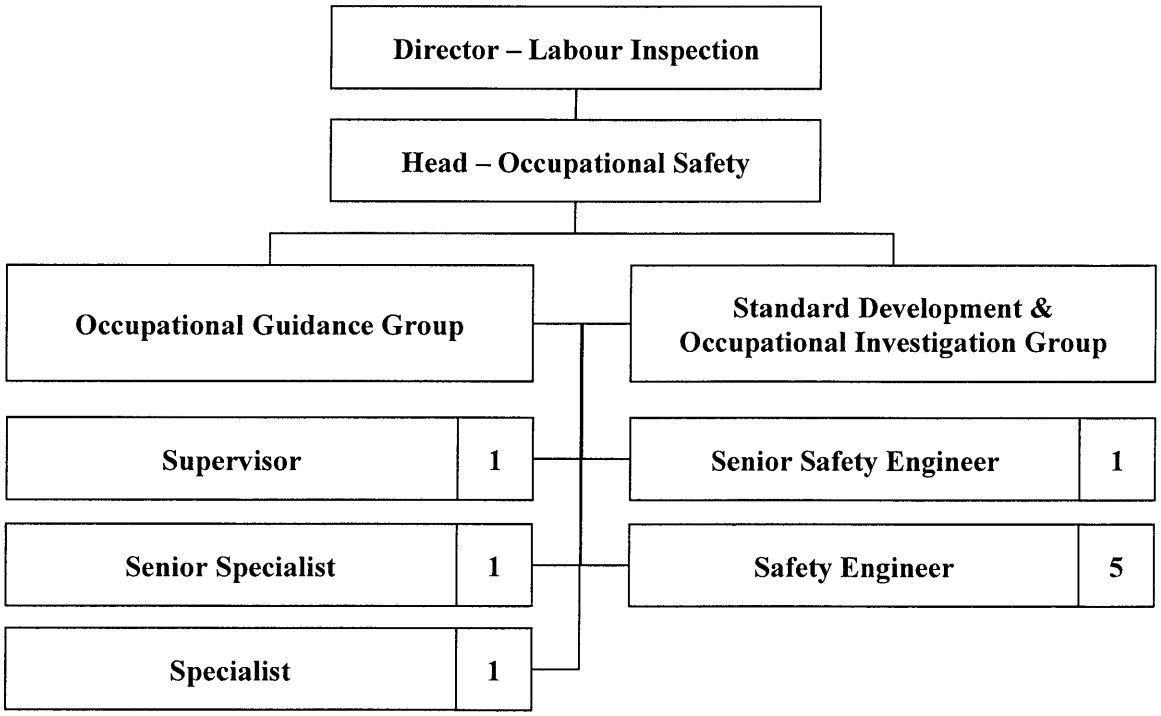


Figure 3 – Organizational Chart of Occupational Safety Section in MOL

As the organizational chart approved by Civil Service Bureau in March 2007, Figure 3, OSS consists of two functional groups. The first one is the standard development and occupational investigation group. This group is responsible for the enforcement

activities. The second group is the Occupational Guidance Group which is responsible for awareness activities.

There are five Engineers led by a senior engineer employed in the first group. All staff have a degree in an engineering discipline and all were trained in the field of OSH. A number of OSH inspectors have NEBOSH certificate which is an international recognized certificate origin in United Kingdom by a foundation called "National Examination Board for Occupational Safety and Health".

The main duties of OSS staff are as follows:

Head of Section

The head of section is responsible for planning and supervising the functions of both groups of OSS. He leads the inspection activities or accident investigation. The section head is responsible for reviewing and approving reports prepared by inspectors and suggests the necessary training programs for them. He is responsible for planning the development of OSH standards and awareness activities for each year.

Senior Occupational Safety Engineer

The Senior Engineer is responsible for technical supervising among OSH inspectors. He is responsible for carrying out the plan put by the head of section. The senior engineer is almost the leader of inspection and investigation teams.

Occupational Safety Engineer

The Engineer is the one who carry out safety inspections and accidents investigation. He should submit a report of his work to the senior engineer. The engineer may participate in a field survey team or an awareness program held for any establishment. He also gives advice for employers and workers regarding OSH in workplace.

Occupational Guidance Group

It is responsible for carrying out the awareness plan. Also it handles the researches and studies regarding OSH and accidents prevention. The Guidance supervisor and his team may involve in inspection and accident investigation and may involve in OSH standard development.

OSS Procedures

OSS carries out its inspections on random basis. Different types of establishments or workplaces are selected and distributed among the team. There are no specialized campaigns based on the level of hazards exist or on the basis of past history. On field, the inspector will study the existing hazards and the level of risk based on his/her experience and will check out whether the measures taken by the establishment to protect works are adequate enough. The inspector may question mangers regarding the status of recent accidents and injuries. Photos of the workplace may be taken by the inspector to document any noticed violations to OSH regulations. The main reference for inspection is the Labour Law and OSH ministerial orders mentioned above. Based on field visits, OSH inspectors may decide upon the actions will be taken to ensure complying with OSH standards and regulations as follows:

- Initiate a verbal notice to the employer.
- Initiate an "Improvement Notice" which is a written document showing the violations found on field and warning him/her to comply with rules.
- Initiate a "Prosecution Notice"; a document to be transferred to the judicial authorities to decide upon the necessary judgment based on the local law.
- Order for closure of the establishment totally or partially by prohibiting one operation or more.

The Shortcomings of Bahrain OSH Framework

A review of Bahrain OSH framework and enforcement structure was carried out in 2007 by NEBOSH (The National Examination Board of Occupational Safety and Health) a professional organization based in the United Kingdom. The Ministry of Labour asked NEBOSH to carry out such evaluation in order to be able to improve and develop this field. It covered the areas of OSH legislations, the enforcement procedures, and the collaboration between Government, Employers and workers. It recommended improving number of areas such as the national framework, the legislations and the enforcement policies. The review emphasized on the importance of demonstrating the fairness and transparency of enforcement decisions to the stakeholders as employers and workers.

The enforcement policy and procedure applicable in any particular circumstance is generally left to the discretion of the Chief Inspector and his staff (Wilkes, 2007). There is no policy or a specific guidance showing the suitable action for any case. Even the "Quality Manual" of OSS does not state anything regarding this issue. This situation made questions about the decisions taken by the OSH inspectors, especially about the level of fairness, consistency or transparency being practiced by Ministry of Labour. Establishments and social parties expect a consistent application of standards for each case. On the other hand ILO standards especially the Occupational Safety and Health Convention No. (155) states that the enforcement of law and regulation shall be secured by an adequate and appropriate system of inspection. Consistency, transparency and fairness are major part of the adequacy of the enforcement body. By revisiting the decisions taken by the inspectors during 2006-2009 it was found that an average of 24% of yearly prosecution notices were changed or cancelled. Table 6 shows the yearly percentage of changed prosecution notices. This was due to two reasons; the first reason was that the decisions of the chief inspector were in conflict with the inspectors' decisions. The second one was the dissatisfaction of the employers for the enforcement action which led them to raise complaints to the top management of the Ministry.

Table 6 – Percentage of Changed Prosecutions

Year	% of Changed Prosecution Notices
2006	11%
2007	31%
2008	42%
2009	12%
Average	**24%**

Source: (OSS, 2005-2010)

It can be concluded that there is no control of discretion made available to OSH inspectors. Also there is no base or criteria for changing the decisions taken by the inspector especially with the interference of the top management.

Another shortcoming of the OSH framework of Bahrain is the lack of accidents and injuries data. Ministry of Labour collects accidents data as well as the Social Insurance Organization (SIO). Both have their separate procedures and objectives for such kind of process. Ministry of Labour represents a law enforcement body; the data collected about occupational accidents are used for investigation purposes. The data is used also for taking necessary legal actions against any offenders to the OSH rules and regulations. On the other hand, Social Insurance Organization collects the data for compensation purposes. The compensations for death or disability can be claimed from such organization. The Occupational Safety Section annual reports showed the number of occupation accidents and injuries investigated by the Ministry. Tables 7 and 8 show such statistics.

Table 7 - Injuries by Economical Sector Recorded by OSS

Sector	2005	2006	2007	2008	2009	2010	Total
Wholesale and retail trade, repair	1	9	4	8	16	11	**49**
Construction	38	40	46	80	96	80	**380**
Manufacturing	15	14	31	28	30	32	**150**
Mining and quarrying	0	0	0	0	1	1	**2**
Personal and social services	2	9	2	2	9	14	**38**
Agriculture, hunting and forestry	0	0	2	0	0	1	**3**
Electricity, gas and water supply	0	0	0	0	2	1	**3**
Financial rmediation	0	0	1	2	1	1	**5**
Transport, storage, communication	0	1	0	6	1	1	**9**
Other social, personal services	0	0	1	0	1	1	**3**
Total	**56**	**73**	**87**	**126**	**157**	**143**	**642**

Source: (OSS, 2005-2010)

Table 8 - Injuries by Consequences Recorded by OSS

Injury Resulting in	2005	2006	2007	2008	2009	2010	Total
Minor Injury	6	7	2	6	30	19	70
3-day absence Injury	0	9	17	25	23	17	91
Major Injury	32	34	39	63	69	84	321
Death	18	23	29	32	35	23	160
Total	**56**	**73**	**87**	**126**	**157**	**143**	**642**

Source: (OSS, 2005-2010)

The SIO annual reports also showed the number of injuries reported to the organization for compensation claims. Table 9 shows the data for the years 2006-2011.

Table 9 - Injuries by Consequences Recorded by SIO

Year	2006	2007	2008	2009	2010	2011
Recovered	1809	1580	1426	1329	884	260
Under Treatment	640	522	525	656	758	506
<30% Disability	247	60	276	51	18	20
>30% Disability	18	2	19	7	2	5
100% Disability	0	0	1	1	1	1
Death	30	26	24	34	19	16
Total Injuries	**2744**	**2190**	**2271**	**2078**	**1682**	**808**

Source: Annual Reports published by SIO (2006-2011)

From the available data, it can be concluded that there is a huge difference between the accidents statistics published by Ministry of Labour and the ones published by Social Insurance Organization. This is a result of the various definitions for occupational accident adopted by each one of them, as well as the different reporting procedures and forms. The absence of sufficient punishment in both MOL and SIO system contributed to the continuation of publishing different occupational accidents statistics during the last years. For instance, failing to report an occupational injury to SIO within 24 hours will lead to additional BD 1 as an extra charge for every month of delay while punishing an employer for non-reporting occupational accidents does not exist in MOL reports. Occupational accidents statistics published in Bahrain do not reflect the actual situation of occupational safety and health (AlBanna, 2002). For instance, it could not be relied on the accidents statistics only to describe the improvement or the decline of the OSH situation in Bahrain. The data published by MOL or SIO do not contain a lot of information about the root causes of the accidents and it is difficult to relate them to the OSH violations after the investigation is closed.

Figure 4 shows that the record of MOL has a significant increase of the occupational accidents while Figure 5 shows that there is a significant drop of the same data registered by SIO. As mentioned previously it could not be referred to significant improvement or decline in OSH situation in workplaces in Bahrain. Especially for

MOL case, the increasing number of accidents reported is due for improvement of working procedures only and for recruiting more OSH inspectors after 2004. So the accidents or injuries data available are not reliable to be used as an OSH performance index.

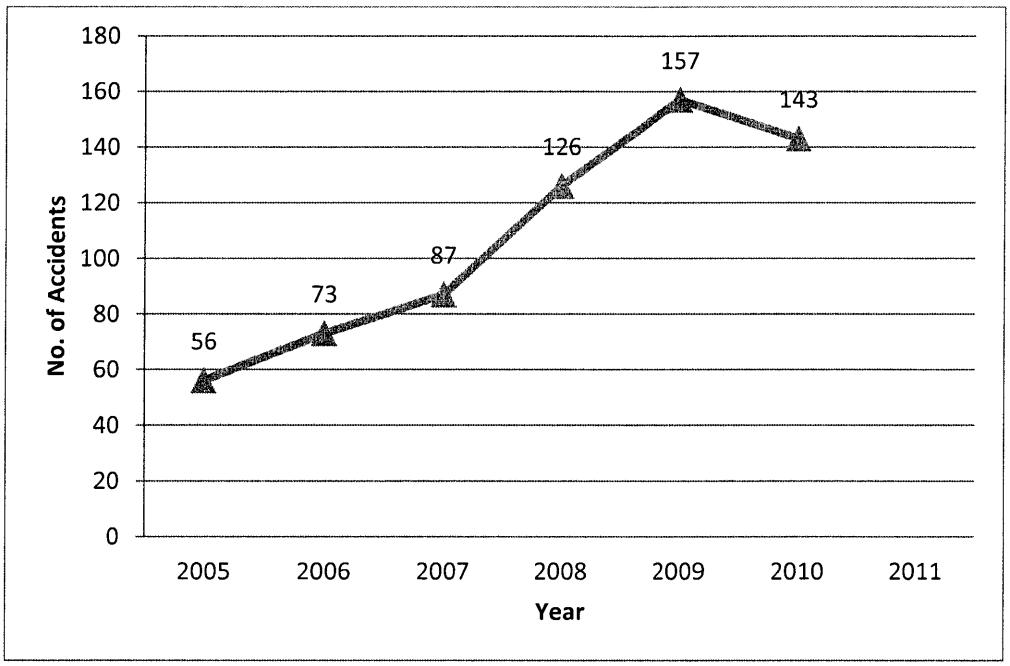


Figure 4 - Injuries Registered by MOL 2005-2010

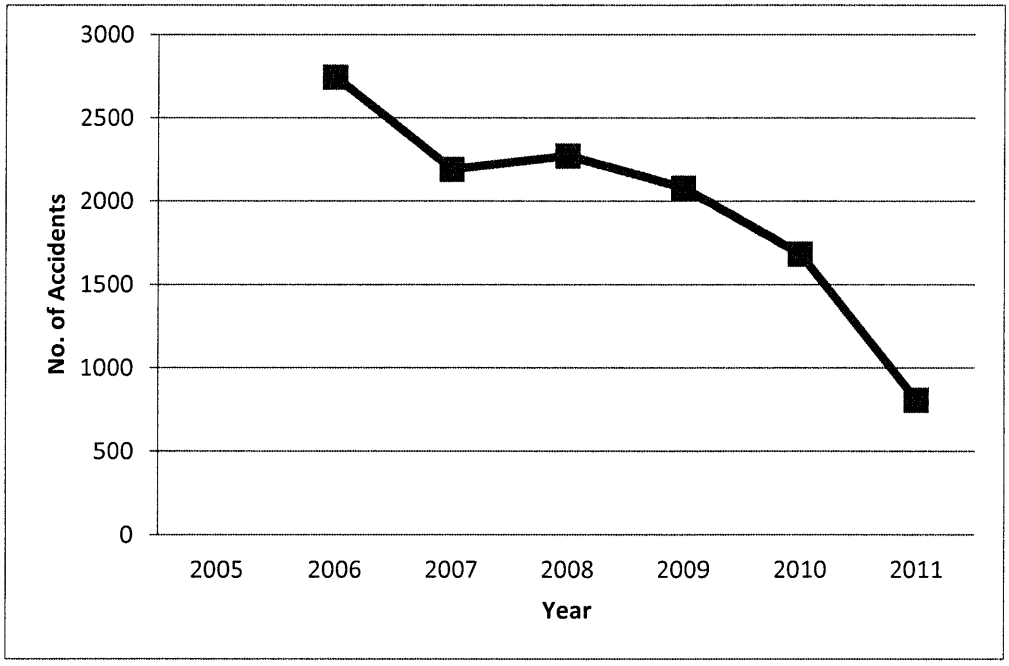


Figure 5 - Injuries Registered by SIO 2006-2011

Perception of Companies to MOL Role and Procedures

To support the study with data regarding the perception of the companies to the occupational safety and health role and the procedure of Ministry of Labour safety inspections, a structured questionnaire was designed and distributed among 150 selected companies. The questionnaire actually had two parts as shown in Appendix A. The objectives of the first part were to discover to what extent that responders evaluate their management knowledge regarding OSH, and to figure out how companies perceived the enforcement actions taken by Ministry of Labour safety inspectors. The second part of the questionnaire will be discussed later in Chapter (5).

The sample was selected from manufacturing and construction companies that employ more than 100 workers as per the database of Ministry of Labour. The aim of this criterion was to insure that the company selected is well established and have at least one occupational safety officer or specialist in charge.

Seventy one (71) replies were received from the distributed questionnaire. Sample replies are shown in Appendix B. The data of the companies were collected and analyzed by referring to the record of OSS during the years from 2005 to 2011. It is found that 51% of the companies that responded to the questionnaire were from the manufacturing sector while the rest represent the construction sector.

Fifty companies, which represent seventy percent (70%) of the responded companies, had previous experience with Ministry of Labour OSH inspection. These companies had a total of 157 inspection records in the Occupational Safety Section database. The distribution of the times of inspections to the responded companies is shown in Figure 6.

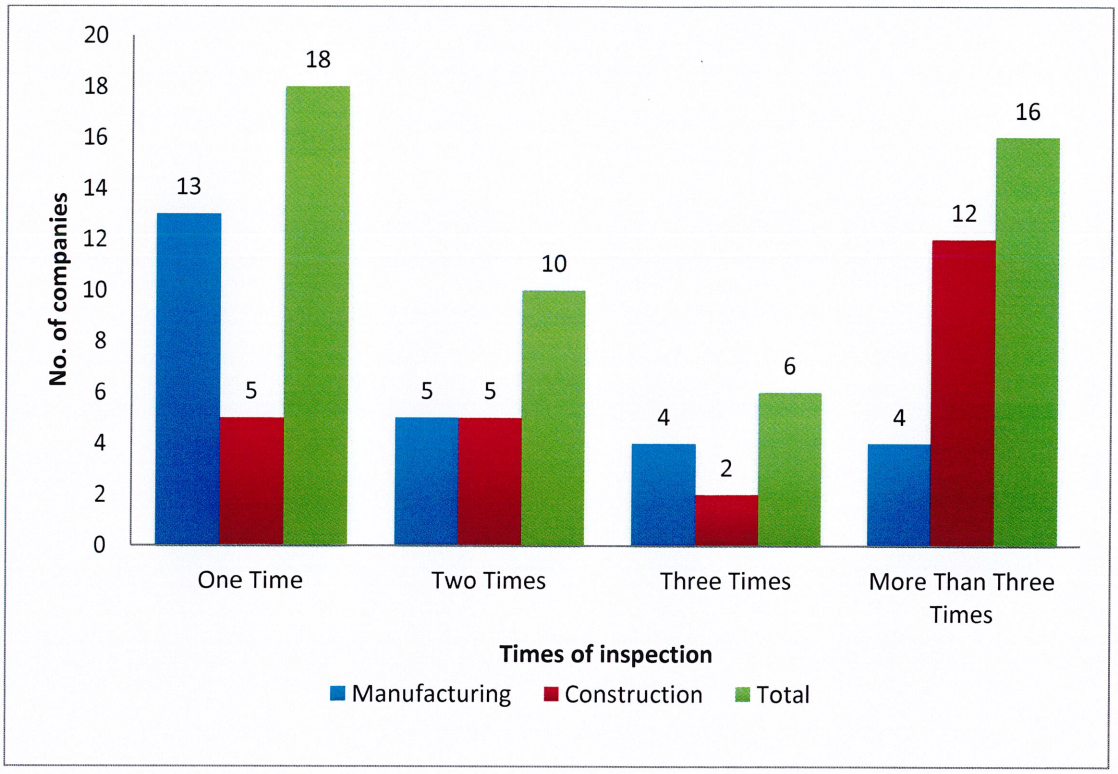


Figure 6 - Companies responded to the Questionnaire by Number of Inspections

Occupational Safety Section database showed variety of actions taken against those companies. Starting from verbal notices to persecution notices as shown in Figure 7.

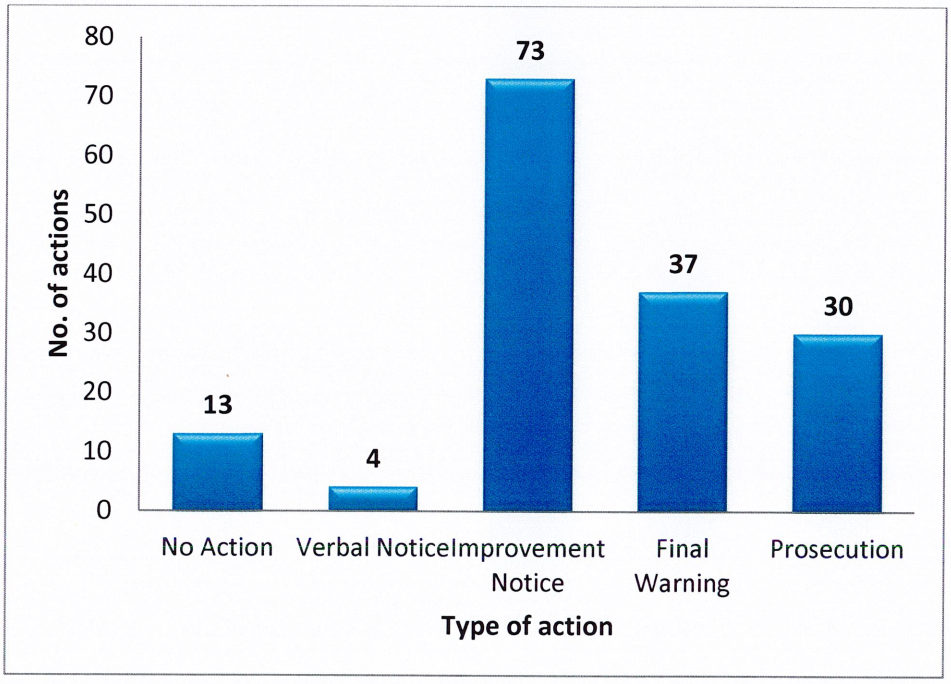


Figure 7 – Number of Actions Taken

The analysis of collected data showed that most of the respondents to the questionnaire were safety specialist from different levels. Few of them were administrative managers or working in other fields as quality or finance.

Survey Results

As mentioned before, the first part deals with how the companies understand and perceive MOL safety inspection procedure. Six questions were analyzed for this purpose. And five levels evaluation scale was used to describe the results.

Section A:

Question 1: How do you evaluate the level of knowledge of the management about the national Occupational Safety and Health legislations?

The first question is about the evaluation of the knowledge of the company's management by the responder. Figure 8 below illustrates that most managements have very good knowledge about the occupational safety and health in workplaces.

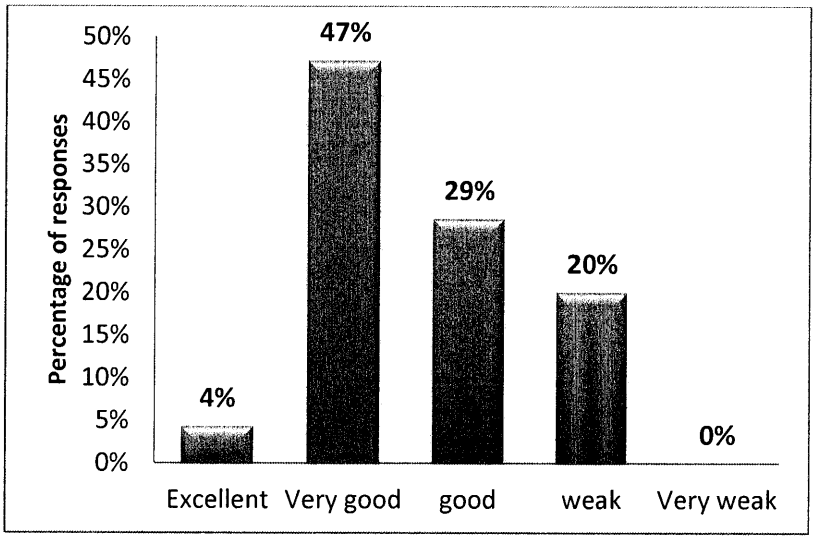


Figure 8 – Evaluation of Management OSH Knowledge

Question 2: How do you evaluate the level of knowledge of the management about the Ministry of Labour role and procedures in term of Occupational Safety and Health?

The second question evaluates the management awareness regarding the rules and procedures of Ministry of Labour safety inspectors. The result, in Figure 9, shows that, from the perspective of the responders, most of management also have good knowledge regarding this issue.

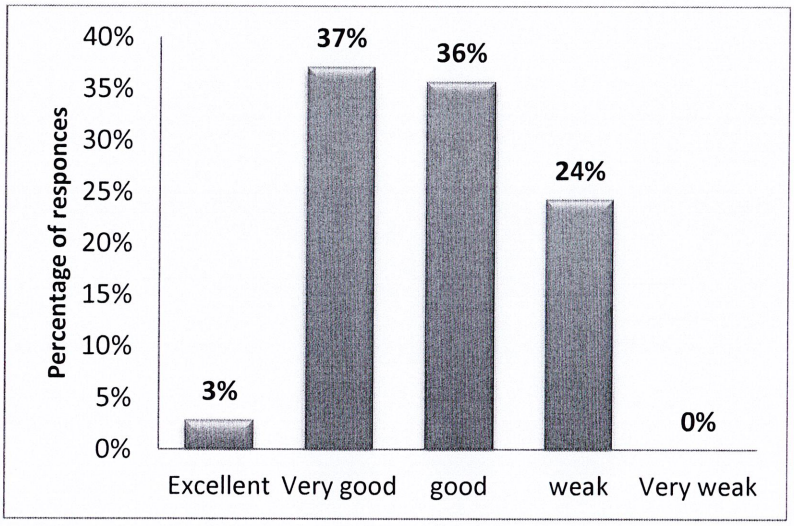


Figure 9 – Evaluation of Management OSH Procedures Awareness

Both conclusions will reflect on the coming questions which evaluate MOL procedures in term of occupational safety and health.

Section B:

Question 1: To what extent do you agree that procedures and the policy for legal actions selected by Safety Inspectors are clear and understandable?

The analysis of the third question, Figure 10, shows that 67% of the sample disagreed that the procedures and policy followed by MOL inspectors for selecting the best legal actions are clear and understandable.

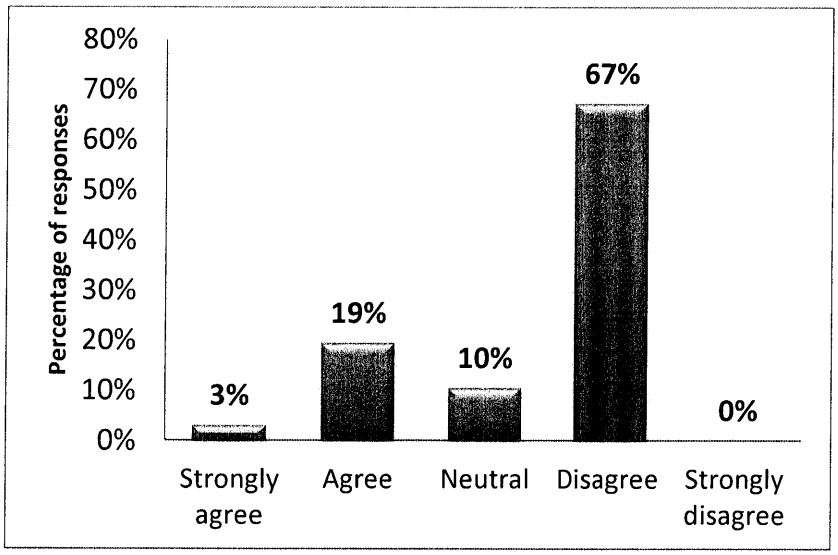


Figure 10 – The clarity and understanding of MOL OSH procedures to select legal actions

Question 2: To what extent do you agree that Ministry of Labour Safety inspectors are taking consistent decisions and legal actions among the workplaces inspected?

Fifty eight percent (58%) of the sample also disagreed that MOL safety inspectors are taking consistent decisions among different workplaces as shown in Figure 11.

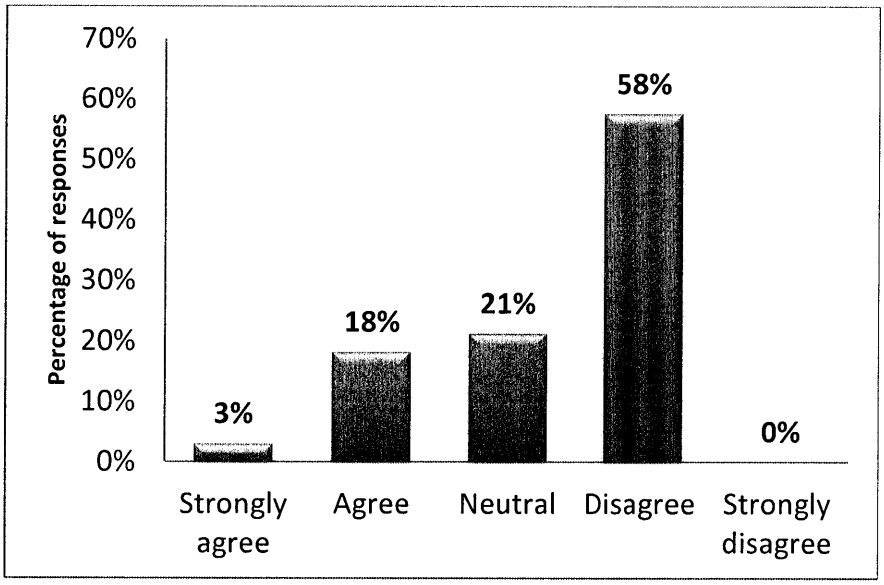


Figure 11 – Consistency of OSH inspector decisions

Question 3: To what extent do you agree that Ministry of Labour Safety inspectors are taking fair legal actions among the workplaces inspected?

Fifty five percent (55%) of the sample, as shown in Figure 12, disagreed also that MOL safety inspectors are taking fair actions.

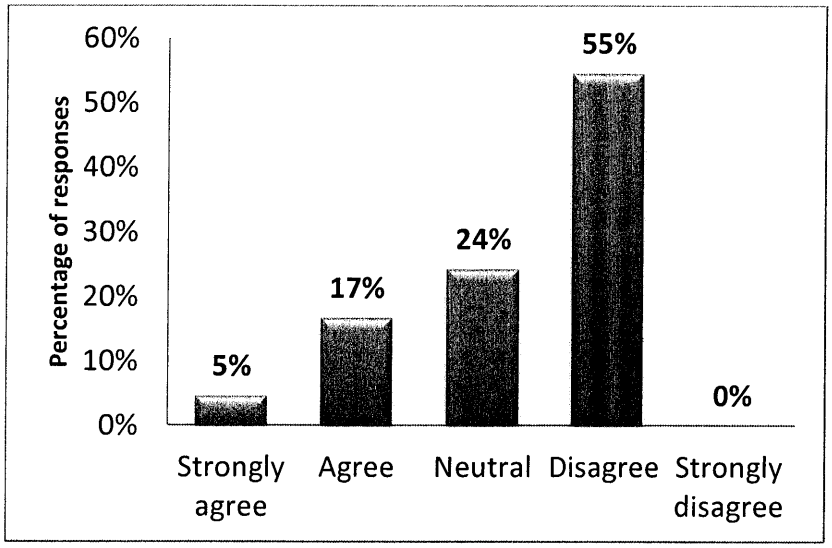


Figure 12 – Fairness of OSH inspector decisions

The results for the previous three questions confirm the fact that the fairness and the consistency of legal actions taken by MOL safety inspectors are questioned and need to be addressed.

Question 4: To what extent do you agree that Ministry of Labour have to introduce a clear policy regarding the standards and procedure to be followed by its Safety Inspectors to decide about the suitable legal actions after inspection or investigation process?

The last question result, Figure 13, shows most of the sample agreed that Ministry of Labour should introduce a clear policy and procedures for its safety inspectors in order to decide upon the suitable legal action taken after an inspection process.

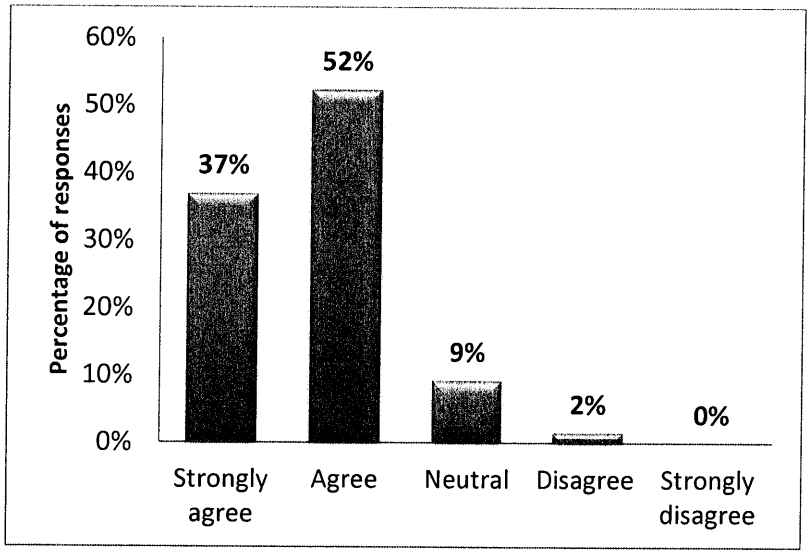


Figure 13 – Opinion regarding the necessity for developing an enforcement policy

Conclusion

Kingdom of Bahrain started to regulate OSH since 1976. It depends on detailed descriptive regulations. However these regulations created a standard reference to evaluate OSH. Although, the OSH inspection formed 30 years ago, minimum development was done to the structure and method of evaluation. The existing of different regulatory agencies caused a sort of confusion in defining the occupation injuries. As a result, different statistics and indicators published about OSH.

The questionnaire showed clearly that there is a need to redesign MOL procedures related to OSH inspection. Companies believe that MOL procedures are ambiguous and do not reflect consistency or fairness.

The need of an OSH performance evaluation model that satisfies all parties is a demand in Bahrain. That is what will be achieved in the coming chapters.

CHAPTER 4

DEVELOPING A NATIONAL OSH ENFORCEMENT MODEL

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DEVELOPING A NATIONAL OSH ENFORCEMENT MODEL

In order to overcome the deficiencies in Bahrain OSH framework, Ministry of Labour shall develop and apply a national enforcement model. The model should set an outline procedure to be followed by OSH inspectors during their visits. The model should set also a process and a criterion that will help them to decide upon the suitable legal actions.

This chapter will discuss the suggested model for Bahrain OSH inspectorate. The model will have two parts; the first one is the descriptive model and the other one is the numerical model. The descriptive model will consist of a policy statement and an algorithm process. The numerical part will be included in the algorithm where a relative weight is suggested for OSH attributes to be inspected and checked in workplaces by inspectors.

Elements of the Enforcement Policy

The enforcement policy is a general statement put by the authority to set out the general vision and mission. Richthofen (2002) illustrated the principles of the enforcement policy as follows:

- Provide uniformity of criteria for standards of enforcement.
- Provide consistent implementation of legislations.
- Provide equal protection for workers in similar situations.
- Eliminate any advantages to employers.
- Provide a common and consistent approach to common problems.
- Provide the consistency of procedures.
- Provide clear guidance to inspectors on the use of their discretion.

- Be clear, transparent, coherent and manageable.

Another two objectives to the enforcement policy were discussed by Linehan (1988), namely, the ability of setting of priorities through determination of risk and the use of flexible and graded system of sanctions. All these objectives will be considered in the suggested enforcement policy below.

ILO provides guidance for governments in order to assist them in developing such policies. The elements may be modified, extended or changed based on the national requirements. The following are the main suggested elements for Bahrain national enforcement policy:

1. **Preamble**: It sets the main government bodies that may join the OSH enforcement over the labour market. It can contain some general statements to declare the objective behind such kind of policy. The sample preamble shown below can be used as a preamble for Bahrain OSH Enforcement Policy (Rice, 2006).

> The aim of the adoption of the National Labour Inspection Enforcement Policy is to give purpose and direction to, and enhance the effectiveness and impact of, all headquarters and field office activities, which all labour inspectors will henceforth apply, and whose application will be strictly monitored from within the service by field offices and the headquarters, and externally also by the social partner organizations.
>
> This National Labour Inspection Enforcement Policy document sets out the general principles that Ministry of labour expects that all field office directors, and all individual labour inspectors to follow. It also allows employers and workers and other duty-holders to better understand inspection activities, including monitoring of inspectors' training and performance, to hold inspectors to account when evident deviations are observed, and to be likewise held accountable by them for compliance.

2. The following box contains a **Vision** of the purpose and direction of the country's labour inspection system. It could be used for the national policy as well as the mission statement mentioned in point 3 below (Rice, 2006).

Vision

The OSH enforcement aims to contribute to the country's balanced socio-economic development and prosperity through the provision of fair and equitable, effective and efficient labour inspection services that will uphold the law, ensure workers' protection and promote employers' competitiveness.

3. A **Mission statement** (Rice, 2006) responding to the question: "what is our business?"

Mission

Labour inspection aims to ensure full compliance with all national labour legislations so that risks to peoples' safety, health, and conditions of employment are properly controlled; and to promote a fair, safe, healthy, stable, and productive working environment in all workplaces under the responsibility of the Ministry of Labour.

4. A set of **objectives** that the enforcement tries to achieve or to promote over the labour market may be as follows:
    a. **To promote good labour practices,** including improved conditions of work, a safe and healthy working environment, and adequate welfare facilities.
    b. **To ensure compliance** with all labour legislations: the OSH inspectorate will be both proactive, (planning annually and monthly, national, field and sectoral inspection activities, identifying cases of non-compliance and taking corrective action), and reactive, (i.e. dealing with complaints, accidents, incidents and disputes).
    c. **To promote Proportionality:** any enforcement action has to be related to, and commensurate with, the risks to health and safety and the seriousness of the apparent violation of labour law. Inspectors have to consider the compliance capacity of the enterprise and whether the advantages of any enforcement measures outweigh the disadvantages,

and if there is a smarter, more appropriate way of achieving the same compliance goal.

d. **Efficiency and effectiveness:** the OSH inspectorates will strive for the best use of available human and material resources.
e. **Transparency:** the OSH inspectorates will strive to help employers, workers and other stakeholders understand their rights and duties, what is expected of them under the law, and what they can expect from the Labour Inspection. Regulations must be accessible to all, and good, easy-to-understand back-up advocacy and explanatory material provided and widely distributed.
f. **Accountability:** inspection staff are public officials assured of stability of employment and independent of improper external influences, whether political or financial. Labour inspectors are accountable for their actions and performance.
g. **Consistency:** the OSH inspectorates will ensure that in labour inspection matters, similar cases will be treated by inspectors in similar ways under similar conditions to achieve similar prevention and compliance ends. Best inspection practice developed in any one part of the Country will be applied in all other areas of the country as well.
h. **Coherence:** the OSH inspectorates will issue clear guidelines for a common, coherent and consistent intervention approach for all inspectors in all field offices, including the exercise of authority, discretion and judgment.

Inspection Process

As stated in Chapter (3), Bahrain OSH inspection depends on a set of sanctions mentioned by the Ministerial Order Number (28) for the year 1978. The sanctions are as follows:

- Verbal notice.

- Improvement Notice.
- Prosecution Notice.
- Order for closure of the establishment totally or partially by prohibiting one operation or more.

The objective of this work is to build a model to enable OSH inspectorate to evaluate the risk and select the best legal action. The model should utilize both descriptive and numerical methods. OSH inspectorate needs to set out a systematic procedure that guide OSH inspector to the final output or the final decision based on the inspection objectives.

The purpose is to set a guideline for the OSH inspectors to follow for each case they face in their daily work. The following descriptive steps shown in Figure 14 suggest the process to be followed by OSH inspectorate in order to select the best legal action by measuring the OSH performance of an establishment.

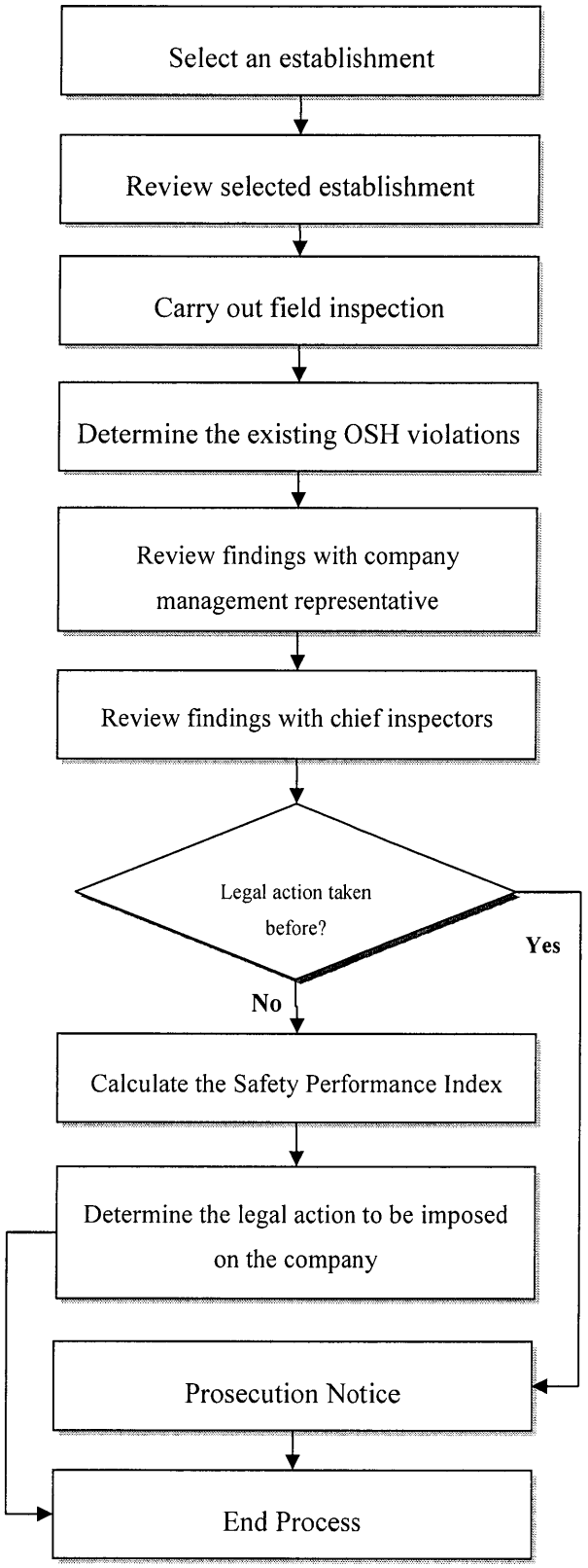


Figure 14 – Inspection Process Chart

Step 1: Selection of an Establishment:

This can be done in several ways. The targeted workplaces could be selected either randomly or by considering a number of indicators such as the number of complaints registered regarding OSH issues or the number of occupational accidents occurred in a certain past period. Also a criteria based on the high risk workplaces could be assigned here.

Step 2: Review the selected establishment:

The selected workplace should pass through a revision on internal and external bases. The internal review should cover the latest history of the organization in terms of occupational accidents and last visits comments. The external issues may cover the economical situation, the official commercial registration and any other permission issued by other authorities. Knowing the activities practiced by an establishment is vital to be aware about the existing hazards and risks that may be found in the workplaces.

Step 3: Field Inspection:

This is the main step in the whole process. Carrying out OSH inspection depends very much on the personality, experience and the knowledge of the inspector. Deciding about the compliance with the law and regulations for any process within the organization that went under revision is an important part of inspection. Then determining the risk gab and put out the recommendation that should be followed by the employers to comply with OSH regulations. Many of OSH inspectors may not be able to provide the companies with suitable alternatives. However, referring to specialized companies or consultant will solve the issue.

To standardize the inspection process and to make easier for the inspector, the OSH ministerial orders were sub-classified into sub-factors. The next section will discuss in details the classification carried out.

Step 4: Review Findings with Company Management Representative:

After deciding about the existing OSH violations, the inspector can set a conference with the company management or any representative to discuss all violations found in the workplace. This will allow the company to be aware about all the points raised by the OSH inspector.

Step 5: Review Findings with Chief Inspectors:

The OSH inspector shall discuss all the findings with chief inspector or any member of the inspectorate top management in terms of the OSH violations found, the expected risk on the workers and the suggested legal action. This action will help to reduce any conflict in the decisions made in case of any complaints raised by the employers.

Step 6: Comparing with History:

After deciding about the existing OSH violations, the inspector may take the benefit from the previous record of the company. If the company history includes any past improvement notice, prosecution notice or any occupational accident related to the existing violations, the inspector shall proceed to step 9 directly by issuing a prosecution notice and refer it to the court. If not, the coming steps will determine the suitable action.

Step 7: Calculate the Safety Performance Index:

After deciding about the suitable relative weight for each main factor and sub-factor the performance calculation can be performed. This step will describe the numerical part of the OSH enforcement model by suggesting a method to calculate the OSH performance of an establishment. The calculation can be performed by using a simple summation model as follows:

a. Find the aggregate weight for the case by the equation below (Bu-Khamsin, 1999):

$$AW = \sum_{i=1}^{n}\left[MF_i \times \left(\sum_{j=1}^{m} SF_{ij} \right) \right] \qquad (9)$$

Where:

AW : Aggregate weight

MF_i : Weight of the Main Factor i

n : Number of main factors

SF_{ij} : Weight of the sub-factor j associated with main factor i

m : Number of sub-factors

b. Then any non-applicable items will be excluded to find the overall safety performance Index (SP%) by using:

$$SP\% = \frac{AW}{1-W_{non}} \times 100 \qquad (10)$$

Where:

SP: Safety Performance Index as a percentage

W_{non}: weight of non-applicable sub-factors

Step 8: Selecting the Legal Action:

After calculating the SP index, Figure 15 illustrates the criteria can be used to select the suitable legal action. The criteria was put in order to standardized the decision making process. It considered not to impose difficulties on the companies to comply with OSH regulation and not to endanger the life of the workers by let them expose to high risk conditions.

If the score of the company is more than 90% then a commitment letter shall be issued for their high compliance with OSH regulations. If the SP% is between 80% and 90% then the OSH inspector can verbally instruct the company to rectify any minor violations found in the workplace such as non-providing enough first aid boxes.

If the SP% lies between 30% and 80% an improvement notice shall be issued, which is a written notice states the violations found and the time allowed for the company to comply with OSH standards otherwise the company will be prosecuted.

For the SP% between 10% and 30%, a prosecution notice shall be imposed as the score shows that there are major violations in the workplace. Finally, if the score is less that 10% it means that the company is totally not committed to OSH regulation and the workplace is very risky so a prohibition notice shall be issued and the work shall be stopped until the company rectifies all problems.

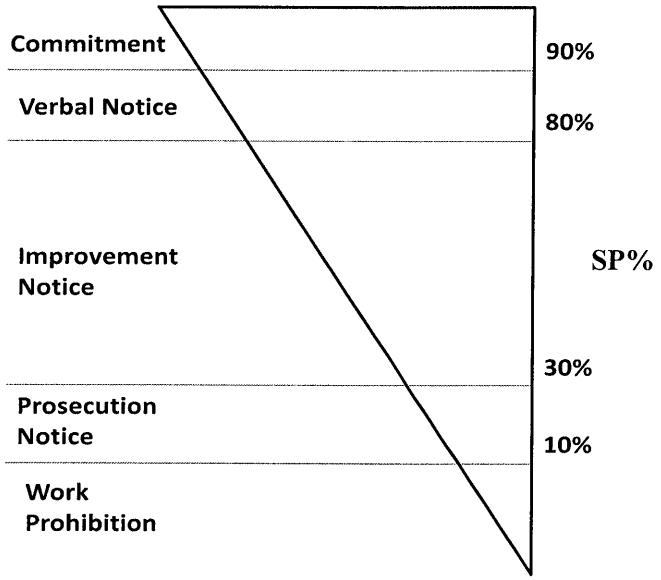


Figure 15 – Legal Action Mapping with SP Index

The scoring system should reflect the size of the problem that a workplace is suffering. The actions are varied from the commitment letter to work prohibition for the most serious cases.

Designing OSH Factors and Sub-Factors

Seventeen Ministerial Orders or regulations were selected to form the main OSH inspection factors. The regulations are as follows:

1. Ministerial Order No. (7) – 1976 respecting the contents of the first aid box.
2. Ministerial Order No. (12) – 1977 concerning the organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding.
3. Ministerial Order No. (13) – 1977 the organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations.
4. Ministerial Order No. (14) – 1977 the organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment.
5. Ministerial Order No. (15) – 1977 the organization of services and precautionary measures necessary for the protection of workers during work from the hazards of dangerous machinery.
6. Ministerial Order No. (25) – 1977 the organization of services and precautionary measures necessary for the protection of workers in workplace.
7. Ministerial Order No. (26) – 1977 the organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines.
8. Ministerial Order No. (27) – 1977 the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery.
9. Ministerial Order No. (31) – 1977 provisions for the protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases.
10. Ministerial Order No. (32) – 1977 provisions for the protection of workers from the hazards of steam boilers, steam containers and receivers.
11. Ministerial Order No. (33) – 1977 provisions for the protection of workers from the hazards of electricity.
12. Ministerial Order No. (34) – 1977 provisions for the protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces.

13. Ministerial Order No. (3) – 1978 the organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work.
14. Ministerial Order No. (6) – 2000 with respect to organization of industrial safety measures in the establishment.
15. Ministerial Order No. (3) – 2001 with respect to periodical medical examination for workers susceptible to infection by vocational diseases.
16. Ministerial Order No. (12) – 2005 with respect to protection of workers during work from the hazards of fire in establishments
17. Ministerial Order No. (1) – 2006 with respect to procedures required for reporting occupational injuries and diseases.

Each Ministerial Order will be divided into a number of sub-factors (j), which will describe all included legal articles. Each sub-factor consists of a set of legal articles that deal with the selected subject. For instance, the First Aid Ministerial order consists of (6) articles, it can be divided into 2 sub-factors as mentioned below, one is "Providing suitable first aid boxes" and the other is "First Aid training". The first sub-factor will represent the articles numbers (1), (3) and (4) while the second one represents article (5) only. The rest of articles are usually describing administrative issues. These will guide the inspector to focus on each topic rather than just seeking for the compliance of each article. Eighty four sub-factors were assigned to all articles included in the selected Ministerial Orders. The mapping done is illustrated in Appendix C for guidance.

By reviewing all the articles, the Ministerial Orders consist of the following sub-factors:

1. The Ministerial Order No. 1976-07: First Aid Box:

1. Providing suitable first aid boxes.
2. First Aid training.

2. The Ministerial Order No. 1977-12: Construction Safety:

1. Adequate erection and proper using of scaffolds.

2. Adequate fixing and using of ladders.
3. Adequate handling and moving of heavy objects.
4. Adequate housekeeping in construction sites.
5. Adequate using and handling of mechanical vehicles.
6. Confined spaces safety precautions.
7. Safety measures while working with paints containing lead.
8. Protection measures against electric shocks.
9. Fire safety precautions for welding and hot cutting jobs.
10. Cartridge tools (Guns) safety measures.
11. Precautions against collapsing hazards of any objects or buildings.
12. Proper site ventilation to reduce the risk of suffocation.
13. Protection while working near water.
14. Providing sufficient lighting for construction site.
15. Providing suitable personal protection equipment (PPE).
16. Safe access to and egress from construction sites.
17. Safety precautions for demolitions works.
18. Taking necessary precautions for working at height.

3. The Ministerial Order No. 1977-13: Grinding Wheels Safety

1. Proper assembly of grinding machines with all necessary elements and controls.
2. Competent operator.
3. Proper using of grinding and abrasive wheels.
4. Providing grinding machines with adequate guarding.
5. Safety awareness signs.
6. Suitable storage for grinding wheels.

4. The Ministerial Order No. 1977-14: Lifting Equipment Safety

1. Proper erection of lifting equipment with all necessary elements.
2. Proper using of lifting equipment/working safe load.
3. Competent operator.
4. Periodical examinations by authorized agencies.
5. Providing suitable operator's cabin.

5. The Ministerial Order No. 1977-15: Dangerous Machines Safety:

1. Duties of designers, manufacturers, importers and exporters of dangerous machines.
2. Providing adequate guarding.
3. Safe operating of dangerous machines.

6. The Ministerial Order No. 1977-25: Workplace Arrangements:

1. Adequate housekeeping in workplace.
2. Taking necessary measures to protect workers from falling hazards.

7. The Ministerial Order No. 1977-26: Eyes Protection:

1. Providing suitable guarding for hazardous operations.
2. Providing suitable PPE.

8. The Ministerial Order No. 1977-27: Woodworking Machines Safety:

1. Competent operator.
2. Control of noise.
3. Proper assembly of woodworking machines with all necessary elements and controls.
4. Proper using of woodworking machines.
5. Providing sufficient lighting.
6. Providing suitable guarding for woodworking machines.

9. The Ministerial Order No. 1977-31: Flammable Material Safety:

1. Prohibition of smoking.

2. Providing adequate firefighting equipment for emergency.
3. Safe handling and storage of highly flammable materials.

10. The Ministerial Order No.1977-32: High Pressure Equipment Safety:

1. Adequate assembly of high pressure equipment.
2. Confined spaces safety precautions.
3. Periodical examinations.

11. The Ministerial Order No.1977-33: Electrical Safety:

1. Hiring competent electricians.
2. Providing adequate and suitable means of protection devices.
3. Providing necessary instructions for emergency response.
4. Safe and organized design of controlling boards and sub-stations.
5. Safety precautions for using portable electrical devices.
6. Sufficient insulation of electrical conductors.

12. The Ministerial Order No.1977-34: Confined Spaces Precautions:

1. Safety precautions for hot jobs in a confined space.
2. Safety precautions for working in a confined space.

13. The Ministerial Order No. 1978-03: Health Precautions:

1. Providing adequate noise reduction PPE for workers in noisy areas.
2. Health measures and services in workplaces (Space/lighting/ventilation ...).
3. Welfare facilities in workplace (dining rooms/bathrooms).
4. Providing healthy drinking water.
5. Providing suitable means of setting.
6. Providing workers with adequate clothes.

14. The Ministerial Order No. 2000-06: Safety Management:

1. Commitment of Employers (Managers) to safety.

2. Establishing of safety committee with sufficient duties and powers.
3. Inclusion of punitive actions against workers for breaking safety procedures in company penal code.
4. Notification of contracting jobs to Ministry of Labour.
5. Providing of adequate PPE.
6. Employment of competent safety officers with sufficient duties and powers.
7. Providing workers with necessary safety training.
8. Commitment of workers to safety.

15. The Ministerial Order No. 2001-03: Health Surveillance:

1. Carrying out suitable health surveillances.
2. Removing any workers suffering an occupational disease from the source of that disease.
3. Workers duty to notify the employer of any occupational illness suffered.

16. The Ministerial Order No. 2005-12: Fire Safety:

1. Carrying out fire risk assessment.
2. Emergency plan.
3. Firefighting training.
4. Obtaining fire certificate from competent authority.
5. Providing and maintaining adequate firefighting equipment.
6. Providing safe and adequate emergency exists.
7. Safety measures for working in high risk of fire areas (hot works near flammable material).

17. The Ministerial Order No. 2006-01: Accident Reporting:

1. Establishing an internal accident reporting system in the premises.
2. Reporting of occupational accidents or illnesses to Ministry of Labour.

The next step is to give a relative weight for each main factor, i.e. the Ministerial Order, and the sub-factor, i.e. the groups. A maximum score of 100 points is considered, these points should be distributed among the factors according to their importance. These weights will be used to calculate the performance of each workplace inspected. The calculation discussed in Step 5 below while developing the relative weight for each item is discussed later in Chapter 5.

In order to seek consistency among evaluation of different workplaces the inspectors should go through the same process of evaluation including the number of Ministerial Orders and OSH attributes to be examined.

For a manufacturing establishment the inspector should examine the compliance of at least the following OSH Ministerial Orders:

1. 07-1976 – First Aid.
2. 15-1977 – Machine Safety.
3. 25-1977 – Workplace arrangements.
4. 31-1977 – Flammable materials.
5. 32-1977 – High Pressure Equipment.
6. 33-1977 – Electrical Safety.
7. 08-1978 – Health precautions.
8. 06-2000 – Safety Management.
9. 03-2001 – Medical Examinations.
10. 12-2005 – Fire Safety.
11. 01-2006 – Accidents Reporting.

And for construction sites the OSH inspector should examine at least the following ones:

1. 07-1976 – First Aid.
2. 12-1977 – Construction Safety.
3. 14-1977 – Lifting Equipment.
4. 33-1977 – Electrical Safety.
5. 08-1978 – Health precautions.

6. 06-2000 – Safety Management.
7. 03-2001 – Medical Examinations.
8. 01-2006 – Accidents Reporting.

This means that the total number of main factors (n) is at least 11 for a manufacturing company and 8 for a construction one. Extra Ministerial Orders May be added according to the case but no exclusion should be done in order to keep a standard comparison any sub-factor may be excluded but not the main factor. The calculation mentioned in Step 5 below will consider also the exclusion of some OSH sub-factors because they are not applicable to the case under investigation.

CHAPTER 5

OSH SCALE DEVELOPMENT

CHAPTER 5

OSH SCALE DEVELOPMENT

As mentioned in chapter (4), OSH factors and sub-factors designed should have relative weights or measures that could be used to establish a single measurement for OSH performance within the National Enforcement Model. The following chapter will discuss the development of these relative weights, recalling that the main factors are the OSH Ministerial Orders, and the sub factors are the groups that subdividing the articles of each Ministerial Order as explained before.

The review of the Kingdom of Bahrain OSH frame work showed that it is not suitable now to depend on accidents or injuries data to develop an evaluation model even on sector basis. This is because of the lack of accident data and the deferent definitions approved by the concerned parties, i.e. MOL and SIO. So building a leading measurement model using a multi-criteria decision making tool will be the best option in order to help the OSH inspectorate to evaluate companies' compliance with OSH standards and regulations.

Two different methods were tested to select one for building a model, the Average Weights Model (AWM) and the Analytic Hierarchy Process (AHP) method. The Average Weights Model is a straight forward simple method to apply. The AHP analysis is also a multi-criteria decision making tool. It was created by Thomas L. Saaty in 1980. A number of researchers described it as one of the best known methods in the multi-criteria decision making environment (Triantaphyllou & Mann, 1995). AHP can be used as priority definition, cost-benefit evaluation, resources allocation, performance measurement or market evaluation. AHP has other advantages over its simplicity; the pair-wise comparisons method will increase the accuracy of compared alternatives. AHP assists the evaluator in dealing with complex situations. It has the ability to define the problem in a number of simple layers that can be compared to gather independently of other layers designed in the problem. AHP does not require consensus, it can represent outcome from diverse judgment (Keren, 2003).

The pair-wise criterion is based on comparing two alternatives with respect to each other. For example what is the level of importance of providing first aid boxes in a workplace with respect to providing of training on how to give first aid. This is the first question, while the second one will be what is the importance of providing first aid training with respect to the providing of first aid boxes in a workplace. So each element will be compared with respect to other elements.

Three models will be used to find relative weights for OSH factors and sub-factors that affect the OSH performance in workplaces, one using simple Average Weights Model, another using Analytic Hierarchy Process (AHP) and a third model created by finding the mean of both Average Weights and AHP.

Average Weights Model (AWM)

In order to build relative weights for OSH factors and sub-factors, the opinion of the customer is sought, i.e. the companies. Following the methodology described by (Bu-Khamsin, 1999) a questionnaire was designed to find out the importance of each factor that affects safety and health performance, mainly part 2 of OSH General Questionnaire shown in Appendix A. For the purpose of the questionnaire a scale from Zero, which means no impact, to four, which means very high impact, is used.

The objective of the second part of the questionnaire is to establish relative weights for all safety attributes that will be used in the model. Seventeen Ministerial Orders were selected for this purpose. Each Ministerial Order was subdivided into a number of sub-factors as shown in Chapter (4). The second part of the questionnaire aims to seek the opinion of the customer, i.e. the companies, about the importance of each factor that affect safety and health performance within their companies, noting that the same sample of companies mentioned in Chapter (3) is used here also,

The equations used in the model are simple, easy to use and understandable. The model shows that it can be applied to different factors and sub-factors designed by the user.

The collected responses (sample of them are shown in Appendix B) from the companies participated in the questionnaire were translated to relative weights according to the following steps:

1. Calculate the mean impact for each sub-factor by calculating the average importance from the questionnaire responses using the rating scale in the questionnaire (Very high = 4, High = 3, Moderate = 2, Low = 1, No impact = 0).
2. Determine the weight of each sub factor by using the equation (2):

$$SF_{ij} = \frac{SFMI_{ij}}{\sum_{j=1}^{M_i} SFMI_{ij}}$$

Where;

SF_{ij} : the weight of the sub factor j that is associated with the main factor i.

$SFMI_{ij}$: The mean impact of the sub factor j that is associated with the main factor i.

M_i : the number of the sub factors in the main factor i.

3. Determine the mean impact of the main factor using Equation (3):

$$MFMI_i = \frac{\sum_{j=1}^{M_i} SFMI_{ij}}{M_i}$$

Where;

$MFMI_i$: the mean impact of the main factor i.

4. Calculate the weights of the main factors by using Equation (4):

$$MF_i = \frac{MFMI_i}{\sum_{j=1}^{17} MFMI_j}$$

Where;

MF_i : The weight of the main factor i.

n : The total number of main factors used.

Note that

$$\sum_{i=1}^{n} MF_i = 1 \qquad (11)$$

And

$$\sum_{j=1}^{M_i} SF_{ij} = 1 \qquad (12)$$

For example, the number of responses collected for the first main factor which is the Ministerial Order No. 1976-07 regarding the content of first aid box is shown in Table 10 below:

Table 10 – Number of Responses to the Groups of the First Main Factor

	Main Factor / Sub Factor	No. of Responses				
1	**1976-07 First Aid Box**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
11	Providing suitable first aid boxes	23	32	8	6	1
12	First aid training	27	17	17	8	1

The calculation of the mean impact for the factor 11 (Providing suitable first aid boxes) is as follows:

$$\text{SFMI}_{11} = \frac{(23\times4)+(32\times3)+(8\times2)+(6\times1)+(1\times0)}{23+32+8+6+1} = 3.0000$$

And for the factor 12 (First aid training) is

$$\text{SFMI}_{12} = \frac{(27\times4)+(17\times3)+(17\times2)+(8\times1)+(1\times0)}{27+17+17+8+1} = 2.8714$$

The relative weights for each sub factor are found by Equation (2):

$$SF_{ij} = \frac{SFMI_{ij}}{\sum_{j=1}^{M_i} SFMI_{ij}}$$

$$SF_{11} = \frac{SFMI_{11}}{SFMI_{11}+SFMI_{12}} = \frac{3.0000}{3.0000+2.8714} = 0.5109$$

$$SF_{12} = \frac{SFMI_{12}}{SFMI_{11}+SFMI_{12}} = \frac{2.8714}{3.0000+2.8714} = 0.4891$$

Where SF_{ij} is the weight of the sub factor j that is associated with the main factor i, and the number of sub-factors M_i is equal to 2.

The mean impact of the main factor 1 is found by using Equation (3):

$$MFMI_1 = \frac{SFMI_{11} + SFMI_{12}}{2} = \frac{3.0000+2.8714}{2} = 2.9357$$

Finally, applying Equation (4) to find the mean impact of the main factor 1, noting that this step will be performed after calculating of the mean impacts for all 17 main factors:

$$MF_1 = \frac{MFMI_1}{\sum_{i=1}^{17} MFMI_i} = \frac{2.9357}{49.6104} = 0.0592$$

Appendix D shows the number of responses collected for all sub-factors and the mean impacts found, see Table D-1, while the mean impacts found for the main factors and the calculations done to find relative weights for the main factors are shown in Table D-2 in the same appendix.

The final calculated relative weights are shown in Table 11 below:

Table 11 – OSH Weights Calculations Using Average Weights

i	j	Ministerial Orders / Sub factors	Weight	
			SF_{ij}	MF_i
1	**The Ministerial Order No. 1976-07: The contents of the first aid box**			**0.0592**
	1	Providing suitable first aid boxes	0.5109	
	2	First Aid training	0.4891	
2	**The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding**			**0.0581**
	1	Adequate erection and Proper using of scaffolds	0.0557	
	2	Adequate fixing and using of ladders	0.0554	
	3	Adequate handling and moving of heavy objects	0.0568	
	4	Adequate housekeeping in construction sites	0.0554	
	5	Adequate using and handling of mechanical vehicles	0.0570	
	6	Confined spaces safety precautions	0.0543	
	7	Safety measures while working with paints containing lead	0.0539	
	8	Protection measures against electric shocks	0.0612	

	9	Fire safety precautions for welding and hot cutting jobs	0.0592	
	10	Cartridge tools (Guns) safety measures	0.0506	
	11	Precautions against collapsing hazards of any objects or buildings	0.0532	
	12	Proper site ventilation to reduce the risk of suffocation	0.0557	
	13	Protection while working near water	0.0488	
	14	Providing sufficient lighting for construction site	0.0551	
	15	Providing suitable PPE	0.0587	
	16	Safe access to and egress from construction sites	0.0587	
	17	Safety precautions for demolitions works	0.0512	
	18	Taking necessary precautions for working at height	0.0592	
3	**The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**			**0.0592**
	1	Proper assembly of grinding machines with all necessary elements and controls	0.1694	
	2	Competent operator	0.1759	
	3	Proper using of grinding and appraising wheels	0.1677	
	4	Providing grinding machines with adequate guarding	0.1734	
	5	Safety awareness signs	0.1621	
	6	Suitable storage for grinding wheels	0.1515	
4	**The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment**			**0.0627**
	1	Proper erection of lifting equipment with all necessary elements	0.2013	
	2	Proper using of lifting equipment/working safe load	0.2031	
	3	Competent operator	0.2086	
	4	Periodical examinations by authorized agencies	0.2059	
	5	Providing suitable operators cabin	0.1811	
5	**The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**			**0.0597**
	1	Duties of designers, manufacturers, importers and exporters of dangerous machines	0.3151	
	2	Providing adequate guarding	0.3457	
	3	Safe operating of dangerous machines	0.3392	
6	**The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace**			**0.0615**
	1	Adequate housekeeping in workplace	0.4848	
	2	Taking necessary measures to protect workers from falling hazards	0.5152	

7	**The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines**			**0.0639**
	1	Providing suitable guarding for hazardous operations	0.5000	
	2	Providing suitable PPE	0.5000	
8	**The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery**			**0.0553**
	1	Competent operator	0.1743	
	2	Control of noise	0.1492	
	3	Proper assembly of woodworking machines with all necessary elements and controls	0.1639	
	4	Proper using of woodworking machines	0.1700	
	5	Providing sufficient lighting	0.1691	
	6	Providing suitable guarding for woodworking machines	0.1735	
9	**The Ministerial Order No. 1977-31: The protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases**			**0.0639**
	1	Prohibition of smoking	0.3438	
	2	Providing adequate fire fighting equipment for emergency	0.3438	
	3	Safe handling and storage of highly flammable materials	0.3123	
10	**The Ministerial Order No. 1977-32: The protection of workers from the hazards of steam boilers, steam containers and receivers**			**0.0548**
	1	Adequate assembly of high pressure equipment	0.3363	
	2	Confined spaces safety precautions	0.3363	
	3	Periodical examinations	0.3275	
11	**The Ministerial Order No. 1977-33: The protection of workers from the hazards of electricity**			**0.0598**
	1	Hiring competent electricians	0.1645	
	2	Providing adequate and suitable means of protection devices	0.1701	
	3	Providing necessary instructions for emergency response	0.1589	
	4	Safe and organized design of controlling boards and sub-stations	0.1605	
	5	Safety precautions for using portable electrical devices	0.1701	
	6	Sufficient insulation of electrical conductors	0.1758	
12	**The Ministerial Order No. 1977-34: The protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces**			**0.0558**
	1	Safety precautions for hot jobs in a confined space	0.4980	
	2	Safety precautions for working in a confined space	0.5020	

13	**The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work**			**0.0560**
	1	Providing adequate noise reduction PPE for workers in noisy areas	0.1740	
	2	Health measures and services in workplaces (Space/lighting/ventilation ..)	0.1628	
	3	Welfare facilities in workplace (dining rooms/bathrooms)	0.1594	
	4	Providing healthy drinking water	0.1722	
	5	Providing suitable means of setting	0.1662	
	6	Providing workers with adequate clothes	0.1654	
14	**The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment**			**0.0571**
	1	Commitment of Employers (Managers) to safety	0.1342	
	2	Establishing of safety committee with sufficient duties and powers	0.1260	
	3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	0.1134	
	4	Notification of contracting jobs to Ministry of Labour	0.1150	
	5	Providing of adequate PPE	0.1272	
	6	Employment of competent safety officers with sufficient duties and powers	0.1291	
	7	Providing workers with necessary safety training	0.1285	
	8	Commitment of workers to safety	0.1265	
15	**The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases**			**0.0527**
	1	Carrying out suitable health surveillances	0.3206	
	2	Removing any workers suffering an occupational disease from the source of that disease	0.3388	
	3	Workers duty to notify the employer of any occupational illness suffered	0.3406	
16	**The Ministerial Order No. 2005-12: Protection of workers during work from the hazards of fire in establishments**			**0.0608**
	1	Carrying out fire risk assessment	0.1502	
	2	Emergency plan	0.1434	
	3	Fire fighting training	0.1394	
	4	Obtaining fire certificate from competent authority	0.1252	
	5	Providing and maintaining adequate fire fighting equipment	0.1475	
	6	Providing safe and adequate emergency exists	0.1488	
	7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	0.1455	

17	**2006-01: Procedures required for reporting occupational injuries and diseases**			**0.0595**
	1	Establishing an internal accident reporting system in the premises	0.5085	
	2	Reporting of occupational accidents or illnesses to Ministry of Labour	0.4915	

Analytic Hierarchy Process

AHP method has the following steps as described by (Saaty, 2008):

1. Define the problem.
2. Structure the decision hierarchy. The top will be the goal which is OSH performance in our situation, then the objectives and sub-objectives.
3. Construct the pair-wise comparison matrices.
4. Use the priority weights calculated to determine the level of importance for each objective and sub-objective.

Similar steps will be followed in order to generate AHP relative weights for OSH factors and sub-factors selected as described above. AHP decisions matrices can be build using the user own opinion:

1. Definition of The Problem:

The problem is how to calculate the safety performance of a company as a single measure by measuring the level of compliance with OSH regulations.

2. Structure the Decision Hierarchy:

The same classification done for all 17 selected OSH Ministerial orders were used also. The Ministerial Orders will be considered as the first level while the sub-factors, or the groups shown in Chapter 4, will represent the second level. The decision tree is

partially shown in Figure 16 because it is not possible to show the whole chart as a matter of complications.

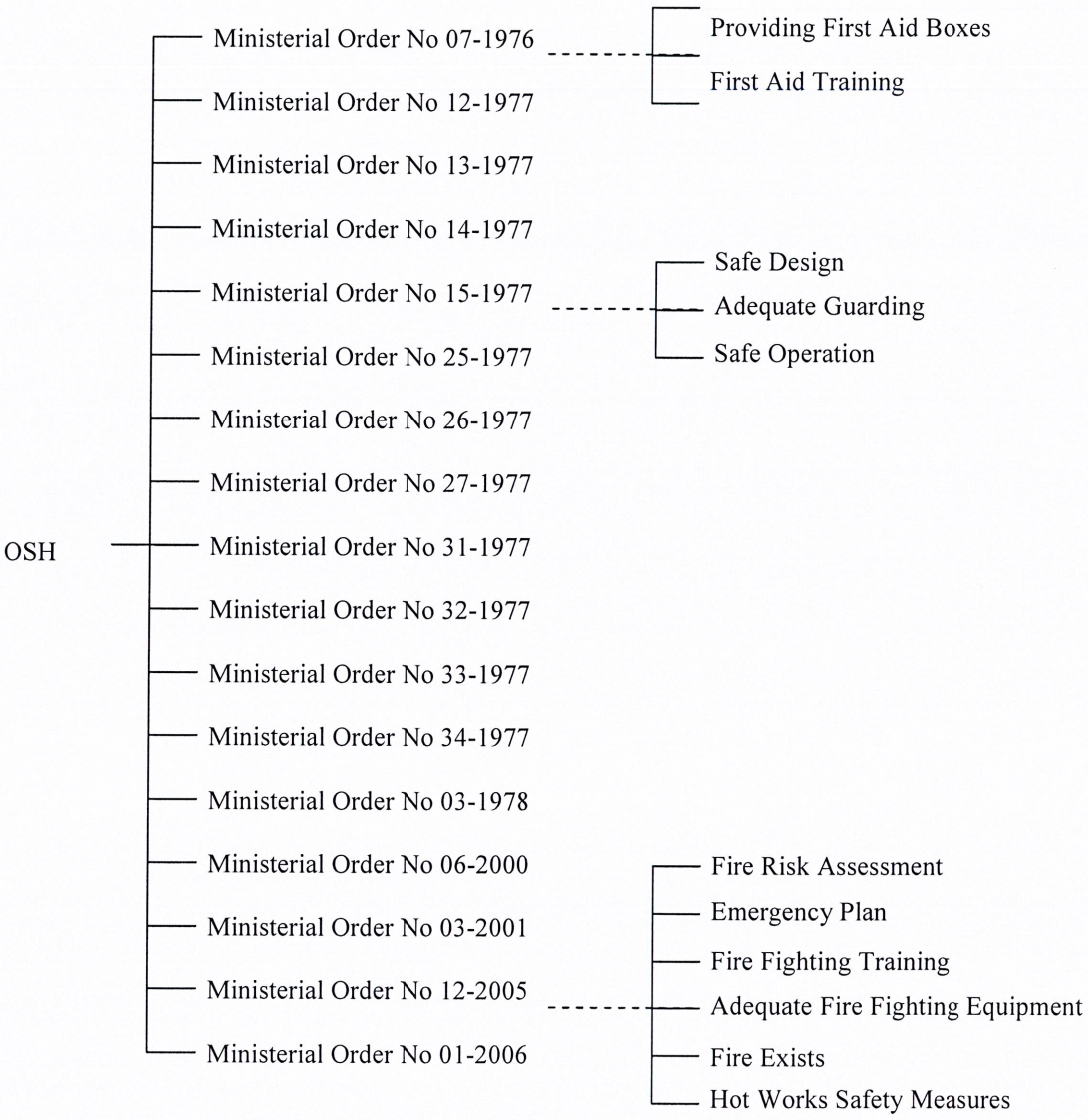


Figure 16 – Part from AHP Problem Chart

3. Construct the Pair-wise Comparison Matrices

In order to build the matrices a questionnaire, see Appendix E, consists of 850 pair-wise questions was prepared and distributed on 15 selected OSH experts to evaluate individually the level of importance of each selected 17 main factors (the OSH Ministerial Orders) and the 84 sub-factors. This step is inspired by the Model created

by (Keren, 2003) as shown in Chapter (2). The OSH experts were selected from different entities. Number of them work as an OSH inspector in Ministry of Labour, the OSH enforcement body, others are either private consultants or work for an industrial firm in the field of safety and health. All of the experts selected have minimum 3 years' experience. So, the AHP questionnaire sought the opinion of independent parties.

The concept of the pair-wise is to compare the relation between two choices with respect to each other. For example, the Ministerial Order No. 1977-15 which deals with dangerous machines safety has 3 groups:

1. Duties of designers, manufacturers, importers and exporters of dangerous machines.
2. Providing adequate guarding.
3. Safe operating of dangerous machines.

So it should have a set of 6 pair-wise questions in order to decide upon the important group, the questions should be as follows:

According to a scale from 1 to 9:

1. Which is more important "The duties of designers, manufacturers, importers and exporters of dangerous machines" or "Providing adequate guarding"?
2. Which is more important "Providing adequate guarding" or "The duties of designers, manufacturers, importers and exporters of dangerous machines"?
3. Which is more important "The duties of designers, manufacturers, importers and exporters of dangerous machines" or "Safe operating of dangerous machines"?
4. Which is more important "Safe operating of dangerous machines" or "The duties of designers, manufacturers, importers and exporters of dangerous machines"?
5. Which is more important "Providing adequate guarding" or "Safe operating of dangerous machines"?

6. Which is more important "Safe operating of dangerous machines" or "Providing adequate guarding"?

Appendix E shows a part from the expert questionnaires that related to the pair-wise comparison of the Ministerial Orders selected.

Table 12 illustrates the scale of comparison which indicates the level of importance for one element over another element with respect to the selected criterion.

Table 12 - AHP Scale of Comparison

Intensity of Importance	Definition
1	Equal importance
2	Weak or slight
3	Moderate importance
4	Moderate plus
5	Strong importance
6	Strong plus
7	Very strong
8	Very, Very Strong importance
9	Extreme importance

(Saaty, 1990)

Assume that a_{ij} is the value of comparison of element i with element j. a_{ij} will represent the ratio between the weights of element i ($\bar{w}_i$) and the element j ($\bar{w}_j$). If the average weight for question 1 is 8, i.e. $\bar{w}_1$= 8, and that for question 2 is 2, i.e. $\bar{w}_2$=2 will lead to that: $a_{12} = \frac{8}{2} = 4$ and so on. Whenever i=j the element value a=1 as the element will be compared with itself.

All the selected attributes will be put into a matrix A to show the compared data as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{21} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} = \begin{bmatrix} 1 & \bar{w}_1/\bar{w}_2 & \dots & \bar{w}_1/\bar{w}_n \\ \bar{w}_2/\bar{w}_1 & 1 & \dots & \bar{w}_2/\bar{w}_n \\ \vdots & \vdots & \ddots & \vdots \\ \bar{w}_n/\bar{w}_1 & \bar{w}_n/\bar{w}_2 & \dots & 1 \end{bmatrix} \quad (13)$$

$$\text{where } a_{ij} = \frac{\bar{w}_i}{\bar{w}_j} \text{ and } a_{ji} = \frac{\bar{w}_j}{\bar{w}_i}$$

The result of all replies to the Experts AHP Questionnaires were collected and averaged to obtain the nearest best value for AHP scale. The generated matrices are shown in Appendix F.

4. Calculating Priority Weights

The normalized matrix is calculated for matrix A by dividing each element by the sum of its column to find matrix B. So matrix B will be:

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{21} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} = \begin{bmatrix} 1/\sum_{i=1}^{n} a_{i1} & \cdots & a_{1n}/\sum_{i=1}^{n} a_{in} \\ \vdots & \ddots & \vdots \\ a_{n1}/\sum_{i=1}^{n} a_{i1} & \cdots & 1/\sum_{i=1}^{n} a_{in} \end{bmatrix} \quad (14)$$

To find the final relative weight the average of each row is calculated:

$$RW_i = \frac{\sum_{j=1}^{n} b_{ij}}{n} \quad (15)$$

To measure the inconsistency, matrix A is multiplied by the relative weight vector calculated to produce vector C.

$$C = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{21} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \begin{bmatrix} RW_1 \\ RW_2 \\ \vdots \\ RW_n \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{bmatrix} \quad (16)$$

Then divide each element of vector C with the corresponding relative weight to produce vector D.

$$D = \begin{bmatrix} \frac{c_1}{RW_1} \\ \frac{c_1}{RW_1} \\ \vdots \\ \frac{c_n}{RW_n} \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_n \end{bmatrix} \quad (17)$$

Calculate the average of vector D to obtain the value of the factor λ.

$$\lambda = \frac{\sum_{i=1}^{n} d_i}{n} \quad (18)$$

Finally The Consistency Ratio for a vector with size n will be calculated by the following formula:

$$CR = \frac{\lambda - n}{RI \times (n-1)} \quad (19)$$

Where RI represents the random coherence index provided by Saaty as shown in Table 13.

Saaty recommends that if the CR value exceeds 0.10, the judgments should be reviewed. If not, that will verify the coherence of the relative weights calculated (Saaty, 2008).

Table 13 – Random Coherence Index

Matrix Size (n)	RI	Matrix Size (n)	RI
1	0	10	1.49
2	0	11	1.52
3	0.58	12	1.54
4	0.89	13	1.56
5	1.11	14	1.58
6	1.25	15	1.59
7	1.35	16	1.60
8	1.40	17	1.61
9	1.45	18	1.62

As the available literature do not provide the RI value for matrix above size of n=10, the RI is derived from the paper done by (Alonso & Lamata, 2006). The authors derived a mathematical equation to find the RI value for any size of matrix.

Example of Applying AHP

The following will illustrate an example of applying AHP method to find the relative weights for the sub-factors selected for The Ministerial Order Ministerial Order No.

1977-15 the organization of services and precautionary measures necessary for the protection of workers during work from the hazards of dangerous machinery. The sub-factors are:

1. Duties of designers, manufacturers, importers and exporters of dangerous machines.
2. Providing adequate guarding.
3. Safe operating of dangerous machines.

The answers of the experts were collected and averaged. The resulted rounded values are shown in Table 14 below.

Table 14 – AHP Values for Ministerial Order No. 1977-15 Sub-factors

	Which is more important	Value
w_{12}	"The duties of designers, manufacturers, importers and exporters of dangerous machines" or "Providing adequate guarding"	3
w_{21}	"Providing adequate guarding" or "The duties of designers, manufacturers, importers and exporters of dangerous machines"?	4
w_{13}	"The duties of designers, manufacturers, importers and exporters of dangerous machines" or "Safe operating of dangerous machines"	4
w_{31}	"Safe operating of dangerous machines" or "The duties of designers, manufacturers, importers and exporters of dangerous machines"?	3
w_{23}	"Providing adequate guarding" or "Safe operating of dangerous machines"?	3
w_{32}	"Safe operating of dangerous machines" or "Providing adequate guarding"?	3

Using Equation (13) to find Matrix A,

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{21} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} 1 & {}^{w_1}/_{w_2} & \cdots & {}^{w_1}/_{w_n} \\ {}^{w_2}/_{w_1} & 1 & \cdots & {}^{w_2}/_{w_n} \\ \vdots & \vdots & \ddots & \vdots \\ {}^{w_n}/_{w_1} & {}^{w_n}/_{w_2} & \cdots & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1.0000 & 0.7500 & 1.3333 \\ 1.3333 & 1.0000 & 1.0000 \\ 0.7500 & 1.0000 & 1.0000 \end{bmatrix}$$

The normalized matrix will be found by Equation (14) as follows,

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{21} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} = \begin{bmatrix} 1/\sum_{i=1}^{n} a_{i1} & \cdots & a_{1n}/\sum_{i=1}^{n} a_{in} \\ \vdots & \ddots & \vdots \\ a_{n1}/\sum_{i=1}^{n} a_{i1} & \cdots & 1/\sum_{i=1}^{n} a_{in} \end{bmatrix}$$

$$= \begin{bmatrix} 0.3243 & 0.2727 & 0.4000 \\ 0.4323 & 0.3636 & 0.3000 \\ 0.2432 & 0.3636 & 0.3000 \end{bmatrix}$$

Then applying Equation (15) to find the relative weights will generate the following vector:

$$RW = \begin{bmatrix} 0.3324 \\ 0.3654 \\ 0.3023 \end{bmatrix}$$

Equation (16) and (17) will be applied respectively to test to inconsistency multiply matrix A with vector RW

$$C = \begin{bmatrix} 1.0000 & 0.7500 & 1.3333 \\ 1.3333 & 1.0000 & 1.0000 \\ 0.7500 & 1.0000 & 1.0000 \end{bmatrix} \begin{bmatrix} 0.3323 \\ 0.3654 \\ 0.3023 \end{bmatrix} = \begin{bmatrix} 1.0094 \\ 1.1108 \\ 0.9169 \end{bmatrix}$$

$$D = \begin{bmatrix} 1.0094/0.3324 \\ 1.1108/0.3654 \\ 0.9169/0.3023 \end{bmatrix} = \begin{bmatrix} 3.0372 \\ 3.0403 \\ 3.0332 \end{bmatrix}$$

The factor λ is calculated by Equation (18) as follows

$$\lambda = \frac{\sum_{i=1}^{n} d_i}{n} = \frac{3.0372+3.0403+3.0332}{3} = 3.0369$$

After that the Critical Ration CR is found by applying Equation (19) where RI for n=3 is equal to 0.58 as shown in Table (13)

$$CR = \frac{\lambda - n}{RI \times (n-1)} = \frac{3.0369-3}{0.58 \times (3-1)} = 0.0318 < 0.1$$

Which implies the feasibility of the calculated relative weights.

The Importance of OSH Ministerial Orders

Seventeen Ministerial Orders were selected to build up the AHP model which considered as the main factors. All orders were evaluated together to measure their impact on the overall performance. Applying the method mentioned above will result in Table 15 which shows the relative weights calculated using AHP Method.

Table 15 – Main Factor Weights

	MO Number	Ministerial Order Name	MF_i	CR
1	1976-07	First Aid Box	0.0101	0.096
2	1977-12	Construction Safety	0.0779	
3	1977-13	Grinding Wheels Safety	0.0249	
4	1977-14	Lifting Equipment Safety	0.0634	
5	1977-15	Dangerous Machines Safety	0.0743	
6	1977-25	Workplace Arrangements	0.0269	
7	1977-26	Eye Protection	0.0190	
8	1977-27	Woodworking Machines Safety	0.0310	
9	1977-31	Flammable Material Safety	0.1059	
10	1977-32	High Pressure Equipment Safety	0.0910	
11	1977-33	Electrical Safety	0.0486	
12	1977-34	Confined Spaces Precautions	0.0870	
13	1978-03	Health Precautions	0.0381	
14	2000-06	Safety Management	0.1145	
15	2001-03	Health Surveillance	0.0723	
16	2005-12	Fire Safety	0.0958	
17	2006-01	Accident Reporting	0.0192	

Similarly as Equation (11), note that

$$\sum_{i=1}^{n} MF_i = 1$$

As provided by Saaty, the consistency ratio found for the main factors is less than 10% which show the feasibility of the relative weights calculated.

The Calculated AHP Priority Weight for Sub-Factors

The same method will be used to calculate the priority weights for the sub-factors associated with each Ministerial Order. All the calculated AHP priority weights are shown in Table 16 below along with critical ratios, so the accuracy of the result is guaranteed.

Equation (12) is applied here also,

$$\sum_{j=1}^{M_i} SF_{ij} = 1$$

Table 16 – AHP Importance Weight

i	j	Ministerial Orders / Sub factors	SF_{ij}	CR_i	MF_i
1	**The Ministerial Order No. 1976-07: The contents of the first aid box**				**0.0101**
	1	Providing suitable first aid boxes	0.3333	0.000	
	2	First Aid training	0.6667		
2	**The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding**				**0.0779**
	1	Adequate erection and Proper using of scaffolds	0.0503	0.050	
	2	Adequate fixing and using of ladders	0.0511		
	3	Adequate handling and moving of heavy objects	0.0339		
	4	Adequate housekeeping in construction sites	0.0369		
	5	Adequate using and handling of mechanical vehicles	0.0399		
	6	Confined spaces safety precautions	0.0606		
	7	Safety measures while working with paints containing lead	0.0371		

	8	Protection measures against electric shocks	0.0688		
	9	Fire safety precautions for welding and hot cutting jobs	0.0581		
	10	Cartridge tools (Guns) safety measures	0.0332		
	11	Precautions against collapsing hazards of any objects or buildings	0.0545		
	12	Proper site ventilation to reduce the risk of suffocation	0.0735		
	13	Protection while working near water	0.0407		
	14	Providing sufficient lighting for construction site	0.0490		
	15	Providing suitable PPE	0.0536		
	16	Safe access to and egress from construction sites	0.0585		
	17	Safety precautions for demolitions works	0.0782		
	18	Taking necessary precautions for working at height	0.1223		
3	**The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**				**0.0249**
	1	Proper assembly of grinding machines with all necessary elements and controls	0.1736	0.021	
	2	Competent operator	0.1877		
	3	Proper using of grinding and appraising wheels	0.2107		
	4	Providing grinding machines with adequate guarding	0.1779		
	5	Safety awareness signs	0.1173		
	6	Suitable storage for grinding wheels	0.1327		
4	**The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment**				**0.0634**
	1	Proper erection of lifting equipment with all necessary elements	0.2282	0.020	
	2	Proper using of lifting equipment/working safe load	0.3042		
	3	Competent operator	0.1965		
	4	Periodical examinations by authorized agencies	0.1567		
	5	Providing suitable operators cabin	0.1144		
5	**The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers from the hazardous of dangerous machines**				**0.0743**
	1	Duties of designers, manufacturers, importers and exporters of dangerous machines	0.3324	0.032	
	2	Providing adequate guarding	0.3654		
	3	Safe operating of dangerous machines	0.3023		
6	**The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace**				**0.0269**
	1	Adequate housekeeping in workplace	0.2000	0.000	
	2	Taking necessary measures to protect workers from falling hazards	0.8000		

7	**The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines**				**0.0190**
	1	Providing suitable guarding for hazardous operations	0.7273	0.000	
	2	Providing suitable PPE	0.2727		
8	**The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery**				**0.0310**
	1	Competent operator	0.1908	0.012	
	2	Control of noise	0.1384		
	3	Proper assembly of woodworking machines with all necessary elements and controls	0.1726		
	4	Proper using of woodworking machines	0.1898		
	5	Providing sufficient lighting	0.1260		
	6	Providing suitable guarding for woodworking machines	0.1825		
9	**The Ministerial Order No. 1977-31: The protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases**				**0.1059**
	1	Prohibition of smoking	0.2536	0.032	
	2	Providing adequate fire fighting equipment for emergency	0.2695		
	3	Safe handling and storage of highly flammable materials	0.4769		
10	**The Ministerial Order No. 1977-32: The protection of workers from the hazards of steam boilers, steam containers and receivers**				**0.0910**
	1	Adequate assembly of high pressure equipment	0.3396	0.008	
	2	Confined spaces safety precautions	0.4111		
	3	Periodical examinations	0.2494		
11	**The Ministerial Order No. 1977-33: The protection of workers from the hazards of electricity**				**0.0486**
	1	Hiring competent electricians	0.2099	0.003	
	2	Providing adequate and suitable means of protection and devices	0.1646		
	3	Providing necessary instructions for emergency response	0.1301		
	4	Safe and organized design of controlling boards and sub-stations	0.1575		
	5	Safety precautions for using portable electrical devices	0.1646		
	6	Sufficient insulation of electrical conductors	0.1733		
12	**The Ministerial Order No. 1977-34: The protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces**				**0.0870**
	1	Safety precautions for hot jobs in a confined space	0.5714	0.000	
	2	Safety precautions for working in a confined space	0.4286		

13	**The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work**				**0.0381**
	1	Providing adequate noise reduction PPE for workers in noisy areas	0.2119	0.041	
	2	Health measures and services in workplaces (Space/lighting/ventilation ...)	0.1982		
	3	Welfare facilities in workplace (dining rooms/bathrooms)	0.1547		
	4	Providing healthy drinking water	0.2320		
	5	Providing suitable means of setting	0.1040		
	6	Providing workers with adequate clothes	0.0992		
14	**The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment**				**0.1145**
	1	Commitment of Employers (Managers) to safety	0.1878	0.058	
	2	Establishing of safety committee with sufficient duties and powers	0.1468		
	3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	0.1017		
	4	Notification of contracting jobs to Ministry of Labour	0.0690		
	5	Providing of adequate PPE	0.0956		
	6	Employment of competent safety officers with sufficient duties and powers	0.1182		
	7	Providing workers with necessary safety training	0.1481		
	8	Commitment of workers to safety	0.1328		
15	**The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases**				**0.0723**
	1	Carrying out suitable health surveillances	0.1829	0.046	
	2	Removing any workers suffering an occupational disease from the source of that disease	0.5282		
	3	Workers duty to notify the employer of any occupational illness suffered	0.2889		
16	**The Ministerial Order No. 2005-12: Protection of workers during work from the hazards of fire in establishments**				**0.0958**
	1	Carrying out fire risk assessment	0.1618	0.012	
	2	Emergency plan	0.1060		
	3	Fire fighting training	0.1543		
	4	Obtaining fire certificate from competent authority	0.1368		
	5	Providing and maintaining adequate fire fighting equipment	0.1626		
	6	Providing safe and adequate emergency exists	0.1013		
	7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	0.1772		

17	**2006-01: Procedures required for reporting occupational injuries and diseases**				**0.0192**
	1	Establishing an internal accident reporting system in the premises	0.5714	0.000	
	2	Reporting of occupational accidents or illnesses to Ministry of Labour	0.4286		

By ending the AHP calculation, it is worth to mention that all calculated AHP weights show consistency ratios within the feasible range which is less than 10%. This will support also the feasibility of the model.

Comparing AWM with AHP

To compare the results of AWM and AHP models, the relative weights for both methods used to find relative weights for the main factors, i.e. the Ministerial orders, are plotted as shown in Figure 17.

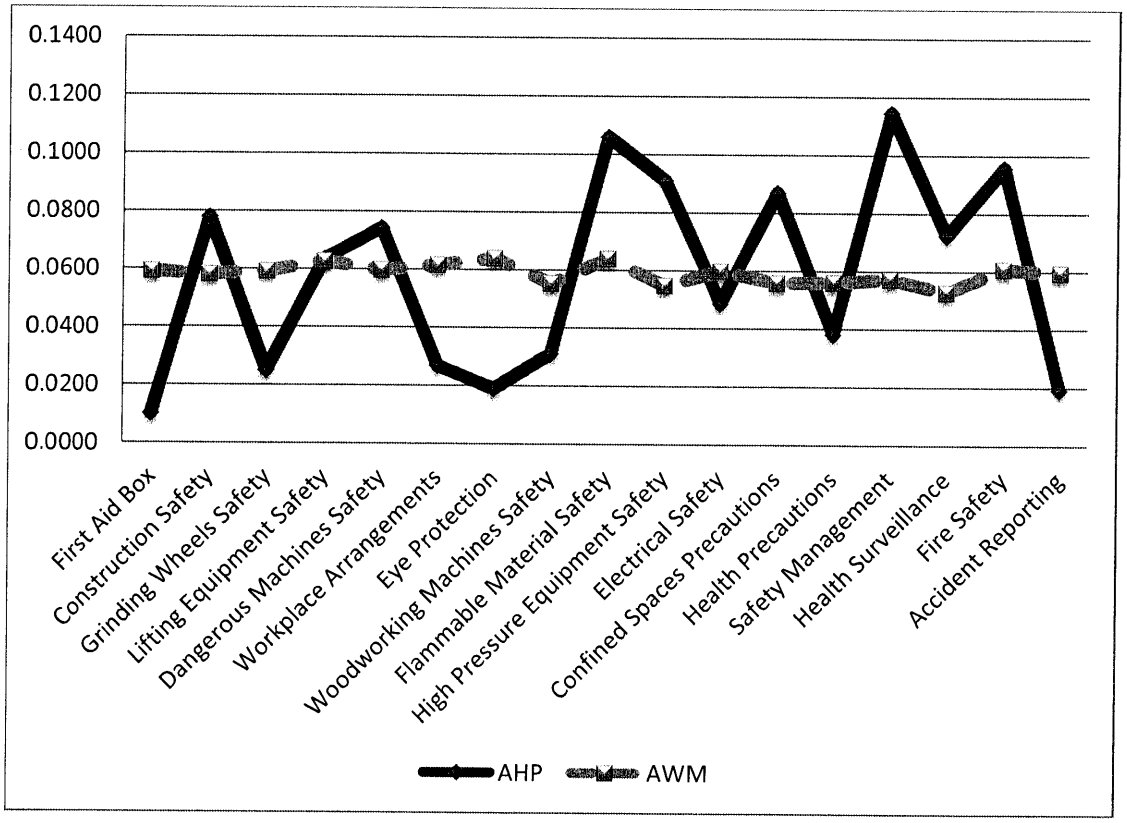


Figure 17 – Relative Weight of Main Factors for Average Weights and AHP

It can be noticed that by the relative weights generated by Average Weights are approximately distributed evenly among all selected OSH Ministerial Orders. However, this means that all Ministerial Orders have equal importance to the companies who responded to the survey. This is not always true, for sure that an OSH specialist will see that protecting people while working at height is more important than just providing First Aid Facility. On the other hand, the AHP relative weights show totally different distribution. AHP gives high importance to a number of Ministerial orders and varied with others, which means more realistic relative weights and more accurate results will be generated.

Combination of the Average Weights and AHP

As discussed before, the data collected and used in Average Weights Model represents the opinion of the companies while the one used in AHP model represents the opinion of independent OSH experts. The companies may be conservative about giving high importance to some OSH points especially if it requires high budget such as providing first aid training. On the other hand, experts are very ideal while dealing with OSH matters. To bridge that gap, it is worth to see the effect of combining results by finding the average relative weights for OSH main factors and sub-factors found above. This combination may generate more acceptable relative weights for both companies and experts. The resulted weights are shown in Table 17 below.

Table 17 – The relative weights found by the combined average model

i	j	Ministerial Orders / Sub factors	Weight	
			SF_{ij}	MF_i
1	**The Ministerial Order No. 1976-07: The contents of the first aid box**			**0.0346**
	1	Providing suitable first aid boxes	0.4221	
	2	First Aid training	0.5779	
2	**The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding**			**0.0680**

	1	Adequate erection and Proper using of scaffolds	0.0530	
	2	Adequate fixing and using of ladders	0.0532	
	3	Adequate handling and moving of heavy objects	0.0453	
	4	Adequate housekeeping in construction sites	0.0461	
	5	Adequate using and handling of mechanical vehicles	0.0485	
	6	Confined spaces safety precautions	0.0574	
	7	Safety measures while working with paints containing lead	0.0455	
	8	Protection measures against electric shocks	0.0650	
	9	Fire safety precautions for welding and hot cutting jobs	0.0587	
	10	Cartridge tools (Guns) safety measures	0.0419	
	11	Precautions against collapsing hazards of any objects or buildings	0.0538	
	12	Proper site ventilation to reduce the risk of suffocation	0.0646	
	13	Protection while working near water	0.0448	
	14	Providing sufficient lighting for construction site	0.0521	
	15	Providing suitable PPE	0.0561	
	16	Safe access to and egress from construction sites	0.0586	
	17	Safety precautions for demolitions works	0.0647	
	18	Taking necessary precautions for working at height	0.0908	
3	**The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**			**0.0421**
	1	Proper assembly of grinding machines with all necessary elements and controls	0.1715	
	2	Competent operator	0.1818	
	3	Proper using of grinding and appraising wheels	0.1892	
	4	Providing grinding machines with adequate guarding	0.1757	
	5	Safety awareness signs	0.1397	
	6	Suitable storage for grinding wheels	0.1421	
4	**The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment**			**0.0630**
	1	Proper erection of lifting equipment with all necessary elements	0.2148	
	2	Proper using of lifting equipment/working safe load	0.2536	
	3	Competent operator	0.2026	
	4	Periodical examinations by authorized agencies	0.1813	
	5	Providing suitable operators cabin	0.1477	

5	**The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**			**0.0670**
	1	Duties of designers, manufacturers, importers and exporters of dangerous machines	0.3237	
	2	Providing adequate guarding	0.3555	
	3	Safe operating of dangerous machines	0.3208	
6	**The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace**			**0.0442**
	1	Adequate housekeeping in workplace	0.3424	
	2	Taking necessary measures to protect workers from falling hazards	0.6576	
7	**The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines**			**0.0415**
	1	Providing suitable guarding for hazardous operations	0.6136	
	2	Providing suitable PPE	0.3864	
8	**The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery**			**0.0432**
	1	Competent operator	0.1825	
	2	Control of noise	0.1438	
	3	Proper assembly of woodworking machines with all necessary elements and controls	0.1683	
	4	Proper using of woodworking machines	0.1799	
	5	Providing sufficient lighting	0.1475	
	6	Providing suitable guarding for woodworking machines	0.1780	
9	**The Ministerial Order No. 1977-31: The protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases**			**0.0849**
	1	Prohibition of smoking	0.2987	
	2	Providing adequate fire fighting equipment for emergency	0.3067	
	3	Safe handling and storage of highly flammable materials	0.3946	
10	**The Ministerial Order No. 1977-32: The protection of workers from the hazards of steam boilers, steam containers and receivers**			**0.0729**
	1	Adequate assembly of high pressure equipment	0.3379	
	2	Confined spaces safety precautions	0.3737	
	3	Periodical examinations	0.2884	

11	**The Ministerial Order No. 1977-33: The protection of workers from the hazards of electricity**			**0.0542**
	1	Hiring competent electricians	0.1872	
	2	Providing adequate and suitable means of protection and devices	0.1674	
	3	Providing necessary instructions for emergency response	0.1445	
	4	Safe and organized design of controlling boards and sub-stations	0.1590	
	5	Safety precautions for using portable electrical devices	0.1674	
	6	Sufficient insulation of electrical conductors	0.1745	
12	**The Ministerial Order No. 1977-34: The protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces**			**0.0714**
	1	Safety precautions for hot jobs in a confined space	0.5347	
	2	Safety precautions for working in a confined space	0.4653	
13	**The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work**			**0.0471**
	1	Providing adequate noise reduction PPE for workers in noisy areas	0.1929	
	2	Health measures and services in workplaces (Space/lighting/ventilation ...)	0.1805	
	3	Welfare facilities in workplace (dining rooms/bathrooms)	0.1571	
	4	Providing healthy drinking water	0.2021	
	5	Providing suitable means of setting	0.1351	
	6	Providing workers with adequate clothes	0.1323	
14	**The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment**			**0.0858**
	1	Commitment of Employers (Managers) to safety	0.1610	
	2	Establishing of safety committee with sufficient duties and powers	0.1364	
	3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	0.1075	
	4	Notification of contracting jobs to Ministry of Labour	0.0920	
	5	Providing of adequate PPE	0.1114	
	6	Employment of competent safety officers with sufficient duties and powers	0.1237	
	7	Providing workers with necessary safety training	0.1383	
	8	Commitment of workers to safety	0.1297	

15	**The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases**			**0.0625**
	1	Carrying out suitable health surveillances	0.2517	
	2	Removing any workers suffering an occupational disease from the source of that disease	0.4335	
	3	Workers duty to notify the employer of any occupational illness suffered	0.3147	
16	**The Ministerial Order No. 2005-12: Protection of workers during work from the hazards of fire in establishments**			**0.0783**
	1	Carrying out fire risk assessment	0.1560	
	2	Emergency plan	0.1247	
	3	Fire fighting training	0.1468	
	4	Obtaining fire certificate from competent authority	0.1310	
	5	Providing and maintaining adequate fire fighting equipment	0.1551	
	6	Providing safe and adequate emergency exists	0.1251	
	7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	0.1613	
17	**2006-01: Procedures required for reporting occupational injuries and diseases**			**0.0393**
	1	Establishing an internal accident reporting system in the premises	0.5400	
	2	Reporting of occupational accidents or illnesses to Ministry of Labour	0.4600	

By plotting the new weights, it can be realized that the average weights are in between of both the Average Weights and AHP. Figure 18 shows the resulted plot and Appendix G shows a table with all relative weights found.

Although this step is very simple, it shows a significant effect on calculating the safety performance index and selecting the legal action. The validation step discussed in Chapter (6) will show this effect.

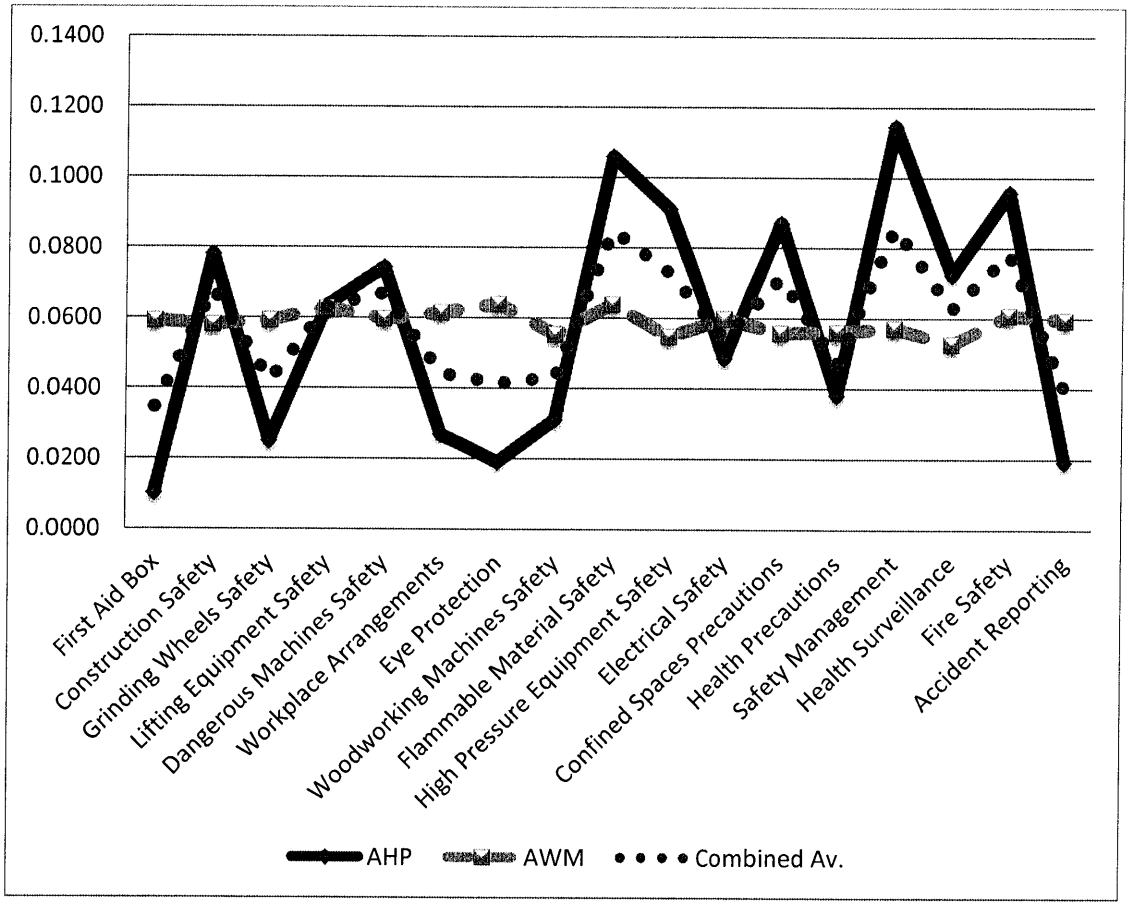


Figure 18 – Comparison between calculated relative weights by all models

CHAPTER 6

MODELS' VALIDATION

CHAPTER 6

MODELS VALIDATION

Validation Steps

To validate the models, the following steps were considered:

1. Twenty cases were selected from the Occupational Safety Section Database. Ten from the manufacturing sector and the other are from construction sector. All the cases were inspected in 2011 by various OSH inspectors.
2. The violations recorded by the inspector and the approved decisions were kept for final comparison.
3. The inspectors were consulted in some cases in order to reflect the correct situation about the case.
4. The final Safety Performance Indices were calculated using Step 5 of the Inspection Process discussed in Chapter 4 along with final legal action as shown in Step 6 from the same chapter. This was done for each of the three models.
5. All results were communicated to the OSH inspector from the Occupational Safety Section and to the Experts who joined the AHP questionnaire. The question was: Which model do you prefer and which one do you feel that is more realistic and fair?
6. The results will be discussed later in this chapter.

Final Results

Table 18 shows the final results after calculating the Safety Performance Index using the weights found by AHP Model, Average Weights Model and a third one considering the average between them. Three examples contain detailed reports are

illustrated in Appendix H. The same form can be used by OSH inspectors to apply the model to calculate the safety performance index.

From the legal actions selected for the different cases tested by the models, it does not show huge difference. The legal actions seem to be identical for all cases except for few of them. It shows that the cases reached to the marginal limits have some differences. However the Safety Performance Indices calculated show slightly different rates.

Comparing these legal actions with the decisions taken by MOL inspectors, it can be noticed that there are no significant difference between taken decisions and models result. Most of companies were given "Improvement Notice" while the inspectors agreed about the OSH existing violations. There was only one case prosecuted for its past history of non-compliance with OSH regulations. MOL database shows one case with no disciplinary action was taken while there were existing OSH violations.

The View of OSH Inspectors

The view of the OSH inspectors in Ministry of Labour is that the average model between AHP and the Average Weights is reducing the legal actions which may not be very helpful in their duty. They see that either the AHP or the combined average model could be applied. Also, they expressed that the results and the legal actions may not be varied from the actions taken by the inspectors themselves but it will create a standard method for decision making.

The View of OSH Experts

The group of experts generally agreed with OSH inspectors. However, they prefer to use the weight calculated by AHP model. The reason they expressed is that AHP weight looks more realistic than the Average Weights because it differentiates between the Ministerial Orders, or the main factors. Such differentiation is not shown

by the weights of Average Weights Model. As an example the case of first aid Ministerial Order is rated the same as the safety construction Ministerial Order. As per the prospective of the experts that could not be acceptable as the risk from violating safety measures in construction sector is more than that of not providing first aid box.

Generally, the model shows the ability to assist the inspectorate to standardize the safety inspection procedure and to promote consistency and fairness.

Table 18 – Safety Performance Calculation for Safety Models

Models:				AHP		AWM		Combined Average Model	
Case ID	Sector	UNIT_SIZE	MOL Decision	SP%	Legal Action	SP%	Legal Action	SP%	Legal Action
1	Construction	210	Improvement Notice	29.50%	Prosecution Notice	30.61%	Improvement Notice	29.34%	Prosecution Notice
2	Construction	238	Improvement Notice	56.20%	Improvement Notice	47.54%	Improvement Notice	51.82%	Improvement Notice
3	Construction	258	Prosecution Notice	66.20%	Improvement Notice	65.52%	Improvement Notice	65.72%	Improvement Notice
4	Construction	258	Improvement Notice	18.07%	Prosecution Notice	16.24%	Prosecution Notice	17.05%	Prosecution Notice
5	Construction	263	Improvement Notice	40.95%	Improvement Notice	50.66%	Improvement Notice	46.20%	Improvement Notice
6	Construction	269	Improvement Notice	29.22%	Prosecution Notice	34.64%	Improvement Notice	31.86%	Improvement Notice
7	Construction	369	No Action	48.00%	Improvement Notice	54.90%	Improvement Notice	51.27%	Improvement Notice
8	Construction	430	Improvement Notice	57.23%	Improvement Notice	70.83%	Improvement Notice	64.24%	Improvement Notice
9	Construction	761	Improvement Notice	76.89%	Improvement Notice	81.21%	Verbal Notice	79.26%	Improvement Notice
10	Construction	1568	Improvement Notice	78.58%	Improvement Notice	84.04%	Verbal Notice	81.40%	Verbal Notice
11	Manufacturing	100	Improvement Notice	46.01%	Improvement Notice	52.67%	Improvement Notice	50.02%	Improvement Notice
12	Manufacturing	118	Improvement Notice	70.69%	Improvement Notice	73.49%	Improvement Notice	71.91%	Improvement Notice
13	Manufacturing	137	Improvement Notice	59.99%	Improvement Notice	66.98%	Improvement Notice	63.71%	Improvement Notice
14	Manufacturing	137	Improvement Notice	56.90%	Improvement Notice	53.13%	Improvement Notice	55.07%	Improvement Notice
15	Manufacturing	168	Improvement Notice	74.97%	Improvement Notice	82.28%	Verbal Notice	78.71%	Improvement Notice
16	Manufacturing	176	Improvement Notice	49.49%	Improvement Notice	47.82%	Improvement Notice	48.78%	Improvement Notice
17	Manufacturing	281	Verbal Notice	43.50%	Improvement Notice	40.62%	Improvement Notice	42.60%	Improvement Notice
18	Manufacturing	425	Improvement Notice	66.60%	Improvement Notice	73.91%	Improvement Notice	70.37%	Improvement Notice
19	Manufacturing	429	Improvement Notice	64.19%	Improvement Notice	63.56%	Improvement Notice	63.61%	Improvement Notice
20	Manufacturing	1703	Improvement Notice	63.90%	Improvement Notice	73.16%	Improvement Notice	68.28%	Improvement Notice

CHAPTER 7

CONCLUSION & RECOMMENDATIONS

CHAPTER 7

CONCLUSION & RECOMMENDATIONS

The study shows that Kingdom of Bahrain must apply an OSH enforcement policy in order to come over the deficiencies exist in the current system such as the level of fairness and consistency applied by OSH inspectors. On other hand, it shows that depending on numerical evaluation and scale system will reduce the subjectivity in the evaluation process carried out by OSH inspector.

The proposed numerical method and the relative weights build up using the AHP and the combined average showed valid results and reasonable evaluation to OSH in workplaces. They also made an easy and understandable approach in this regard. The model shows the ability to standardize the inspection work carried by OSH inspectorate. Applying such model may promote consistency and fairness and increase the level of trust between the inspectorate and employers.

By testing the validity of the models, the AHP method shows more accurate relative weights over the AWM; it clearly distinguished between the high ranked violations and other minor ones. The decisions selected by the model were valid and accepted by the OSH experts and OSH inspectors who were consulted. It is recommended to use AHP method to find the relative weights for OSH attributes as it gives varied relative weights compared to the AWM.

Further research is recommended to this work in the field of utilizing occupational accidents data available to improve the accuracy of the model. Further research can be done also to modify the evaluation method to workplaces by considering the level of compliance. Combining two methods of calculating OSH relative weights is another area of further research in order to generate more accurate and acceptable results.

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APPENDICES

APPENDIX A

OSH GENERAL QUESTIONNAIRE

University of Bahrain
Collage of Engineering
Department of Mechanical Engineering
OSH Measurement Factors
General Questionnaire

General Information

Company Name (Optional)	
Economic Activity	❒ Manufacturing ❒ Construction
No. of Workers	
Position of the Person who Filled this Questionnaire	
Experience (Years)	
Notes	

For any questions do not hesitate to call me any time on Mobile no. +973 66348884 - Abbas Matooq or by email: Abbas.Matooq@gmail.com
You may resend the questionnaire to mentioned email or by fax to 17003846
This questionnaire is in 7 pages.

Part 2: General Questions:

A. Please mark the answer that reflects your opinion:

1	How do you evaluate the level of knowledge of the management about the national Occupational Safety and Health legislations	**Excellent ❐**	**Very good ❐**	**good ❐**	**weak ❐**	**Very weak ❐**
2	How do you evaluate the level of knowledge of the management about the Ministry of Labour role and procedures in term of Occupational Safety and Health	**Excellent ❐**	**Very good ❐**	**good ❐**	**weak ❐**	**Very weak ❐**
3	Did the company pass through inspection or investigation process by Occupational Safety Section in Ministry of Labour	**Yes ❐**	**No ❐**			
4	What was the legal action(s) taken by the inspector (you can select more than one option)	**[ ] Commitment Letter**	**[ ] Verbal Notice**	**[ ] Written Improvement Notice**	**[ ] Prosecution Notice**	**[ ] Work Prohibition**

B. To what extend do you agree to the following statements:

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
1	The procedures and the policy for legal actions selected by Safety Inspectors are clear and understandable	❐	❐	❐	❐	❐
2	Ministry of Labour Safety inspectors are taking consistent decisions and legal actions among the workplaces inspected	❐	❐	❐	❐	❐
3	Ministry of Labour Safety inspectors are taking fair legal actions among the workplaces inspected	❐	❐	❐	❐	❐
4	Ministry of Labour has to introduce a clear policy regarding the standards and procedure to be followed by its Safety Inspectors to decide about the suitable legal actions after inspection or investigation process.	❐	❐	❐	❐	❐

Part 2: OSH Factors:

This part of the questionnaire uses the current national OSH legislations. It sub-classified the articles to a number of groups mentioned below. Please indicate how you feel about the level of the impact of each group on company safety performance. Do not answer in terms of your company's safety performance.

A	The Ministerial Order No. 1976-07: The contents of the first aid box	Very High	High	Mode	Low	No Impact
1	Providing suitable first aid boxes	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	First Aid training	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

B	The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding	Very High	High	Mode	Low	No Impact
1	Adequate erection and prober using of scaffolds	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Adequate fixing and using of ladders	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Adequate handling and moving of heavy objects	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Adequate housekeeping in construction sites	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Adequate using and handling of mechanical vehicles	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Confined spaces safety precautions	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
7	Safety measures while working with paints containing lead	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
8	Protection measures against electric shocks	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
9	Fire safety precautions for welding and hot cutting jobs	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
10	Cartridge tools (Guns) safety measures	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
11	Precautions against collapsing hazards of any objects or buildings	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
12	Proper site ventilation to reduce the risk of suffocation	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
13	Protection while working near water	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
14	Providing sufficient lighting for construction site	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
15	Providing suitable PPE	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
16	Safe access to and egress from construction sites	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
17	Safety precautions for demolitions works	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
18	Taking necessary precautions for working at height	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

C	The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations	Very High	High	Mode	Low	No Impact
1	Prober assembly of grinding machines with all necessary elements and controls	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Competent operator	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Proper using of grinding and appraising wheels	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Providing grinding machines with adequate guarding	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Safety awareness signs	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Suitable storage for grinding wheels	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

D	The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment	Very High	High	Mode	Low	No Impact
1	Prober erection of lifting equipments with all necessary elements	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Prober using of lifting equipments/working safe load	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Competent operator	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Periodical examinations by authorized agencies	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing suitable operators cabin	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

E	The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations	Very High	High	Mode	Low	No Impact
1	Duties of designers, manufacturers, importers and exporters of dangerous machines	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing adequate guarding	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Safe operating of dangerous machines	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

F	The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace	Very High	High	Mode	Low	No Impact
1	Adequate housekeeping in workplace	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Taking necessary measures to protect workers from falling hazards	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

G	The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines	Very High	High	Mode	Low	No Impact
1	Providing suitable guarding for hazardous operations	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing suitable PPE	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

H	precautionary measures necessary for the protection of workers from the hazards of woodworking machinery	Very High	High	Mode	Low	No Impact
1	Competent operator	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Control of noise	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Proper assembly of woodworking machines with all necessary elements and controls	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Proper using of woodworking machines	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing sufficient lighting	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing suitable guarding for woodworking machines	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

I	The Ministerial Order No. 1977-31: The protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases	Very High	High	Mode	Low	No Impact
1	Prohibition of smoking	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing adequate firefighting equipment for emergency	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Safe handling and storage of highly flammable materials					

J	The Ministerial Order No. 1977-32: The protection of workers from the hazards of steam boilers, steam containers and receivers	Very High	High	Mode	Low	No Impact
1	Adequate assembly of high pressure equipments	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Confined spaces safety precautions	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Periodical examinations	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

K	The Ministerial Order No. 1977-33: The protection of workers from the hazards of electricity	Very High	High	Mode	Low	No Impact
1	Hiring competent electricians	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing adequate and suitable means of protection and devices	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Providing necessary instructions for emergency response	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Safe and organized design of controlling boards and sub-stations	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Safety precautions for using portable electrical devices	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Sufficient insulation of electrical conductors	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

L	The Ministerial Order No. 1977-34: The protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces	Very High	High	Mode	Low	No Impact
1	Safety precautions for hot jobs in a confined space	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Safety precautions for working in a confined space	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

M	The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work	Very High	High	Mode	Low	No Impact
1	Providing adequate noise reduction PPE for workers in noisy areas	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Welfare facilities in workplace (dining rooms/bathrooms)	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Providing healthy drinking water	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing suitable means of setting	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing workers with adequate clothes	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
7	Providing adequate noise reduction PPE for workers in noisy areas	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

N	The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment	Very High	High	Mode	Low	No Impact
1	Commitment of Employers (Managers) to safety	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Establishing of safety committee with sufficient duties and powers	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Notification of contracting jobs to Ministry of Labour	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing of adequate PPE	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Employment of competent safety officers with sufficient duties and powers	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
7	Providing workers with necessary safety training	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
8	Commitment of workers to safety	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

O	The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases	Very High	High	Mode	Low	No Impact
1	Carrying out suitable health surveillances	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Removing any workers suffering an occupational disease from the source of that disease	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Workers duty to notify the employer of any occupational illness suffered	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

P	The Ministerial Order No. 2005-12: Protection of workers during work from the hazards of fire in establishments	Very High	High	Mode	Low	No Impact
1	Carrying out fire risk assessment	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Emergency plan	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Fire fighting training	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Obtaining fire certificate from competent authority	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing and maintaining adequate fire fighting equipments	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing safe and adequate emergency exists	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

Q	The Ministerial Order No. 2006-01: Procedures required for reporting occupational injuries and diseases	Very High	High	Mode	Low	No Impact
1	Establishing an internal accident reporting system in the premises	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Reporting of occupational accidents or illnesses to Ministry of Labour	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

The End of Questionnaire..
Thanks very much for your participation

APPENDIX B

SAMPLE REPLIES FOR THE OSH GENERAL QUESTIONNAIRE

University of Bahrain
Collage of Engineering
Department of Mechanical Engineering
OSH Measurement Factors
General Questionnaire

General Information

Company Name	POULLAIDES CONSTRUCTION Co. WLL
Business Type	☐ Manufacturing ☒ Construction
No. of Workers	1,500
Position of the Person Who Will Fill the Questionnaire	SNR. SAFETY OFFICER
Experience in Current Position	10 YRS
Notes	

For any questions do not hesitate to call me any time on Mobile no. +973 66348884 - Abbas Matooq or by email: Abbas.Matooq@gmail.com
You may resend the questionnaire to mentioned email or by fax to 17003846
This questionnaire is in 7 pages.

Fax sent by : 00973 17003846 IRS MOL BH 05-04-02 12:05 Pg: 2/8

Part 1: General Questions:

Please mark the answer that reflects your opinion:

1	How do you evaluate the level of knowledge of the management about the national Occupational Safety and Health legislations	Excellent ☐	Very good ☑	good ☐	weak ☐	Very weak ☐
2	How do you evaluate the level of knowledge of the management about the Ministry of Labour role and procedures in term of Occupational Safety and Health	Excellent ☐	Very good ☐	good ☑	weak ☐	Very weak ☐
3	Did the company pass through inspection or investigation process by Occupational Safety Section in Ministry of Labour	Yes ☑	No ☐			
4	What was the legal action(s) taken by the inspector (you can select more than one option)	[ ] Commitment Letter	[ ] Verbal Notice	[✓] Written Improvement Notice		
		[✓] Prosecution Notice	[ ] Work Prohibition			

To what extend do you agree to the following statements:

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	The procedures and the policy for legal actions selected by Safety Inspectors are clear and understandable	☐	☑	☐	☐	☐
2	Ministry of Labour Safety Inspectors are taking consistent decisions and legal actions among the workplaces inspected	☐	☑	☐	☐	☐
3	Ministry of Labour Safety inspectors are taking fair legal actions among the workplaces inspected	☐	☑	☐	☐	☐
4	Ministry of Labour have to introduce a clear policy regarding the standards and procedure to be followed by its Safety Inspectors to decide about the suitable legal actions after inspection or investigation process.	☐	☑	☐	☐	☐

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Part 2: OSH Factors:

This part of the questionnaire uses the current national OSH legislations. It sub-classified the articles to a number of groups mentioned below. Please indicate how you feel about the level of the impact of each group on company safety performance. Do not answer in terms of your company's safety performance.

A	The Ministerial Order No. 1976-07: The contents of the first aid box	Very High	High	Mode	Low	No Impact
1	Providing suitable first aid boxes	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
2	First Aid training	4 ☐	3 ☐	2 ☐	1 ☑	0 ☐

B	The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding	Very High	High	Mode	Low	No Impact
1	Adequate erection and prober using of scaffolds	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Adequate fixing and using of ladders	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Adequate handling and moving of heavy objects	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Adequate housekeeping in construction sites	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Adequate using and handling of mechanical vehicles	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Confined spaces safety precautions	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Safety measures while working with paints containing lead	4 ☐	3 ☐	2 ☐	1 ☑	0 ☐
8	Protection measures against electric shocks	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
9	Fire safety precautions for welding and hot cutting jobs	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
10	Cartridge tools (Guns) safety measures	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
11	Precautions against collapsing hazards of any objects or buildings	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
12	Proper site ventilation to reduce the risk of suffocation	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
13	Protection while working near water	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
14	Providing sufficient lighting for construction site	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
15	Providing suitable PPE	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
16	Safe access to and egress from construction sites	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
17	Safety precautions for demolitions works	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
18	Taking necessary precautions for working at height	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐

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C	The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers form the hazardous of grinding wheel operations	Very High	High	Mode	Low	No Impact
1	Prober assembly of grinding machines with all necessary elements and controls	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Competent operator	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Proper using of grinding and appraising wheels	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Providing grinding machines with adequate guarding	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Safety awareness signs	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Suitable storage for grinding wheels	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

D	The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers form the hazardous of work on lifting equipment	Very High	High	Mode	Low	No Impact
1	Prober erection of lifting equipments with all necessary elements	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Prober using of lifting equipments/working safe load	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Competent operator	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Periodical examinations by authorized agencies	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing suitable operators cabin	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

E	The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers form the hazardous of grinding wheel operations	Very High	High	Mode	Low	No Impact
1	Duties of designers, manufacturers, importers and exporters of dangerous machines	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
2	Providing adequate guarding	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Safe operating of dangerous machines	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

F	The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace	Very High	High	Mode	Low	No Impact
1	Adequate housekeeping in workplace	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Taking necessary measures to protect workers from falling hazards	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

G	The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines	Very High	High	Mode	Low	No Impact
1	Providing suitable guarding for hazardous operations	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Providing suitable PPE	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

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H	The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery	Very High	High	Mode	Low	No Impact
1	Competent operator	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Control of noise	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
3	Proper assembly of woodworking machines with all necessary elements and controls	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Proper using of woodworking machines	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing sufficient lighting	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing suitable guarding for woodworking machines	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

I	The Ministerial Order No. 1977-31: The protection of workers form the hazards of highly flammable liquids and liquefied petroleum gases	Very High	High	Mode	Low	No Impact
1	Prohibition of smoking	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing adequate fire fighting equipment for emergency	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Safe handling and storage of highly flammable materials					

J	The Ministerial Order No. 1977-32: The protection of workers form the hazards of steam boilers, steam containers and receivers	Very High	High	Mode	Low	No Impact
1	Adequate assembly of high pressure equipments	4 ☐	3 ☐	2 ☐	1 ☐	0 ☑
2	Confined spaces safety precautions	4 ☐	3 ☐	2 ☐	1 ☐	0 ☑
3	Periodical examinations	4 ☐	3 ☐	2 ☐	1 ☐	0 ☑

N/A

K	The Ministerial Order No. 1977-33: The protection of workers form the hazards of electricity	Very High	High	Mode	Low	No Impact
1	Hiring competent electricians	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
2	Providing adequate and suitable means of protection and devices	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
3	Providing necessary instructions for emergency response	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
4	Safe and organized design of controlling boards and sub-stations	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Safety precautions for using portable electrical devices	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Sufficient insulation of electrical conductors	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

L	The Ministerial Order No. 1977-34: The protection of workers form the hazards of the repair and demolition of tanks, drums and work in confined spaces	Very High	High	Mode	Low	No Impact
1	Safety precautions for hot jobs in a confined space	4 ☐	3 ☐	2 ☐	1 ☐	0 ☑
2	Safety precautions for working in a confined space	4 ☐	3 ☐	2 ☐	1 ☐	0 ☑

N/A

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M	The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work	Very High	High	Mode	Low	No Impact
1	Providing adequate noise reduction PPE for workers in noisy areas	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Welfare facilities in workplace (dining rooms/bathrooms)	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Providing healthy drinking water	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing suitable means of setting	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Providing workers with adequate clothes	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Providing adequate noise reduction PPE for workers in noisy areas	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐

N	The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment	Very High	High	Mode	Low	No Impact
1	Commitment of Employers (Managers) to safety	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Establishing of safety committee with sufficient duties and powers	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
4	Notification of contracting jobs to Ministry of Labour	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing of adequate PPE	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Employment of competent safety officers with sufficient duties and powers	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Providing workers with necessary safety training	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
8	Commitment of workers to safety	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

O	The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases	Very High	High	Mode	Low	No Impact
1	Carrying out suitable health surveillances	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
2	Removing any workers suffering an occupational disease from the source of that disease	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐
3	Workers duty to notify the employer of any occupational illness suffered	4 ☐	3 ☐	2 ☑	1 ☐	0 ☐

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P	The Ministerial Order No. 2005-12: Protection of workers during work form the hazards of fire in establishments	Very High	High	Mode	Low	No Impact
1	Carrying out fire risk assessment	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Emergency plan	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Fire fighting training	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Obtaining fire certificate form competent authority	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing and maintaining adequate fire fighting equipments	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Providing safe and adequate emergency exists	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

Q	2006-01: Procedures required for reporting occupational injuries and diseases	Very High	High	Mode	Low	No Impact
1	Establishing an internal accident reporting system in the premises	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Reporting of occupational accidents or illnesses to Ministry of Labour	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

The End of Questionnaire..
Thanks very much for your participation

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Fax sent by : 80973 17883845 IRS MOL BH 05-04-02 12:06 Pg: 8/8

Fax sent by : 00973 17003846 IRS MOL BH 05-04-02 10:54 Pg: 2/8

University of Bahrain
Collage of Engineering
Department of Mechanical Engineering
OSH Measurement Factors
General Questionnaire

General Information

Company Name (Optional)	MIDAL CABLES LTD.
Economic Activity	☑ Manufacturing ☐ Construction
No. of Workers	462
Position of the Person who Fills this Questionnaire	QSSHE MANAGER
Experience (Years)	More than 8 years
Notes	

For any questions do not hesitate to call me any time on Mobile no. +973 66348884 - Abbas Matooq or by email: Abbas.Matooq@gmail.com
You may resend the questionnaire to mentioned email or by fax to 17003846
This questionnaire is in 7 pages.

Part 1: General Questions:

Please mark the answer that reflects your opinion:

1	How do you evaluate the level of knowledge of the management about the national Occupational Safety and Health legislations	**Excellent ☒**	**Very good ☐**	**good ☐**	**weak ☐**	**Very weak ☐**
2	How do you evaluate the level of knowledge of the management about the Ministry of Labour role and procedures in term of Occupational Safety and Health	**Excellent ☒**	**Very good ☐**	**good ☐**	**weak ☐**	**Very weak ☐**
3	Did the company pass through inspection or investigation process by Occupational Safety Section in Ministry of Labour	**Yes ☒**	**No ☐**			
4	What was the legal action(s) taken by the inspector (you can select more than one option)	**[ ] Commitment Letter**	**[o] Verbal Notice**	**[ ] Written Improvement Notice**		
		[ ] Prosecution Notice	**[ ] Work Prohibition**			

To what extend do you agree to the following statements:

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	The procedures and the policy for legal actions selected by Safety Inspectors are clear and understandable	☐	☒	☐	☐	☐
2	Ministry of Labour Safety Inspectors are taking consistent decisions and legal actions among the workplaces inspected	☐	☒	☐	☐	☐
3	Ministry of Labour Safety inspectors are taking fair legal actions among the workplaces inspected	☐	☒	☐	☐	☐
4	Ministry of Labour have to introduce a clear policy regarding the standards and procedure to be followed by its Safety Inspectors to decide about the suitable legal actions after inspection or investigation process.	☐	☒	☐	☐	☐

Part 2: OSH Factors:

This part of the questionnaire uses the current national OSH legislations. It sub-classified the articles to a number of groups mentioned below. Please indicate how you feel about the level of the impact of each group on company safety performance. Do not answer in terms of your company's safety performance.

A	The Ministerial Order No. 1976-07: The contents of the first aid box	Very High	High	Mode	Low	No Impact
1	Providing suitable first aid boxes	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	First Aid training	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

B	The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding	Very High	High	Mode	Low	No Impact
1	Adequate erection and prober using of scaffolds	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
2	Adequate fixing and using of ladders	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
3	Adequate handling and moving of heavy objects	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
4	Adequate housekeeping in construction sites	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
5	Adequate using and handling of mechanical vehicles	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
6	Confined spaces safety precautions	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
7	Safety measures while working with paints containing lead	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
8	Protection measures against electric shocks	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
9	Fire safety precautions for welding and hot cutting jobs	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
10	Cartridge tools (Guns) safety measures	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
11	Precautions against collapsing hazards of any objects or buildings	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
12	Proper site ventilation to reduce the risk of suffocation	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
13	Protection while working near water	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
14	Providing sufficient lighting for construction site	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
15	Providing suitable PPE	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
16	Safe access to and egress from construction sites	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
17	Safety precautions for demolitions works	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐
18	Taking necessary precautions for working at height	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

C	The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers form the hazardous of grinding wheel operations	Very High	High	Mode	Low	No Impact
1	Prober assembly of grinding machines with all necessary elements and controls	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Competent operator	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Proper using of grinding and appraising wheels	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
4	Providing grinding machines with adequate guarding	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
5	Safety awareness signs	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
6	Suitable storage for grinding wheels	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

D	The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers form the hazardous of work on lifting equipment	Very High	High	Mode	Low	No Impact
1	Prober erection of lifting equipments with all necessary elements	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Prober using of lifting equipments/working safe load	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Competent operator	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
4	Periodical examinations by authorized agencies	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing suitable operators cabin	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

E	The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers ~~form the hazardous of grinding wheel operations~~ from the hazards of dangerous machinery	Very High	High	Mode	Low	No Impact
1	Duties of designers, manufacturers, importers and exporters of dangerous machines	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing adequate guarding	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Safe operating of dangerous machines	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

F	The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace	Very High	High	Mode	Low	No Impact
1	Adequate housekeeping in workplace	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Taking necessary measures to protect workers from falling hazards	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

G	The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines	Very High	High	Mode	Low	No Impact
1	Providing suitable guarding for hazardous operations	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
2	Providing suitable PPE	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

H	The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery	Very High	High	Mode	Low	No Impact
1	Competent operator	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
2	Control of noise	4 ☐	3 ☐	2 ☒	1 ☐	0 ☐
3	Proper assembly of woodworking machines with all necessary elements and controls	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
4	Proper using of woodworking machines	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
5	Providing sufficient lighting	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
6	Providing suitable guarding for woodworking machines	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐

I	The Ministerial Order No. 1977-31: The protection of workers form the hazards of highly flammable liquids and liquefied petroleum gases	Very High	High	Mode	Low	No Impact
1	Prohibition of smoking	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
2	Providing adequate fire fighting equipment for emergency	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Safe handling and storage of highly flammable materials		o			

J	The Ministerial Order No. 1977-32: The protection of workers form the hazards of steam boilers, steam containers and receivers	Very High	High	Mode	Low	No Impact
1	Adequate assembly of high pressure equipments	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
2	Confined spaces safety precautions	4 ☐	3 ☐	2 ☒	1 ☐	0 ☐
3	Periodical examinations	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

K	The Ministerial Order No. 1977-33: The protection of workers form the hazards of electricity	Very High	High	Mode	Low	No Impact
1	Hiring competent electricians	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
2	Providing adequate and suitable means of protection and devices	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Providing necessary instructions for emergency response	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
4	Safe and organized design of controlling boards and sub-stations	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
5	Safety precautions for using portable electrical devices	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
6	Sufficient insulation of electrical conductors	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

L	The Ministerial Order No. 1977-34: The protection of workers form the hazards of the repair and demolition of tanks, drums and work in confined spaces	Very High	High	Mode	Low	No Impact
1	Safety precautions for hot jobs in a confined space	4 ☐	3 ☐	2 ☐	1 ☒	0 ☐
2	Safety precautions for working in a confined space	4 ☐	3 ☐	2 ☐	1 ☒	0 ☐

M	The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work	Very High	High	Mode	Low	No Impact
1	Providing adequate noise reduction PPE for workers in noisy areas	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Welfare facilities in workplace (dining rooms/bathrooms)	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
4	Providing healthy drinking water	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
5	Providing suitable means of setting	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
6	Providing workers with adequate clothes	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
7	Providing adequate noise reduction PPE for workers in noisy areas	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐

N	The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment	Very High	High	Mode	Low	No Impact
1	Commitment of Employers (Managers) to safety	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Establishing of safety committee with sufficient duties and powers	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
4	Notification of contracting jobs to Ministry of Labour	4 ☐	3 ☐	2 ☒	1 ☐	0 ☐
5	Providing of adequate PPE	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
6	Employment of competent safety officers with sufficient duties and powers	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
7	Providing workers with necessary safety training	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
8	Commitment of workers to safety	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

O	The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases	Very High	High	Mode	Low	No Impact
1	Carrying out suitable health surveillances	4 ☐	3 ☐	2 ☒	1 ☐	0 ☐
2	Removing any workers suffering an occupational disease from the source of that disease	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
3	Workers duty to notify the employer of any occupational illness suffered	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

P	The Ministerial Order No. 2005-12: Protection of workers during work form the hazards of fire in establishments	Very High	High	Mode	Low	No Impact
1	Carrying out fire risk assessment	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
2	Emergency plan	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
3	Fire fighting training	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
4	Obtaining fire certificate form competent authority	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
5	Providing and maintaining adequate fire fighting equipments	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing safe and adequate emergency exists	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	4 ☒	3 ☐	2 ☐	1 ☐	0 ☐

Q	2006-01: Procedures required for reporting occupational injuries and diseases	Very High	High	Mode	Low	No Impact
1	Establishing an internal accident reporting system in the premises	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐
2	Reporting of occupational accidents or illnesses to Ministry of Labour	4 ☐	3 ☒	2 ☐	1 ☐	0 ☐

The End of Questionnaire..
Thanks very much for your participation

University of Bahrain
Collage of Engineering
Department of Mechanical Engineering
OSH Measurement Factors
General Questionnaire

General Information

Company Name (Optional)	**AWAL GULF MANUFACTURING COMPANY**
Economic Activity	☑ Manufacturing ☐ Construction
No. of Workers	**1200**
Position of the Person who Fill this Questionnaire	Abbas Mubarak (Safety
Experience (Years)	8 years
Notes	

For any questions do not hesitate to call me any time on Mobile no. +973 66348884 - Abbas Matooq or by email: Abbas.Matooq@gmail.com
You may resend the questionnaire to mentioned email or by fax to 17003846
This questionnaire is in 7 pages.

Part 1:General Questions:

Please mark the answer that reflects your opinion:

1	How do you evaluate the level of knowledge of the management about the national Occupational Safety and Health legislations	**Excellent** ☐	**Very good** ☑	**good** ☐	**weak** ☐	**Very weak** ☐
2	How do you evaluate the level of knowledge of the management about the Ministry of Labour role and procedures in term of Occupational Safety and Health	**Excellent** ☐	**Very good** ☑	**good** ☐	**weak** ☐	**Very weak** ☐
3	Did the company pass through inspection or investigation process by Occupational Safety Section in Ministry of Labour	**Yes** ☐	**No** ☐			
4	What was the legal action(s) taken by the inspector (you can select more than one option)	**[ ] Commitment Letter**	**[ ] Verbal Notice**	**[ ] Written Improvement Notice**	**[ ] Prosecution Notice**	**[ ] Work Prohibition**

To what extend do you agree to the following statements:

		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
1	The procedures and the policy for legal actions selected by Safety Inspectors are clear and understandable	☐	☑	☐	☐	☐
2	Ministry of Labour Safety inspectors are taking consistent decisions and legal actions among the workplaces inspected	☐	☑	☐	☐	☐
3	Ministry of Labour Safety inspectors are taking fair legal actions among the workplaces inspected	☐	☑	☐	☐	☐
4	Ministry of Labourhave to introduce a clear policy regarding the standards and procedure to be followed by its Safety Inspectors to decide about the suitable legal actions after inspection or investigation process.	☐	☑	☐	☐	☐

Part 2:OSH Factors:

This part of the questionnaire uses the current national OSH legislations. It sub-classified the articles to a number of groups mentioned below. Please indicate how you feel about the level of the impact of each group on company safety performance. Do not answer in terms of your company's safety performance.

A	**The Ministerial Order No. 1976-07: The contents of the first aid box**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Providing suitable first aid boxes	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
2	First Aid training	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

B	**The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Adequate erection and prober using of scaffolds	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Adequate fixing and using of ladders	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Adequate handling and moving of heavy objects	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Adequate housekeeping in construction sites	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
5	Adequate using and handling of mechanical vehicles	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Confined spaces safety precautions	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Safety measures while working with paints containing lead	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
8	Protection measures against electric shocks	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
9	Fire safety precautions for welding and hot cutting jobs	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
10	Cartridge tools (Guns) safety measures	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
11	Precautions against collapsing hazards of any objects or buildings	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
12	Proper site ventilation to reduce the risk of suffocation	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

13	Protection while working near water	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
14	Providing sufficient lighting for construction site	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
15	Providing suitable PPE	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
16	Safe access to and egress from construction sites	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
17	Safety precautions for demolitions works	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
18	Taking necessary precautions for working at height	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

C	**The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers form the hazardous of grinding wheel operations**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Prober assembly of grinding machines with all necessary elements and controls	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Competent operator	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Proper using of grinding and appraising wheels	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Providing grinding machines with adequate guarding	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Safety awareness signs	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Suitable storage for grinding wheels	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

D	**The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers form the hazardous of work on lifting equipment**	**Very High**	**High**	**Mode**	**Low**	**No Impact**

1	Prober erection of lifting equipments with all necessary elements	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Prober using of lifting equipments/working safe load	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Competent operator	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Periodical examinations by authorized agencies	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing suitable operators cabin	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
E	**The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers form the hazardous of grinding wheel operations**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Duties of designers, manufacturers, importers and exporters of dangerous machines	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Providing adequate guarding	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Safe operating of dangerous machines	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
F	**The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Adequate housekeeping in workplace	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
2	Taking necessary measures to protect workers from falling hazards	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
G	**The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Providing suitable guarding for hazardous operations	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Providing suitable PPE	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
H	**The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the**	**Very High**	**High**	**Mode**	**Low**	**No Impact**

	hazards of woodworking machinery					
1	Competent operator	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Control of noise	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Proper assembly of woodworking machines with all necessary elements and controls	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Proper using of woodworking machines	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing sufficient lighting	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing suitable guarding for woodworking machines	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

I	**The Ministerial Order No. 1977-31: The protection of workers form the hazards of highly flammable liquids and liquefied petroleum gases**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Prohibition of smoking	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
2	Providing adequate fire fighting equipment for emergency	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Safe handling and storage of highly flammable materials	√				

J	**The Ministerial Order No. 1977-32: The protection of workers form the hazards of steam boilers, steam containers and receivers**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Adequate assembly of high pressure equipments	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Confined spaces safety precautions	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
3	Periodical examinations	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

K	**The Ministerial Order No. 1977-33: The protection of workers form the hazards of electricity**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Hiring competent electricians	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Providing adequate and suitable means of protection and devices	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

3	Providing necessary instructions for emergency response	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
4	Safe and organized design of controlling boards and sub-stations	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Safety precautions for using portable electrical devices	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Sufficient insulation of electrical conductors	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

L	**The Ministerial Order No. 1977-34: The protection of workers form the hazards of the repair and demolition of tanks, drums and work in confined spaces**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Safety precautions for hot jobs in a confined space	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Safety precautions for working in a confined space	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

M	**The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Providing adequate noise reduction PPE for workers in noisy areas	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Welfare facilities in workplace (dining rooms/bathrooms)	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Providing healthy drinking water	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing suitable means of setting	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
6	Providing workers with adequate clothes	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Providing adequate noise reduction PPE for workers in noisy areas	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

N	**The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment**	**Very High**	**High**	**Mode**	**Low**	**No Impact**

1	Commitment of Employers (Managers) to safety	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
2	Establishing of safety committee with sufficient duties and powers	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
4	Notification of contracting jobs to Ministry of Labour	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
5	Providing of adequate PPE	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Employment of competent safety officers with sufficient duties and powers	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
7	Providing workers with necessary safety training	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
8	Commitment of workers to safety	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

O	**The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Carrying out suitable health surveillances	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Removing any workers suffering an occupational disease from the source of that disease	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Workers duty to notify the employer of any occupational illness suffered	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐

P	**The Ministerial Order No. 2005-12: Protection of workers during work form the hazards of fire in establishments**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Carrying out fire risk assessment	4 ☐	3 ☐	2 ☐	1 ☐	0 ☐

2	Emergency plan	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
3	Fire fighting training	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
4	Obtaining fire certificate form competent authority	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
5	Providing and maintaining adequate fire fightingequipments	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
6	Providing safe and adequate emergency exists	4 ☑	3 ☐	2 ☐	1 ☐	0 ☐
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

Q	**2006-01: Procedures required for reporting occupational injuries and diseases**	**Very High**	**High**	**Mode**	**Low**	**No Impact**
1	Establishing an internal accident reporting system in the premises	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐
2	Reporting of occupational accidents or illnesses to Ministry of Labour	4 ☐	3 ☑	2 ☐	1 ☐	0 ☐

The End of Questionnaire..
Thanks very much for your participation

APPENDIX C

LEGAL ITEMS MAPPING WITH SUB-FACTORS DESIGNED

Appendix C -
Legal Items Mapping with Sub-Factors

1976-07 First Aid Box

1. **Providing suitable first aid boxes**
   - Article No: 01
   - Article No: 03
   - Article No: 04
2. **Training on providing first aid services**
   - Article No: 05

1977-12 Construction Safety

1. **Adequate erection and using of scaffolds**
   - Article No: 04
   - Article No: 05
   - Article No: 06
   - Article No: 07
   - Article No: 09
   - Article No: 10
   - Article No: 11
   - Article No: 12
   - Article No: 13
   - Article No: 16
   - Article No: 19
   - Article No: 48
2. **Adequate fixing and using of ladders**
   - Article No: 08
3. **Adequate handling and moving of heavy objects**
   - Article No: 27
4. **Adequate housekeeping in construction sites**
   - Article No: 28
   - Article No: 33
5. **Adequate using and handling of mechanical vehicles**
   - Article No: 24
6. **Confined spaces safety precautions**
   - Article No: 34
   - Article No: 35
   - Article No: 40
   - Article No: 41
   - Article No: 42
   - Article No: 43
   - Article No: 44
7. **Control of noise**
   - Article No: 31
8. **Electrical safety in construction**
   - Article No: 26

9. **Fire safety precuations for welding and cutting jobs using flammable gas**
   - Article No: 36
   - Article No: 37
   - Article No: 38
   - Article No: 39
10. **Painting and sand plasting jobs precuations**
   - Article No: 46
   - Article No: 47
11. **Precuations against collapsing hazards**
   - Article No: 49
12. **Protection against suffocation hazards**
   - Article No: 21
13. **Protection while working near water**
   - Article No: 22
   - Article No: 23
14. **Providing suffecient lighting**
   - Article No: 29
15. **Providing suitable PPE**
   - Article No: 30
   - Article No: 32
   - Article No: 45
16. **Safe access and egress to construction sites**
   - Article No: 03
17. **Safety percations for demolations works**
   - Article No: 25
18. **Taking necessary precautions for working at hieght**
   - Article No: 14
   - Article No: 15
   - Article No: 17
   - Article No: 18
   - Article No: 20

1977-13 Grinding Wheels Safety

1. **Adequate fixing of grinding wheels**
   - Article No: 05
   - Article No: 06
   - Article No: 14
2. **Competent operator**
   - Article No: 07
3. **Proper using of grinding and appraising wheels**
   - Article No: 03
   - Article No: 04
   - Article No: 10
4. **Providing adequate guarding**
   - Article No: 08
   - Article No: 09

Article No: 15

5. **Providing each grinding machine with starting and stopping control**
   Article No: 11
6. **Providing suitable stands**
   Article No: 12
7. **Safety awarness signs**
   Article No: 13
8. **Suitabel storage for grinding wheels**
   Article No: 16

1977-14 Lifting Equipment Safety

1. **Adequate erection of lifting equipments**
   Article No: 05
   Article No: 06
   Article No: 09
   Article No: 10
   Article No: 11
   Article No: 12
   Article No: 13
   Article No: 15
   Article No: 20
   Article No: 21
   Article No: 22
   Article No: 23
   Article No: 24
   Article No: 25
2. **Adequate using of lifting equipments**
   Article No: 19
   Article No: 26
   Article No: 27
3. **Competent operator**
   Article No: 16
4. **Periodical examinations**
   Article No: 17
   Article No: 28
5. **Providing lefting equipment with starting and stopping controls**
   Article No: 14
6. **Providing suitable operators cabin**
   Article No: 07
   Article No: 08
7. **Working safe load**
   Article No: 18

1977-15 Dangerous Machines Safety

1. **Duties of designers, manufacturers, importers and exporters of dangerou**
   Article No: 03

2. **Providing adequate guarding**
   Article No: 04
   Article No: 06
3. **Safe operating of dangerous machines**
   Article No: 05
   Article No: 07

1977-25 Workplace Arrangments

1. **Adequate housekeeping in workplace**
   Article No: 06
2. **Taking necessary measures to protect workers from falling hazards**
   Article No: 05

1977-26 Eye Protection

1. **Providing suitable guarding for hazardous operations**
   Article No: 04
   Article No: 08
2. **Providing suitable PPE**
   Article No: 03
   Article No: 05
   Article No: 06
   Article No: 07
   Article No: 09

1977-27 Woodworking Machines Safety

1. **Competent operator**
   Article No: 11
   Article No: 12
   Article No: 38
2. **Control of noise**
   Article No: 42
3. **Proper assemply of woodworking machines**
   Article No: 08
   Article No: 09
   Article No: 10
   Article No: 14
   Article No: 22
   Article No: 23
   Article No: 27
   Article No: 30
   Article No: 31
   Article No: 37
   Article No: 40
4. **Proper using of woodworking machies**
   Article No: 15
   Article No: 16
   Article No: 17

Article No: 18
Article No: 35
Article No: 36

5. **Providing effective exhuast devices for woodworking machines**
   Article No: 39
6. **Providing suffecient lighting**
   Article No: 41
7. **Providing suitable guarding for woodworking machines**
   Article No: 03
   Article No: 04
   Article No: 05
   Article No: 06
   Article No: 19
   Article No: 20
   Article No: 21
   Article No: 24
   Article No: 25
   Article No: 26
   Article No: 28
   Article No: 29
   Article No: 32
   Article No: 33
   Article No: 34
8. **Providing woodworking machine with starting and stopping control**
   Article No: 07

1977-31 Flammable Material Safety

1. **Prohibition of smoking**
   Article No: 14
2. **Providing adequate fire fighting equipment for emergency**
   Article No: 12
   Article No: 15
   Article No: 16
3. **Safe handling and storage of highly flammable materials**
   Article No: 05
   Article No: 06
   Article No: 07
   Article No: 08
   Article No: 09
   Article No: 10
   Article No: 11
   Article No: 13

1977-32 High Pressure Equipment Safety

1. **Adequate assemply of high pressure equibments**
   Article No: 03
   Article No: 05
2. **Confined spaces safety precuations**

Article No: 06

3. **Periodical examinations**
   Article No: 04

1977-33 Electrical Safety

1. **Hiring competent electricians**
   Article No: 21
2. **Providing adequate and suitable protection devices**
   Article No: 06
   Article No: 07
   Article No: 08
   Article No: 09
   Article No: 10
   Article No: 19
3. **Providing necessary instructions for emergency response**
   Article No: 22
4. **Safe and organized design of controlling boards**
   Article No: 12
   Article No: 13
   Article No: 14
   Article No: 16
5. **Safe design of sub-stations**
   Article No: 23
6. **Safe guarding of high voltage devices**
   Article No: 17
   Article No: 18
7. **Safety precautions for using portable electrical devices**
   Article No: 11
8. **Suffecient insulation of electrical conductors**
   Article No: 05
   Article No: 15
   Article No: 20

1977-34 Confined Spaces Precuations

1. **Safety precautions for hot jobs in a confined space**
   Article No: 03
2. **Safety precautions for working in a confined space**
   Article No: 05

1978-03 Health Precuations

1. **Control of noise**
   Article No: 09
2. **Hygiene measures and services in workplaces**
   Article No: 04
   Article No: 11

3. **Providing dining rooms**
   Article No: 06
4. **Providing healthy drinking water**
   Article No: 07
5. **Providing suitable means of setting**
   Article No: 08
6. **Providing workers with adequate clothes**
   Article No: 05
7. **Welfare in workplace**
   Article No: 10

2000-06 Safety Management

1. **Employers commitment to their safety duties**
   Article No: 22
2. **Establishing and duties of safety committee**
   Article No: 07
   Article No: 08
   Article No: 09
   Article No: 10
   Article No: 11
3. **Inculsion of punitive actions against workers for breaking safety measure**
   Article No: 24
4. **Notification of contracting jobs**
   Article No: 19
5. **Provideing adquate PPE**
   Article No: 20
6. **Safety officer duties**
   Article No: 05
7. **Safety training**
   Article No: 16
8. **Using competent safety officer**
   Article No: 04
   Article No: 06
9. **Workers commitment to their safety duties**
   Article No: 23

2001-03 Health Surveillance

1. **Carrying out suitable health surveillances**
   Article No: 02
   Article No: 03
   Article No: 04
   Article No: 05
   Article No: 08

2. **Removing any workers suffering an occupational disease from the source**
   Article No: 06
3. **Workers duty to notify the employer of any occupational illness suffered**
   Article No: 10

2005-12 Fire Safety

1. **Carrying out fire risk assessment**
   Article No: 05
2. **Emergency plan**
   Article No: 14
3. **Fire fighting training**
   Article No: 11
4. **Obtaining fire certificate**
   Article No: 15
5. **Periodical examinations**
   Article No: 08
   Article No: 09
6. **Providing and maintaining adequate fire fighting equipments**
   Article No: 07
   Article No: 10
7. **Providing safe and adequate emergency exists**
   Article No: 12
8. **Safety precuations against the risk of fire**
   Article No: 13

2006-01 Accident Reporting

1. **Establishing an internal accident reporting system in the premises**
   Article No: 09
   Article No: 11
   Article No: 12
2. **Reporting of occupational accidents or illnesses to Ministry of Labour**
   Article No: 03
   Article No: 04
   Article No: 05
   Article No: 10

APPENDIX D

AWM SURVEY RESULTS AND SAMPLE CALCULATIONS

Appendix D - AWM Survey results and sample Calculations

Table D-1: Mean Impact and Relative Weights for Sub-Factors

ID	Main Factor / Sub Factor							
1	**1976-07 First Aid Box**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Providing suitable first aid boxes	23	32	8	6	1	3.0000	0.5109
2	First Aid training	27	17	17	8	1	2.8714	0.4891
		Total					**5.8714**	**1.0000**
2	**1977-12 Construction Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Adequate erection and prober using of scaffolds	28	23	9	3	7	2.8857	0.0557
2	Adequate fixing and using of ladders	24	28	8	5	5	2.8714	0.0554
3	Adequate handling and moving of heavy objects	21	28	18	2	1	2.9429	0.0568
4	Adequate housekeeping in construction sites	12	39	18	0	1	2.8714	0.0554
5	Adequate using and handling of mechanical vehicles	16	38	14	1	1	2.9571	0.0570
6	Confined spaces safety precautions	29	17	13	4	7	2.8143	0.0543
7	Safety measures while working with paints containing lead	22	26	10	4	6	2.7941	0.0539
8	Protection measures against electric shocks	31	23	14	1	1	3.1714	0.0612
9	Fire safety precautions for welding and hot cutting jobs	20	38	10	1	1	3.0714	0.0592
10	Cartridge tools (Guns) safety measures	19	27	10	4	9	2.6232	0.0506
11	Precautions against collapsing hazards of any objects or buildings	21	27	12	4	6	2.7571	0.0532
12	Proper site ventilation to reduce the risk of suffocation	22	28	12	6	2	2.8857	0.0557
13	Protection while working near water	16	27	15	2	10	2.5286	0.0488
14	Providing sufficient lighting for construction site	19	28	19	2	2	2.8571	0.0551
15	Providing suitable PPE	27	25	14	2	2	3.0429	0.0587
16	Safe access to and egress from construction sites	24	30	13	1	2	3.0429	0.0587
17	Safety precautions for demolitions works	17	28	15	1	8	2.6522	0.0512
18	Taking necessary precautions for working at height	32	23	8	2	5	3.0714	0.0592
		Total					**51.8409**	**1.0000**

ID	Main Factor / Sub Factor							
3	**1977-13 Grinding Wheels Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Prober assembly of grinding machines with all necessary elements and controls	17	40	9	3	1	2.9857	0.1694
2	Competent operator	27	29	9	4	1	3.1000	0.1759
3	Proper using of grinding and appraising wheels	21	32	11	5	1	2.9571	0.1677
4	Providing grinding machines with adequate guarding	25	30	11	2	2	3.0571	0.1734
5	Safety awareness signs	21	27	15	5	2	2.8571	0.1621
6	Suitable storage for grinding wheels	11	36	14	7	2	2.6714	0.1515
		Total					**17.6286**	**1.0000**
4	**1977-14 Lifting Equipment Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Prober erection of lifting equipment with all necessary elements	28	29	9	2	2	3.1286	0.2013
2	Prober using of lifting equipment/working safe load	31	26	7	5	1	3.1571	0.2031
3	Competent operator	31	29	7	2	1	3.2429	0.2086
4	Periodical examinations by authorized agencies	33	22	12	2	1	3.2000	0.2059
5	Providing suitable operators cabin	18	31	13	6	2	2.8143	0.1811
		Total					**15.5429**	**1.0000**
5	**1977-15 Dangerous Machines Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Duties of designers, manufacturers, importers and exporters of dangerous machines	17	34	11	4	4	2.8000	0.3151
2	Providing adequate guarding	25	32	9	1	3	3.0714	0.3457
3	Safe operating of dangerous machines	27	25	12	4	2	3.0143	0.3392
		Total					**8.8857**	**1.0000**
6	**1977-25 Workplace Arrangements**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Adequate housekeeping in workplace	19	32	16	3	0	2.9571	0.4848
2	Taking necessary measures to protect workers from falling hazards	25	34	8	2	1	3.1429	0.5152
		Total					**6.1000**	**1.0000**
7	**1977-26 Eye Protection**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Providing suitable guarding for hazardous operations	25	35	8	1	1	3.1714	0.5000
2	Providing suitable PPE	32	23	11	3	1	3.1714	0.5000
		Total					**6.3429**	**1.0000**

ID	Main Factor / Sub Factor							
8	**1977-27 Woodworking Machines Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Competent operator	24	25	14	2	5	2.8714	0.1743
2	Control of noise	7	35	16	7	5	2.4571	0.1492
3	Proper assembly of woodworking machines with all necessary elements and controls	15	32	15	3	5	2.7000	0.1639
4	Proper using of woodworking machines	20	29	14	1	6	2.8000	0.1700
5	Providing sufficient lighting	22	25	15	2	6	2.7857	0.1691
6	Providing suitable guarding for woodworking machines	26	24	11	2	7	2.8571	0.1735
		Total					**16.4714**	**1.0000**
9	**1977-31 Flammable Material Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Prohibition of smoking	39	18	8	3	2	3.2714	0.3438
2	Providing adequate firefighting equipment for emergency	39	16	12	1	2	3.2714	0.3438
3	Safe handling and storage of highly flammable materials	25	26	15	0	4	2.9714	0.3123
		Total					**9.5143**	**1.0000**
10	**1977-32 High Pressure Equipment Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Adequate assembly of high pressure equipment	28	21	8	1	12	2.7429	0.3363
2	Confined spaces safety precautions	30	16	12	0	12	2.7429	0.3363
3	Periodical examinations	22	25	11	2	10	2.6714	0.3275
		Total					**8.1571**	**1.0000**
11	**1977-33 Electrical Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Hiring competent electricians	18	34	14	3	1	2.9286	0.1645
2	Providing adequate and suitable means of protection and devices	22	32	13	2	1	3.0286	0.1701
3	Providing necessary instructions for emergency response	20	29	12	7	2	2.8286	0.1589
4	Safe and organized design of controlling boards and sub-stations	17	33	16	1	3	2.8571	0.1605
5	Safety precautions for using portable electrical devices	22	31	15	1	1	3.0286	0.1701
6	Sufficient insulation of electrical conductors	26	32	9	1	2	3.1286	0.1758
		Total					**17.8000**	**1.0000**
12	**1977-34 Confined Spaces Precautions**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Safety precautions for hot jobs in a confined space	32	12	13	3	10	2.7571	0.4980
2	Safety precautions for working in a confined space	29	16	11	3	9	2.7794	0.5020
		Total					**5.5366**	**1.0000**

ID	Main Factor / Sub Factor							
13	**1978-03 Health Precautions**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Providing adequate noise reduction PPE for workers in noisy areas	13	41	12	4		2.9000	0.1740
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	13	30	22	4	1	2.7143	0.1628
3	Welfare facilities in workplace (dining rooms/bathrooms)	17	25	16	11	1	2.6571	0.1594
4	Providing healthy drinking water	20	25	21	4		2.8714	0.1722
5	Providing suitable means of setting	16	27	22	5		2.7714	0.1662
6	Providing workers with adequate clothes	18	26	19	5	2	2.7571	0.1654
		Total					**16.6714**	**1.0000**
14	**2000-06 Safety Management**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Commitment of Employers (Managers) to safety	29	21	15	4	1	3.0429	0.1342
2	Establishing of safety committee with sufficient duties and powers	19	28	17	6		2.8571	0.1260
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	10	29	23	7	1	2.5714	0.1134
4	Notification of contracting jobs to Ministry of Labour	14	23	26	3	3	2.6087	0.1150
5	Providing of adequate PPE	21	26	19	2	2	2.8857	0.1272
6	Employment of competent safety officers with sufficient duties and powers	18	34	14	3	1	2.9286	0.1291
7	Providing workers with necessary safety training	17	34	15	4		2.9143	0.1285
8	Commitment of workers to safety	18	27	21	3		2.8696	0.1265
		Total					**22.6783**	**1.0000**
15	**2001-03 Health Surveillance**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Carrying out suitable health surveillances	11	24	26	8	1	2.5143	0.3206
2	Removing any workers suffering an occupational disease from the source of that disease	14	29	20	3	4	2.6571	0.3388
3	Workers duty to notify the employer of any occupational illness suffered	14	31	14	10	1	2.6714	0.3406
		Total					**7.8429**	**1.0000**

ID	Main Factor / Sub Factor							
16	**2005-12 Fire Safety**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Carrying out fire risk assessment	31	23	14	1	1	3.1714	0.1502
2	Emergency plan	25	27	14	3	1	3.0286	0.1434
3	Firefighting training	22	26	19	2	1	2.9429	0.1394
4	Obtaining fire certificate form competent authority	20	22	14	11	3	2.6429	0.1252
5	Providing and maintaining adequate firefighting equipment	25	33	8	3	1	3.1143	0.1475
6	Providing safe and adequate emergency exists	25	32	12	0	1	3.1429	0.1488
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	22	33	14	0	1	3.0714	0.1455
		Total					**21.1143**	**1.0000**
17	**2006-01 Accident Reporting**	**Very High**	**High**	**Mode**	**Low**	**No Impact**	**Mean Impact**	**SF**
1	Establishing an internal accident reporting system in the premises	22	30	14	1	2	3.0000	0.5085
2	Reporting of occupational accidents or illnesses to Ministry of Labour	20	32	12	3	3	2.9000	0.4915
		Total					**5.9000**	**1.0000**

Table D-2: Mean Impacts and Relative Weights for Main Factors

	ID	Ministerial Order (Main Factor)	Sum	No. of sub factors	Mean Impact	MF
1	1976-07	First Aid Box	5.8714	2	2.9357	0.0592
2	1977-12	Construction Safety	51.8409	18	2.8801	0.0581
3	1977-13	Grinding Wheels Safety	17.6286	6	2.9381	0.0592
4	1977-14	Lifting Equipment Safety	15.5429	5	3.1086	0.0627
5	1977-15	Dangerous Machines Safety	8.8857	3	2.9619	0.0597
6	1977-25	Workplace Arrangements	6.1000	2	3.0500	0.0615
7	1977-26	Eye Protection	6.3429	2	3.1714	0.0639
8	1977-27	Woodworking Machines Safety	16.4714	6	2.7452	0.0553
9	1977-31	Flammable Material Safety	9.5143	3	3.1714	0.0639
10	1977-32	High Pressure Equipment Safety	8.1571	3	2.7190	0.0548
11	1977-33	Electrical Safety	17.8000	6	2.9667	0.0598
12	1977-34	Confined Spaces Precautions	5.5366	2	2.7683	0.0558
13	1978-03	Health Precautions	16.6714	6	2.7786	0.0560
14	2000-06	Safety Management	22.6783	8	2.8348	0.0571
15	2001-03	Health Surveillance	7.8429	3	2.6143	0.0527
16	2005-12	Fire Safety	21.1143	7	3.0163	0.0608
17	2006-01	Accident Reporting	5.9000	2	2.9500	0.0595
Total					**49.6104**	**1.0000**

Applying Equation (3) to find the mean impact for the main factor 1

$$MIMF_1 = \frac{3.0000+2.8714}{2} = 2.9357$$

Applying Equation (4) to find the relative weight for the main factor 1

$$MF_1 = \frac{2.9357}{49.6104} = 0.0592$$

APPENDIX E

PART OF AHP OSH EXPERTS QUESTIONNAIRE

OSH Performance Measurement AHP Experts Questionnaire - PART II

The Ministerial Order No. 1977-14 The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment

What is the degree of importance of:											Compared to:
D.01 Prober erection of lifting equipments with all necessary elements	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.02 Prober using of lifting equipments/working safe load
D.01 Prober erection of lifting equipments with all necessary elements	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.03 Competent operator
D.01 Prober erection of lifting equipments with all necessary elements	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.04 Periodical examinations by authorized agencies
D.01 Prober erection of lifting equipments with all necessary elements	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.06 Providing suitable operators cabin
D.02 Prober using of lifting equipments/working safe load	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.01 Prober erection of lifting equipments with all necessary elements
D.02 Prober using of lifting equipments/working safe load	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.03 Competent operator
D.02 Prober using of lifting equipments/working safe load	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.04 Periodical examinations by authorized agencies
D.02 Prober using of lifting equipments/working safe load	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.06 Providing suitable operators cabin
D.03 Competent operator	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.01 Prober erection of lifting equipments with all necessary elements
D.03 Competent operator	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.02 Prober using of lifting equipments/working safe load
D.03 Competent operator	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.04 Periodical examinations by authorized agencies
D.03 Competent operator	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.06 Providing suitable operators cabin
D.04 Periodical examinations by authorized agencies	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.01 Prober erection of lifting equipments with all necessary elements
D.04 Periodical examinations by authorized agencies	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.02 Prober using of lifting equipments/working safe load
D.04 Periodical examinations by authorized agencies	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.03 Competent operator
D.04 Periodical examinations by authorized agencies	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.06 Providing suitable operators cabin
D.06 Providing suitable operators cabin	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.01 Prober erection of lifting equipments with all necessary elements
D.06 Providing suitable operators cabin	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.02 Prober using of lifting equipments/working safe load
D.06 Providing suitable operators cabin	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.03 Competent operator
D.06 Providing suitable operators cabin	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1		D.04 Periodical examinations by authorized agencies

Numeric Values Indications:

9- Absolutly more important. 8- Very strongly to absolutely more important. 7- Very strongly more important. 6- Strongly to very strongly important.
5- Strongly more imporntat. 4- Weakly to strongly more importnat. 3- Weakly more important. 2- Equal to weakly important. 1- Equal importance.

OSH Performance Measurement AHP Experts Questionnaire - PART II

The Ministerial Order No. 1977-15 The organization of services and precautionary measures necessary for the protection of workers during work from the hazards of dangerous machinery

What is the degree of importance of:										Compared to:
E.01 Duties of designers, manufacturers, importers and exporters of dangerous machines	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	E.02 Providing adequate guarding
E.01 Duties of designers, manufacturers, importers and exporters of dangerous machines	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	E.03 Safe operating of dangerous machines
E.02 Providing adequate guarding	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	E.01 Duties of designers, manufacturers, importers and exporters of dangerous machines
E.02 Providing adequate guarding	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	E.03 Safe operating of dangerous machines
E.03 Safe operating of dangerous machines	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	E.01 Duties of designers, manufacturers, importers and exporters of dangerous machines
E.03 Safe operating of dangerous machines	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	E.02 Providing adequate guarding

Numeric Values Indications:

9- Absolutly more important. 8- Very strongly to absolutely more important. 7- Very strongly more important. 6- Strongly to very strongly important.
5- Strongly more imporntat. 4- Weakly to strongly more importnat. 3- Weakly more important. 2- Equal to weakly important. 1- Equal importance.

OSH Performance Measurement AHP Experts Questionnaire - PART II

The Ministerial Order No. 1977-25 The organization of services and precautionary measures necessary for the protection of workers in workplace

What is the degree of importance of:										Compared to:
F.01 Adequate housekeeping in workplace	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	F.02 Taking necessary measures to protect workers from falling hazards
F.02 Taking necessary measures to protect workers from falling hazards	☐ 9	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	F.01 Adequate housekeeping in workplace

Numeric Values Indications:

9- Absolutly more important. 8- Very strongly to absolutely more important. 7- Very strongly more important. 6- Strongly to very strongly important.
5- Strongly more imporntat. 4- Weakly to strongly more importnat. 3- Weakly more important. 2- Equal to weakly important. 1- Equal importance.

APPENDIX F

AHP COMPARISION MATRICIES

Minsterial Orders AHP Comparison Matrix

A	**1976-07**	1.0000	0.1250	0.1429	0.1250	0.1111	0.1667	0.3333	0.2500	0.1111	0.1429	0.2000	0.2000	0.1250	0.3333	0.1429	0.1250	0.5000
B	**1977-12**	8.0000	1.0000	3.5000	0.2000	0.6000	2.0000	3.5000	2.5000	0.6667	1.2500	2.3333	3.0000	2.0000	0.7500	0.8333	1.0000	7.0000
C	**1977-13**	7.0000	0.2857	1.0000	0.3333	0.2500	0.6000	3.0000	2.0000	0.1429	0.1667	0.3333	0.5000	0.1429	0.1429	0.3333	0.3333	1.0000
D	**1977-14**	8.0000	5.0000	3.0000	1.0000	1.3333	2.0000	3.0000	2.0000	0.3750	1.0000	1.0000	0.4000	1.0000	0.3750	0.4000	0.3333	1.0000
E	**1977-15**	9.0000	1.6667	4.0000	0.7500	1.0000	3.5000	2.5000	4.0000	0.5714	1.0000	1.5000	2.5000	1.3333	0.5714	1.0000	0.8000	2.6667
F	**1977-25**	6.0000	0.5000	1.6667	0.5000	0.2857	1.0000	1.3333	0.6667	0.1250	0.2500	0.4286	0.3333	3.0000	0.1250	0.2857	0.1250	1.5000
G	**1977-26**	3.0000	0.2857	0.3333	0.3333	0.4000	0.7500	1.0000	0.2000	0.2857	0.1111	0.3750	0.1667	0.6667	0.2857	0.2500	0.1111	2.0000
H	**1977-27**	4.0000	0.4000	0.5000	0.5000	0.2500	1.5000	5.0000	1.0000	0.2500	0.2500	0.7500	0.1429	1.0000	0.2857	0.2857	0.6667	2.0000
I	**1977-31**	9.0000	1.5000	7.0000	2.6667	1.7500	8.0000	3.5000	4.0000	1.0000	1.0000	1.6667	1.3333	2.0000	0.8000	1.3333	2.0000	7.0000
J	**1977-32**	7.0000	0.8000	6.0000	1.0000	1.0000	4.0000	9.0000	4.0000	1.0000	1.0000	1.5000	2.0000	4.0000	0.4000	1.6667	1.0000	6.0000
K	**1977-33**	5.0000	0.4286	3.0000	1.0000	0.6667	2.3333	2.6667	1.3333	0.6000	0.6667	1.0000	0.6000	2.5000	0.6000	0.7500	0.2500	2.5000
L	**1977-34**	5.0000	0.3333	2.0000	2.5000	0.4000	3.0000	6.0000	7.0000	0.7500	0.5000	1.6667	1.0000	8.0000	0.5000	2.6667	1.0000	4.0000
M	**1978-03**	8.0000	0.5000	7.0000	1.0000	0.7500	0.3333	1.5000	1.0000	0.5000	0.2500	0.4000	0.1250	1.0000	0.2500	0.4000	0.2857	1.6667
N	**2000-06**	3.0000	1.3333	7.0000	2.6667	1.7500	8.0000	3.5000	3.5000	1.2500	2.5000	1.6667	2.0000	4.0000	1.0000	2.0000	1.5000	4.5000
O	**2001-03**	7.0000	1.2000	3.0000	2.5000	1.0000	3.5000	4.0000	3.5000	0.7500	0.6000	1.3333	0.3750	2.5000	0.5000	1.0000	0.5000	8.0000
P	**2005-12**	8.0000	1.0000	3.0000	3.0000	1.2500	8.0000	9.0000	1.5000	0.5000	1.0000	4.0000	1.0000	3.5000	0.6667	2.0000	1.0000	2.6667
Q	**2006-01**	2.0000	0.1429	1.0000	1.0000	0.3750	0.6667	0.5000	0.5000	0.1429	0.1667	0.4000	0.2500	0.6000	0.2222	0.1250	0.3750	1.0000

A.The Ministerial Order No. 1976-07: The contents of the first aid box

1	Providing suitable first aid boxes	1.0000	0.5000
2	First Aid training	2.0000	1.0000

B. The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding

1	Adequate erection and prober using of scaffolds	1.0000	1.6667	1.3333	2.5000	1.5000	0.8000	2.3333	1.2500	1.0000	1.3333	0.7500	0.6000	1.3333	1.0000	0.6667	0.6667	0.2500	0.2500
2	Adequate fixing and using of ladders	0.6000	1.0000	1.5000	2.0000	2.0000	0.6000	1.3333	1.0000	1.0000	1.6667	1.0000	0.6000	1.3333	1.3333	1.0000	1.0000	0.5000	0.5000
3	Adequate handling and moving of heavy objects	0.7500	0.6667	1.0000	0.7500	0.7500	0.4000	1.0000	0.5000	1.0000	1.5000	0.6000	0.5000	0.7500	0.2500	1.5000	0.5000	0.2500	0.4000
4	Adequate housekeeping in construction sites	0.4000	0.5000	1.3333	1.0000	0.7500	0.6000	1.0000	0.4286	0.6000	1.0000	0.5000	0.6000	0.7500	0.7500	3.0000	0.5000	0.5000	0.2000
5	Adequate using and handling of mechanical vehicles	0.6667	0.5000	1.3333	1.3333	1.0000	0.6667	0.6667	0.4000	1.0000	2.0000	1.5000	0.5000	0.5000	0.7500	1.5000	0.5000	0.5000	0.3333
6	Confined spaces safety precautions	1.2500	1.6667	2.5000	1.6667	1.5000	1.0000	1.3333	0.7500	1.0000	1.5000	0.6667	1.3333	1.2500	2.0000	2.6667	0.6667	0.6667	0.2500
7	Safety measures while working with paints containing lead	0.4286	0.7500	1.0000	1.0000	1.5000	0.7500	1.0000	0.2000	0.7500	1.0000	1.0000	0.5000	1.0000	1.0000	0.6667	1.0000	0.6667	0.2000
8	Protection measures against electric shocks	0.8000	1.0000	2.0000	2.3333	2.5000	1.3333	5.0000	1.0000	1.0000	1.5000	1.0000	1.0000	1.3333	1.5000	0.6667	1.0000	1.0000	1.0000
9	Fire safety precautions for welding and hot cutting jobs	1.0000	1.0000	1.0000	1.6667	1.0000	1.0000	1.3333	1.0000	1.0000	3.0000	1.5000	1.3333	1.3333	1.5000	1.3333	0.6667	0.6667	0.6667
10	Cartridge tools (Guns) safety measures	0.7500	0.6000	0.6667	1.0000	0.5000	0.6667	1.0000	0.6667	0.3333	1.0000	0.3333	0.4000	0.5000	1.0000	0.6667	1.0000	1.0000	0.2500
11	Precautions against collapsing hazards of any objects or buildings	1.3333	1.0000	1.6667	2.0000	0.6667	1.5000	1.0000	1.0000	0.6667	3.0000	1.0000	1.5000	1.3333	1.0000	1.3333	0.6667	0.5000	0.2500
12	Proper site ventilation to reduce the risk of suffocation	1.6667	1.6667	2.0000	1.6667	2.0000	0.7500	2.0000	1.0000	0.7500	2.5000	0.6667	1.0000	3.0000	1.6667	0.6667	1.6667	1.6667	1.2500
13	Protection while working near water	0.7500	0.7500	1.3333	1.3333	2.0000	0.8000	1.0000	0.7500	0.7500	2.0000	0.7500	0.3333	1.0000	1.0000	0.6667	0.5000	0.5000	0.2500
14	Providing sufficient lighting for construction site	1.0000	0.7500	4.0000	1.3333	1.3333	0.5000	1.0000	0.6667	0.6667	1.0000	1.0000	0.6000	1.0000	1.0000	1.0000	1.0000	1.0000	0.5000
15	Providing suitable PPE	1.5000	1.0000	0.6667	0.3333	0.6667	0.3750	1.5000	1.5000	0.7500	1.5000	0.7500	1.5000	1.5000	1.0000	1.0000	1.0000	1.0000	1.0000
16	Safe access to and egress from construction sites	1.5000	1.0000	2.0000	2.0000	2.0000	1.5000	1.0000	1.0000	1.5000	1.0000	1.5000	0.6000	2.0000	1.0000	1.0000	1.0000	0.5000	0.5000
17	Safety precautions for demolitions works	4.0000	2.0000	4.0000	2.0000	2.0000	1.5000	1.5000	1.0000	1.5000	1.0000	2.0000	0.6000	2.0000	1.0000	1.0000	2.0000	1.0000	0.5000
18	Taking necessary precautions for working at height	4.0000	2.0000	2.5000	5.0000	3.0000	4.0000	5.0000	1.0000	1.5000	4.0000	4.0000	0.8000	4.0000	2.0000	1.0000	2.0000	2.0000	1.0000

C. The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations

1	Prober assembly of grinding machines with all necessary elements and controls	1.0000	1.3333	1.0000	0.7500	1.0000	1.3333
2	Competent operator	0.7500	1.0000	1.0000	1.0000	2.3333	1.3333
3	Proper using of grinding and appraising wheels	1.0000	1.0000	1.0000	1.3333	2.6667	1.3333
4	Providing grinding machines with adequate guarding	1.3333	1.0000	0.7500	1.0000	1.3333	1.3333
5	Safety awareness signs	1.0000	0.4286	0.3750	0.7500	1.0000	1.0000
6	Suitable storage for grinding wheels	0.7500	0.7500	0.7500	0.7500	1.0000	1.0000

D. The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment

1	Prober erection of lifting equipments with all necessary elements	1.0000	1.0000	1.0000	1.3333	2.0000
2	Prober using of lifting equipments/working safe load	1.0000	1.0000	1.3333	2.0000	4.0000
3	Competent operator	1.0000	0.7500	1.0000	1.0000	1.6667
4	Periodical examinations by authorized agencies	0.7500	0.5000	1.0000	1.0000	1.0000
5	Providing suitable operators cabin	0.5000	0.2500	0.6000	1.0000	1.0000

E. The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers from the hazardous of dangerous machines

1	Duties of designers, manufacturers, importers and exporters of dangerous machines	1.0000	0.7500	1.3333
2	Providing adequate guarding	1.3333	1.0000	1.0000
3	Safe operating of dangerous machines	0.7500	1.0000	1.0000

F. The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace

1	Adequate housekeeping in workplace	1.0000	0.2500
2	Taking necessary measures to protect workers from falling hazards	4.0000	1.0000

G. The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines

1	Providing suitable guarding for hazardous operations	1.0000	2.6667
2	Providing suitable PPE	0.3750	1.0000

H. The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery

1	Competent operator	1.0000	1.5000	0.7500	0.7500	2.0000	1.3333
2	Control of noise	0.6667	1.0000	0.7500	0.7500	1.0000	1.0000
3	Proper assembly of woodworking machines with all necessary elements and controls	1.3333	1.3333	1.0000	0.7500	1.3333	0.7500
4	Proper using of woodworking machines	1.3333	1.3333	1.3333	1.0000	1.3333	0.7500
5	Providing sufficient lighting	0.5000	1.0000	0.7500	0.7500	1.0000	0.7500
6	Providing suitable guarding for woodworking machines	0.7500	1.0000	1.3333	1.3333	1.3333	1.0000

I. The Ministerial Order No. 1977-31: The protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases

1	Prohibition of smoking	1.0000	1.0000	0.5000
2	Providing adequate fire fighting equipment for emergency	1.0000	1.0000	0.6000
3	Safe handling and storage of highly flammable materials	2.0000	1.6667	1.0000

J. The Ministerial Order No. 1977-32: The protection of workers from the hazards of steam boilers, steam containers and receivers

1	Adequate assembly of high pressure equipments	1.0000	0.7500	1.5000
2	Confined spaces safety precautions	1.3333	1.0000	1.5000
3	Periodical examinations	0.6667	0.6667	1.0000

K. The Ministerial Order No. 1977-33: The protection of workers from the hazards of electricity

1	Hiring competent electricians	1.0000	1.3333	1.3333	1.3333	1.3333	1.3333
2	Providing adequate and suitable means of protection and devices	0.7500	1.0000	1.3333	1.0000	1.0000	1.0000
3	Providing necessary instructions for emergency response	0.7500	0.7500	1.0000	0.7500	0.7500	0.7500
4	Safe and organized design of controlling boards and sub-stations	0.7500	1.0000	1.3333	1.0000	1.0000	0.7500
5	Safety precautions for using portable electrical devices	0.7500	1.0000	1.3333	1.0000	1.0000	1.0000
6	Sufficient insulation of electrical conductors	0.7500	1.0000	1.3333	1.3333	1.0000	1.0000

L. The Ministerial Order No. 1977-34: The protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces

1	Safety precautions for hot jobs in a confined space	1.0000	1.3333
2	Safety precautions for working in a confined space	0.7500	1.0000

M. The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work

1	Providing adequate noise reduction PPE for workers in noisy areas	1.0000	2.0000	1.3333	0.5000	2.0000	2.0000
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	0.5000	1.0000	1.5000	1.0000	3.0000	1.5000
3	Welfare facilities in workplace (dining rooms/bathrooms)	0.7500	0.6667	1.0000	1.0000	1.3333	1.5000
4	Providing healthy drinking water	2.0000	1.0000	1.0000	1.0000	1.5000	3.0000
5	Providing suitable means of setting	0.5000	0.3333	0.7500	0.6667	1.0000	1.0000
6	Providing workers with adequate clothes	0.5000	0.6667	0.6667	0.3333	1.0000	1.0000

N. The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment

1	Commitment of Employers (Managers) to safety	1.0000	3.0000	1.3333	1.5000	3.0000	1.0000	1.3333	1.3333
2	Establishing of safety committee with sufficient duties and powers	0.3333	1.0000	1.0000	4.0000	2.5000	1.3333	1.3333	0.7500
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	0.7500	1.0000	1.0000	1.5000	1.3333	0.7500	0.6000	0.6000
4	Notification of contracting jobs to Ministry of Labour	0.6667	0.2500	0.6667	1.0000	0.3333	1.0000	0.2500	0.6667
5	Providing of adequate PPE	0.3333	0.4000	0.7500	3.0000	1.0000	0.6667	0.7500	1.0000
6	Employment of competent safety officers with sufficient duties and powers	1.0000	0.7500	1.3333	1.0000	1.5000	1.0000	1.0000	0.6667
7	Providing workers with necessary safety training	0.7500	0.7500	1.6667	4.0000	1.3333	1.0000	1.0000	1.3333
8	Commitment of workers to safety	0.7500	1.3333	1.6667	1.5000	1.0000	1.5000	0.7500	1.0000

O. The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases

1	Carrying out suitable health surveillances	1.0000	0.4286	0.5000
2	Removing any workers suffering an occupational disease from the source of that disease	2.3333	1.0000	2.3333
3	Workers duty to notify the employer of any occupational illness suffered	2.0000	0.4286	1.0000

P. The Ministerial Order No. 2005-12: Protection of workers during work from the hazards of fire in establishments

1	Carrying out fire risk assessment	1.0000	1.3333	1.0000	1.3333	1.0000	1.6667	1.0000
2	Emergency plan	0.7500	1.0000	0.7500	0.7500	0.7500	0.7500	0.6000
3	Fire fighting training	1.0000	1.3333	1.0000	1.3333	0.7500	2.0000	0.7500
4	Obtaining fire certificate from competent authority	0.7500	1.3333	0.7500	1.0000	0.7500	2.0000	0.7500
5	Providing and maintaining adequate fire fightingequipments	1.0000	1.3333	1.3333	1.3333	1.0000	1.6667	0.7500
6	Providing safe and adequate emergency exists	0.6000	1.3333	0.5000	0.5000	0.6000	1.0000	0.7500
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	1.0000	1.6667	1.3333	1.3333	1.3333	1.3333	1.0000

Q. The Ministerial Order No. 2006-01: Procedures required for reporting occupational injuries and diseases

1	Establishing an internal accident reporting system in the premises	1.0000	1.3333
2	Reporting of occupational accidents or illnesses to Ministry of Labour	0.7500	1.0000

APPENDIX G

RELATIVE WEIGHTS FOUND BY ALL MODELS

RELATIVE WEIGHTS FOUND BY ALL MODELS

	Minsterial Order / Sub-Factors	AHP Weight	Average Weights	Combined Average
A	**The Ministerial Order No. 1976-07: The contents of the first aid box**	**0.0101**	**0.0592**	**0.0346**
1	Providing suitable first aid boxes	0.3333	0.5109	**0.4221**
2	First Aid training	0.6667	0.4891	**0.5779**
B	**The Ministerial Order No. 1977-12: The organization of precautionary measures necessary for the protection of workers engaged in construction, civil engineering and shipbuilding**	**0.0779**	**0.0581**	**0.0680**
1	Adequate erection and prober using of scaffolds	0.0503	0.0557	**0.0530**
2	Adequate fixing and using of ladders	0.0511	0.0554	**0.0532**
3	Adequate handling and moving of heavy objects	0.0339	0.0568	**0.0453**
4	Adequate housekeeping in construction sites	0.0369	0.0554	**0.0461**
5	Adequate using and handling of mechanical vehicles	0.0399	0.0570	**0.0485**
6	Confined spaces safety precautions	0.0606	0.0543	**0.0574**
7	Safety measures while working with paints containing lead	0.0371	0.0539	**0.0455**
8	Protection measures against electric shocks	0.0688	0.0612	**0.0650**
9	Fire safety precautions for welding and hot cutting jobs	0.0581	0.0592	**0.0587**
10	Cartridge tools (Guns) safety measures	0.0332	0.0506	**0.0419**
11	Precautions against collapsing hazards of any objects or buildings	0.0545	0.0532	**0.0538**
12	Proper site ventilation to reduce the risk of suffocation	0.0735	0.0557	**0.0646**
13	Protection while working near water	0.0407	0.0488	**0.0448**
14	Providing sufficient lighting for construction site	0.0490	0.0551	**0.0521**
15	Providing suitable PPE	0.0536	0.0587	**0.0561**
16	Safe access to and egress from construction sites	0.0585	0.0587	**0.0586**
17	Safety precautions for demolitions works	0.0782	0.0512	**0.0647**
18	Taking necessary precautions for working at height	0.1223	0.0592	**0.0908**
C	**The Ministerial Order No. 1977-13: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**	**0.0249**	**0.0592**	**0.0421**
1	Prober assembly of grinding machines with all necessary elements and controls	0.1736	0.1694	**0.1715**
2	Competent operator	0.1877	0.1759	**0.1818**
3	Proper using of grinding and appraising wheels	0.2107	0.1677	**0.1892**
4	Providing grinding machines with adequate guarding	0.1779	0.1734	**0.1757**
5	Safety awareness signs	0.1173	0.1621	**0.1397**
6	Suitable storage for grinding wheels	0.1327	0.1515	**0.1421**
D	**The Ministerial Order No. 1977-14: The organization of precautionary measures necessary for the protection of workers from the hazardous of work on lifting equipment**	**0.0634**	**0.0627**	**0.0630**
1	Prober erection of lifting equipments with all necessary elements	0.2282	0.2013	**0.2148**
2	Prober using of lifting equipments/working safe load	0.3042	0.2031	**0.2536**
3	Competent operator	0.1965	0.2086	**0.2026**
4	Periodical examinations by authorized agencies	0.1567	0.2059	**0.1813**
5	Providing suitable operators cabin	0.1144	0.1811	**0.1477**
E	**The Ministerial Order No. 1977-15: The organization of precautionary measures necessary for the protection of workers from the hazardous of grinding wheel operations**	**0.0743**	**0.0597**	**0.0670**
1	Duties of designers, manufacturers, importers and exporters of dangerous machines	0.3324	0.3151	**0.3237**
2	Providing adequate guarding	0.3654	0.3457	**0.3555**
3	Safe operating of dangerous machines	0.3023	0.3392	**0.3208**
F	**The Ministerial Order No. 1977-25: The organization of services and precautionary measures necessary for the protection of workers in workplace**	**0.0269**	**0.0615**	**0.0442**
1	Adequate housekeeping in workplace	0.2000	0.4848	**0.3424**
2	Taking necessary measures to protect workers from falling hazards	0.8000	0.5152	**0.6576**
G	**The Ministerial Order No. 1977-26: The organization of services and precautionary measures necessary for the protection of the eyes of workers from the hazards of work and of the machines**	**0.0190**	**0.0639**	**0.0415**
1	Providing suitable guarding for hazardous operations	0.7273	0.5000	**0.6136**
2	Providing suitable PPE	0.2727	0.5000	**0.3864**
H	**The Ministerial Order No. 1977-27: the organization of services and precautionary measures necessary for the protection of workers from the hazards of woodworking machinery**	**0.0310**	**0.0553**	**0.0432**
1	Competent operator	0.1908	0.1743	**0.1825**
2	Control of noise	0.1384	0.1492	**0.1438**
3	Proper assembly of woodworking machines with all necessary elements and controls	0.1726	0.1639	**0.1683**
4	Proper using of woodworking machines	0.1898	0.1700	**0.1799**
5	Providing sufficient lighting	0.1260	0.1691	**0.1475**
6	Providing suitable guarding for woodworking machines	0.1825	0.1735	**0.1780**
I	**The Ministerial Order No. 1977-31: The protection of workers from the hazards of highly flammable liquids and liquefied petroleum gases**	**0.1059**	**0.0639**	**0.0849**
1	Prohibition of smoking	0.2536	0.3438	**0.2987**
2	Providing adequate fire fighting equipment for emergency	0.2695	0.3438	**0.3067**
3	Safe handling and storage of highly flammable materials	0.4769	0.3123	**0.3946**
J	**The Ministerial Order No. 1977-32: The protection of workers from the hazards of steam boilers, steam containers and receivers**	**0.0910**	**0.0548**	**0.0729**
1	Adequate assembly of high pressure equipments	0.3396	0.3363	**0.3379**
2	Confined spaces safety precautions	0.4111	0.3363	**0.3737**
3	Periodical examinations	0.2494	0.3275	**0.2884**
K	**The Ministerial Order No. 1977-33: The protection of workers from the hazards of electricity**	**0.0486**	**0.0598**	**0.0542**
1	Hiring competent electricians	0.2099	0.1645	**0.1872**

	Minsterial Order / Sub-Factors	AHP Weight	Average Weights	Combined Average
2	Providing adequate and suitable means of protection and devices	0.1646	0.1701	**0.1674**
3	Providing necessary instructions for emergency response	0.1301	0.1589	**0.1445**
4	Safe and organized design of controlling boards and sub-stations	0.1575	0.1605	**0.1590**
5	Safety precautions for using portable electrical devices	0.1646	0.1701	**0.1674**
6	Sufficient insulation of electrical conductors	0.1733	0.1758	**0.1745**
L	**The Ministerial Order No. 1977-34: The protection of workers from the hazards of the repair and demolition of tanks, drums and work in confined spaces**	**0.0870**	**0.0558**	**0.0714**
1	Safety precautions for hot jobs in a confined space	0.5714	0.4980	**0.5347**
2	Safety precautions for working in a confined space	0.4286	0.5020	**0.4653**
M	**The Ministerial Order No. 1978-03: Organization of means of protection against occupational diseases and the necessary health precautions for safeguarding workers during work**	**0.0381**	**0.0560**	**0.0471**
1	Providing adequate noise reduction PPE for workers in noisy areas	0.2119	0.1740	**0.1929**
2	Health measures and services in workplaces (Space/lighting/ventilation ..)	0.1982	0.1628	**0.1805**
3	Welfare facilities in workplace (dining rooms/bathrooms)	0.1547	0.1594	**0.1571**
4	Providing healthy drinking water	0.2320	0.1722	**0.2021**
5	Providing suitable means of setting	0.1040	0.1662	**0.1351**
6	Providing workers with adequate clothes	0.0992	0.1654	**0.1323**
N	**The Ministerial Order No. 2000-06: organization of occupational safety measures in the establishment**	**0.1145**	**0.0571**	**0.0858**
1	Commitment of Employers (Managers) to safety	0.1878	0.1342	**0.1610**
2	Establishing of safety committee with sufficient duties and powers	0.1468	0.1260	**0.1364**
3	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	0.1017	0.1134	**0.1075**
4	Notification of contracting jobs to Ministry of Labour	0.0690	0.1150	**0.0920**
5	Providing of adequate PPE	0.0956	0.1272	**0.1114**
6	Employment of competent safety officers with sufficient duties and powers	0.1182	0.1291	**0.1237**
7	Providing workers with necessary safety training	0.1481	0.1285	**0.1383**
8	Commitment of workers to safety	0.1328	0.1265	**0.1297**
O	**The Ministerial Order No. 2001-03: Periodical medical examination for workers susceptible to infection by vocational diseases**	**0.0723**	**0.0527**	**0.0625**
1	Carrying out suitable health surveillances	0.1829	0.3206	**0.2517**
2	Removing any workers suffering an occupational disease from the source of that disease	0.5282	0.3388	**0.4335**
3	Workers duty to notify the employer of any occupational illness suffered	0.2889	0.3406	**0.3147**
P	**The Ministerial Order No. 2005-12: Protection of workers during work from the hazards of fire in establishments**	**0.0958**	**0.0608**	**0.0783**
1	Carrying out fire risk assessment	0.1618	0.1502	**0.1560**
2	Emergency plan	0.1060	0.1434	**0.1247**
3	Fire fighting training	0.1543	0.1394	**0.1468**
4	Obtaining fire certificate from competent authority	0.1368	0.1252	**0.1310**
5	Providing and maintaining adequate fire fightingequipments	0.1626	0.1475	**0.1551**
6	Providing safe and adequate emergency exists	0.1013	0.1488	**0.1251**
7	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	0.1772	0.1455	**0.1613**
Q	**2006-01: Procedures required for reporting occupational injuries and diseases**	**0.0192**	**0.0595**	**0.0393**
1	Establishing an internal accident reporting system in the premises	0.5714	0.5085	**0.5400**
2	Reporting of occupational accidents or illnesses to Ministry of Labour	0.4286	0.4915	**0.4600**

APPENDIX H

SAMPLE OF EVALUATION FORMS USED IN MODEL VALIDATION

SAFETY PERFORMANCE EVALUATION FORM

Case ID:	3
Sector Description:	Construction
No. of Workers:	258

		Evaluation
1976-07	**First Aid Box**	
A.01	Providing suitable first aid boxes	Yes
A.02	First Aid training	Yes
1977-12	**Construction Safety**	
B.01	Adequate erection and prober using of scaffolds	Yes
B.02	Adequate fixing and using of ladders	Yes
B.03	Adequate handling and moving of heavy objects	Yes
B.04	Adequate housekeeping in construction sites	Yes
B.05	Adequate using and handling of mechanical vehicles	Yes
B.06	Confined spaces safety precautions	Yes
B.07	Safety measures while working with paints containing lead	N/A
B.08	Protection measures against electric shocks	Yes
B.09	Fire safety precautions for welding and hot cutting jobs	Yes
B.10	Cartridge tools (Guns) safety measures	N/A
B.11	Precautions against collapsing hazards of any objects or buildings	Yes
B.12	Proper site ventilation to reduce the risk of suffocation	Yes
B.13	Protection while working near water	N/A
B.14	Providing sufficient lighting for construction site	Yes
B.15	Providing suitable PPE	Yes
B.16	Safe access to and egress from construction sites	Yes
B.17	Safety precautions for demolitions works	Yes
B.18	Taking necessary precautions for working at height	Yes
1977-13	**Grinding Wheels Safety**	
C.01	Prober assembly of grinding machines with all necessary elements and controls	N/A
C.02	Competent operator	N/A
C.03	Proper using of grinding and appraising wheels	N/A
C.04	Providing grinding machines with adequate guarding	N/A
C.07	Safety awareness signs	N/A
C.08	Suitable storage for grinding wheels	N/A
1977-14	**Lifting Equipment Safety**	
D.01	Prober erection of lifting equipments with all necessary elements	Yes
D.02	Prober using of lifting equipments/working safe load	Yes
D.03	Competent operator	No
D.04	Periodical examinations by authorized agencies	Yes
D.06	Providing suitable operators cabin	Yes
1977-15	**Dangerous Machines Safety**	
E.01	Duties of designers, manufacturers, importers and exporters of dangerous machines	N/A
E.02	Providing adequate guarding	N/A
E.03	Safe operating of dangerous machines	N/A
1977-25	**Workplace Arrangments**	
F.01	Adequate housekeeping in workplace	N/A
F.02	Taking necessary measures to protect workers from falling hazards	N/A
1977-26	**Eye Protection**	
G.01	Providing suitable guarding for hazardous operations	N/A
G.02	Providing suitable PPE	N/A

SAFETY PERFORMANCE EVALUATION FORM

1977-27	**Woodworking Machines Safety**	
H.01	Competent operator	No
H.02	Control of noise	No
H.03	Proper assembly of woodworking machines with all necessary elements and controls	Yes
H.04	Proper using of woodworking machines	Yes
H.06	Providing sufficient lighting	Yes
H.07	Providing suitable guarding for woodworking machines	No
1977-31	**Flammable Material Safety**	
I.01	Prohibition of smoking	N/A
I.02	Providing adequate fire fighting equipment for emergency	N/A
I.03	Safe handling and storage of highly flammable materials	N/A
1977-32	**High Pressure Equipment Safety**	
J.01	Adequate assembly of high pressure equipments	N/A
J.02	Confined spaces safety precautions	N/A
J.03	Periodical examinations	N/A
1977-33	**Electrical Safety**	
K.01	Hiring competent electricians	Yes
K.02	Providing adequate and suitable means of protection and devices	Yes
K.03	Providing necessary instructions for emergency response	Yes
K.04	Safe and organized design of controlling boards and sub-stations	Yes
K.07	Safety precautions for using portable electrical devices	Yes
K.08	Sufficient insulation of electrical conductors	Yes
1977-34	**Confined Spaces Precuations**	
L.01	Safety precautions for hot jobs in a confined space	N/A
L.02	Safety precautions for working in a confined space	N/A
1978-03	**Health Precuations**	
M.01	Providing adequate noise reduction PPE for workers in noisy areas	Yes
M.02	Health measures and services in workplaces (Space/lighting/ventilation ..)	Yes
M.03	Welfare facilities in workplace (dining rooms/bathrooms)	Yes
M.04	Providing healthy drinking water	Yes
M.05	Providing suitable means of setting	N/A
M.06	Providing workers with adequate clothes	Yes
2000-06	**Safety Management**	
N.01	Commitment of Employers (Managers) to safety	Yes
N.02	Establishing of safety committee with sufficient duties and powers	Yes
N.03	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	No
N.04	Notification of contracting jobs to Ministry of Labour	No
N.05	Providing of adequate PPE	Yes
N.06	Employment of competent safety officers with sufficient duties and powers	Yes
N.07	Providing workers with necessary safety training	No
N.09	Commitment of workers to safety	Yes
2001-03	**Health Surveillance**	
O.01	Carrying out suitable health surveillances	No
O.02	Removing any workers suffering an occupational disease from the source of that disease	No
O.03	Workers duty to notify the employer of any occupational illness suffered	No
2005-12	**Fire Safety**	
P.01	Carrying out fire risk assessment	N/A
P.02	Emergency plan	N/A
P.03	Fire fighting training	N/A
P.05	Obtaining fire certificate form competent authority	N/A
P.07	Providing and maintaining adequate fire fighting equipments	N/A

SAFETY PERFORMANCE EVALUATION FORM

P.08	Providing safe and adequate emergency exists	N/A
P.09	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	N/A

2006-01 Accident Reporting

Q.01	Establishing an internal accident reporting system in the premises	No
Q.02	Reporting of occupational accidents or illnesses to Ministry of Labour	No

Model	Performance Rate	Legal Action Selected
AHP	66.20%	Improvement Notice
AWM	65.52%	Improvement Notice
Combined Av.	65.72%	Improvement Notice

SAFETY PERFORMANCE EVALUATION FORM

Case ID:	14
Sector Description:	Manufacturing
No. of Workers:	137

		Evaluation
1976-07	**First Aid Box**	
A.01	Providing suitable first aid boxes	No
A.02	First Aid training	No
1977-12	**Construction Safety**	
B.01	Adequate erection and prober using of scaffolds	N/A
B.02	Adequate fixing and using of ladders	N/A
B.03	Adequate handling and moving of heavy objects	N/A
B.04	Adequate housekeeping in construction sites	N/A
B.05	Adequate using and handling of mechanical vehicles	N/A
B.06	Confined spaces safety precautions	N/A
B.07	Safety measures while working with paints containing lead	N/A
B.08	Protection measures against electric shocks	N/A
B.09	Fire safety precautions for welding and hot cutting jobs	N/A
B.10	Cartridge tools (Guns) safety measures	N/A
B.11	Precautions against collapsing hazards of any objects or buildings	N/A
B.12	Proper site ventilation to reduce the risk of suffocation	N/A
B.13	Protection while working near water	N/A
B.14	Providing sufficient lighting for construction site	N/A
B.15	Providing suitable PPE	N/A
B.16	Safe access to and egress from construction sites	N/A
B.17	Safety precautions for demolitions works	N/A
B.18	Taking necessary precautions for working at height	N/A
1977-13	**Grinding Wheels Safety**	
C.01	Prober assembly of grinding machines with all necessary elements and controls	N/A
C.02	Competent operator	N/A
C.03	Proper using of grinding and appraising wheels	N/A
C.04	Providing grinding machines with adequate guarding	N/A
C.07	Safety awareness signs	N/A
C.08	Suitable storage for grinding wheels	N/A
1977-14	**Lifting Equipment Safety**	
D.01	Prober erection of lifting equipments with all necessary elements	N/A
D.02	Prober using of lifting equipments/working safe load	N/A
D.03	Competent operator	N/A
D.04	Periodical examinations by authorized agencies	N/A
D.06	Providing suitable operators cabin	N/A
1977-15	**Dangerous Machines Safety**	
E.01	Duties of designers, manufacturers, importers and exporters of dangerous machines	Yes
E.02	Providing adequate guarding	Yes
E.03	Safe operating of dangerous machines	Yes
1977-25	**Workplace Arrangments**	
F.01	Adequate housekeeping in workplace	Yes
F.02	Taking necessary measures to protect workers from falling hazards	No
1977-26	**Eye Protection**	
G.01	Providing suitable guarding for hazardous operations	N/A
G.02	Providing suitable PPE	N/A

SAFETY PERFORMANCE EVALUATION FORM

1977-27	**Woodworking Machines Safety**	
H.01	Competent operator	N/A
H.02	Control of noise	N/A
H.03	Proper assembly of woodworking machines with all necessary elements and controls	N/A
H.04	Proper using of woodworking machines	N/A
H.06	Providing sufficient lighting	N/A
H.07	Providing suitable guarding for woodworking machines	N/A
1977-31	**Flammable Material Safety**	
I.01	Prohibition of smoking	Yes
I.02	Providing adequate fire fighting equipment for emergency	Yes
I.03	Safe handling and storage of highly flammable materials	No
1977-32	**High Pressure Equipment Safety**	
J.01	Adequate assembly of high pressure equipments	N/A
J.02	Confined spaces safety precautions	N/A
J.03	Periodical examinations	N/A
1977-33	**Electrical Safety**	
K.01	Hiring competent electricians	Yes
K.02	Providing adequate and suitable means of protection and devices	Yes
K.03	Providing necessary instructions for emergency response	Yes
K.04	Safe and organized design of controlling boards and sub-stations	Yes
K.07	Safety precautions for using portable electrical devices	Yes
K.08	Sufficient insulation of electrical conductors	No
1977-34	**Confined Spaces Precuations**	
L.01	Safety precautions for hot jobs in a confined space	N/A
L.02	Safety precautions for working in a confined space	N/A
1978-03	**Health Precuations**	
M.01	Providing adequate noise reduction PPE for workers in noisy areas	Yes
M.02	Health measures and services in workplaces (Space/lighting/ventilation ..)	No
M.03	Welfare facilities in workplace (dining rooms/bathrooms)	No
M.04	Providing healthy drinking water	Yes
M.05	Providing suitable means of setting	No
M.06	Providing workers with adequate clothes	No
2000-06	**Safety Management**	
N.01	Commitment of Employers (Managers) to safety	Yes
N.02	Establishing of safety committee with sufficient duties and powers	No
N.03	Inclusion of punitive actions against workers for breaking safety procedures in company penal code	No
N.04	Notification of contracting jobs to Ministry of Labour	No
N.05	Providing of adequate PPE	Yes
N.06	Employment of competent safety officers with sufficient duties and powers	Yes
N.07	Providing workers with necessary safety training	No
N.09	Commitment of workers to safety	Yes
2001-03	**Health Surveillance**	
O.01	Carrying out suitable health surveillances	No
O.02	Removing any workers suffering an occupational disease from the source of that disease	No
O.03	Workers duty to notify the employer of any occupational illness suffered	No
2005-12	**Fire Safety**	
P.01	Carrying out fire risk assessment	No
P.02	Emergency plan	Yes
P.03	Fire fighting training	Yes
P.05	Obtaining fire certificate form competent authority	Yes
P.07	Providing and maintaining adequate fire fighting equipments	Yes

SAFETY PERFORMANCE EVALUATION FORM

P.08	Providing safe and adequate emergency exists	Yes
P.09	Safety measures for working in high risk of fire areas (hot works/near flammable materials)	Yes

2006-01 Accident Reporting

Q.01	Establishing an internal accident reporting system in the premises	Yes
Q.02	Reporting of occupational accidents or illnesses to Ministry of Labour	No

Model	Performance Rate	Legal Action Selected
AHP	56.90%	Improvement Notice
AWM	53.13%	Improvement Notice
Combined Av.	55.07%	Improvement Notice