Number 11 Volume 20 November - 2014 Journal of Engineering

Study on Safety Construction Management Plan

Assist. Prof. Dr. Sawsan Rasheed Mohammad
University of Baghdad / College of Engineering
Civil Engineering Department
Sawsan_2@yahoo.com

Eng. Ahmed M. Rasheed
University of Baghdad / College of Engineering
Civil Engineering Department

ABSTRACT

After studying the reality of application to occupational safety in new Iraqi building projects and sampling the situation wilt that in developed and neighboring countries, researcher found that there is a big gap in the level of safety application conditions, this indicates the need fora quick and clear reference for local engineers to use it on site for safety conditions in their projects . As a case study the monitors work the researcher studied a huge project in the United Arab Emirates.This project considered for safety requirements to highest grades. This case study may be far away from the projects in Iraq, but we hope to rise the Iraqi work level in the near future. After seeing the way of administration work and how they were rated the severity of each phase of the work, an idea was builtabout the most dangerous situations in projects with multiple floorsbuildings. To find multiple solutions to the risk, researchers identified 46 cases with their ratings, type of perceived risk in each case, and displayed a format survey to the most important specialized institutions and companies operating in Iraq and the United Arab Emirates. Finally theresearcher takes the results,and format a software that any user can use in his personal computer to studythe expected risk,how to avoid it and how to deal with it if it happens.

Key Word: construction management safety.

دراسة في خطة ادارة الانشاء والسلامة

سوسن رشيد محمد
استاذ مساعد

احمد محمد رشيد

الخلاصة

بعد دراسة واقع حال مستوى تطبيق السلامة المهنية في مشاريع بناء العراق الجديد ومقارنة ذلك الحال بما هو عليه في البلدان المتطورة والبلدان المجاورة وجدالباحث ان هنالك فجوة كبيرة في مستوى تطبيق شروط السلامة ومن ذلك تكونت الفكرة في ايجاد مرجع سريع وواضح يستطيع المهندسون المحليون الاستعانة به موقعياً لتطبيق شروط السلامة في مشاريعهم , لذلك قام الباحث بدراسة حالة لمشروع ضخم في دولة الامارات العربية المتحدة تم فيه تطبيق شروط السلامة بأعلى الدرجات ونحن نعلم ان الحالة الدراسية قد تكون بعيدة نوعاً ما عن نوع المشاريع المطبقة في العراق ولكننا نأمل ان يرتقي مستوى العمل في العراق الى ذلك الحجم في المستقبل القريب . وبالفعل بعد الاطلاع على طريقة ادارة العمل وكيف تم تصنيف درجة خطورة كل مرحلة من مراحل العمل اصبح لدى الباحث تصور عن اهم الحالات الخطرة في مشاريع البنايات متعددت الطوابق ولكي يكون لدينا حلول متعددة للمخاطر قام الباحث بتحديد 46 حالة مع تصنيفاتها ونوع المخاطر المتوقعة لكل حالة وعرضها بصيغة استبيان شمل اهم المؤسسات المتخصصة والشركات العاملة في العراق ودولة الامارات وخرج الباحث بنتائج تم تبويبها بصيغة برنامج حاسوبي يستطيع اي مستخدم ان يستعمله في حاسوبه الشخصي موقعياً وبمجرد الضغط على مربع اي حالة نستطيع معرفة الخطر المتوقع وكيفية تجنبه وطريقة التعامل معه ان حدث. مع عمل جزء نظري لشرح طريقة التعامل مع البرنامج الحاسوبي.

1. INTRODUCTION

After independence the construction industry has grown significantly. In civil engineering projects many works big or small are executed, for the execution of these works skilled and unskilled labor along with machines and equipment are employed. with the introduction of machines for increasing the output of the work, the number of the accidents also increasing. It is a hard fact where the safety ends, accident start. Any work completed without accidents results economical. Nobody wants to be injured, but it happens so sudden that one cannot help. On the one hand accidents cause injury to the worker and agony to his family and on the hand;they cause mental tension and financial burden to the owner.

Though the social concern of the safety of construction workers and their protection against injury is quite evident since long, but so far no tangible results have been observed. The survey of occupational injury and illness incidence carried out in 1992 shows that up to 14,5% workers suffer from these injuries . thebreakup of occupational injury in different industries is shown in **Table1, Gupta, 2005.**

When management found itself in the problem, by legislation, of having to pay for injures in the job, it was decided that it would be financially better to stop the injuries from happening. This decision by the industry all over the world gave birth to the organized industrial safety movement .Management concentrated heavily, if not entirely, on correcting the hazardous physical conditions that exist in work place in the early years of safety movement. This showed a significant decline in the death rate (deaths per million men –hours worked) during the first 20 years of the safety movement, Petersen**, 1971**, after**Mirza, 2001**.

The interest in safety awareness among construction industry and the whole industry at large has greatly increased in the past decade. This can be attributed to many factors .Recognition of relationship between safety management and the return on investment is one of the factors, **www.arab_eng .org ,2007**.

Up until 1970, there were no codes that required safety of the employees at their worksites in United State **,www.arab_eng .org ,2007.** At that time, the Occupational Safety and Health Administration (OSHA) was formed to establish a safe workplace, which is defined as free of both health hazards and dangerous conditions for all employees. OSHA has since produced the Occupational Safety and Health Standards. The standards are continually updated. Specific standards for the construction industry are classified as 29 (CFR) 1926 code of federal regulations, here in after called the standard all employers are required to implement these standards to ensure that any persons employed by them would be free from any danger while at the workplace. Since1970, the standards have grown to include nearly all worksite activities,**www.arab_eng .org ,2007.**

The 0bjective of this research is to establish a practical and effective program for the prevention of and response to incidents and injuries, and to assign specific responsibilities to contractors and owners and their supervisors in the recognition, evaluation and control of hazardous activities or conditions within their respective areas of contract responsibility.

2. SAFETYDEFINITION

In order to understand safety, it is necessary to consider what is meant by “safety”. Depending on one’s perspective, the concept of aviation safety may have different connotations, such as**Berardinis, 1999**.

zero accidents (or serious incidents), a view widely held by the travelling public; construction works: manufactures work;

the freedom from danger or risks, i.e. those factors which cause or are likely to cause harm;

the attitude towards unsafe acts and conditions by employees (reflecting a “safe” corporate culture);

the degree to which the inherent risks in aviation are *“acceptable”;*

the process of hazard identification and risk management; and the control of accidental loss (of persons and property, and damage to the environment).

Safety is a condition in which the risk of harm or damage is limited to an acceptable level. The safety hazards creating risk may become evident after an obvious breach of safety, such as an accident or incident, or they may be proactively identified through formal safety management programmer before an actual safety event occurs. Having identified a safety hazard, the associated risks must be assessed. With a clear understanding of the nature of the risks, a determination can be made as to the “acceptability” of the risks. Those found to be unacceptable must be acted upon. **Berardinis, 1999**.

Safety management is centered on such a systematic approach to hazard identification and risk management — in the interests of minimizing the loss of human life, property damage, and financial, environmental and societal losses.**Keller, 1998**.

Safety is the state in which the risk of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management. (***Researcher***)

3- Safety Cycle

Safety cycle given the number and a potential relationship of the factors that may affect safety, an effective (SMS safety management system) is required. An example of the type of systematic process required is shown in **Fig.1**,**Abdul-Rahman, 1988.**

Hazard identification is the critical first step in managing safety. Evidence of hazards is required and may be obtained in a number of ways from a variety of sources, for example: **Bush, 1975.**

a) Hazard and incident reporting systems;
b) Investigation and follow-up of reported hazards and incidents;
c) Trend analysis;
d) Feedback from training;
e) Flight data analysis;
f) Safety surveys and operational oversight safety audits;
g) Monitoring of normal operations;
h) State investigation of accidents and serious incidents; and
i) Information exchange systems.

Each hazard identified must be evaluated and prioritized. This evaluation requires the compilation and analysis of all available data. The data is then assessed to determine the extent of the hazard; is it a “one-of-a-kind” or is it systemic? A database may be required to facilitate the storage and retrieval of the data. Appropriate tools are needed to analyses the data. Having validated a safety deficiency, decisions must then be made as to the most appropriate action to avoid or eliminate the hazard or reduce the associated risks. The solution must take into account the local conditions, as “one size” does not fit all situations. Care must be taken that the solution does not introduce new hazards. This is the process of risk management.

Once appropriate safety action has been implemented, performance must be monitored to ensure that the desired outcome has been achieved, for example: **Saudi Aramco, 1993.**

a) The hazard has been eliminated (or at least the associated risks have been reduced in probability or severity).
b) The action taken permits coping satisfactorily with the hazard.
c) No new hazards have been introduced into the system.

If the outcome is unsatisfactory, the whole process must be repeated.

4- Factors Affecting System Safety

The factors affecting safety within the defined system can be looked at two ways: first, by discussing those factors which may result in situations in which safety is compromised; and second, by examining how an understanding of these factors can be applied to the design of systems in order to reduce the likelihood of occurrences which may compromise safety.

The search for factors that could compromise safety must include all levels of the organization responsible for operations and the provision of supporting services. Safety starts at the highest level of the organization, **DiBerardinis,1999** and these factors are:

4-1 **Active failures and latent conditions**

Active failures are generally the result of equipment faults or errors committed by operational personnel. Latent conditions, however, always have a human element. They may be the result of undetected design flaws. They may be related to unrecognized consequences of officially approved procedures. There have also been a number of cases where latent conditions have been the direct result of decisions taken by the management of the organization. For example, latent conditions exist when the culture of the organization encourages taking short cuts rather than always following approved procedures. The direct consequence of a condition associated with taking short cuts would materialize at the operational level by non-adherence to correct procedures. However, if there is general acceptance of this sort of behavior among operational personnel, and management is either unaware of this or takes no action, there is a latent condition in the system at the management level.**Keller** and **Associates, 1989.**

4-2 Equipment Faults

The likelihood of system failures due to equipment faults is in the domain of reliability engineering. The probability of system failure is determined by analyzing the failure rates of individual components of the equipment. The causes of the component failures may include electrical, mechanical and software faults. **DeReamer,1980**.

A safety analysis is required to consider both the likelihood of failures during normal operations and the effects of continued unavailability of any one element on other aspects of the system. The analysis should include the implications of any loss of functionality or redundancy as a result of equipment being taken out of service for maintenance. It is therefore important that the scope of the analysis and the definition of the boundaries of the system for purposes of the analysis be sufficiently broad so that all necessary supporting services and activities are included.

The techniques for estimating the probability of overall system failure as a result of equipment faults and for estimating parameters, such as availability and continuity of service, are well established and are described in standard texts on reliability and safety engineering. These issues will not be addressed further in this manual. **Keller** and**Associates, 1989.**

4-3 Human Error

An error occurs when the outcome of a task being performed by a human is not the intended outcome. The way in which a human operator approaches a task depends on the nature of the task and on how familiar the operator is with it. Human performance may be skill-based, rule-based or knowledge-based. Errors may be the consequence of lapses in memory, slips in doing what was intended, or the result of mistakes which are conscious errors in judgment. A distinction should also be made between honest or normal errors committed in the fulfillment of assigned duties, and deliberate violations of prescribed procedures or accepted safe practices. **Saudi Aramco,1993.**

4-4 System Design

Given the complex interplay of human, material and environmental factors in operations, the complete elimination of risk is an unachievable goal. Even in organizations with the best training programmers and a positive safety culture, human operators will occasionally make errors. The best designed and maintained equipment will occasionally fail. System designers must therefore take into account the inevitability of errors and failures. It is important that the system be designed and implemented in such a way that, to the maximum extent possible, errors and equipment failures will not result in an accident. In other words, the system is *"error-tolerant"*. **Hinze, and Gambatese,2003**. The hardware and software components of a system are generally designed to meet specified levels of availability, continuity and integrity. The techniques for estimating system performance in terms of these parameters are well established. When necessary, redundancy can be built into the system to provide alternatives in the event of failure of one or more elements of the system.

The performance of the human element cannot be specified as precisely; however, it is essential that the possibility of human error be considered as part of the overall design of the system. This requires an analysis to identify potential weaknesses in the procedural aspects of the system, taking into account the normal shortcomings in human performance. The analysis should also take into account the fact that accidents rarely, if ever, have a single cause. As noted earlier, they usually occur as part of a sequence of events in a complex situational context. Therefore, the analysis needs to consider combinations of events and circumstances in order to identify sequences that could possibly result in safety being compromised. **DeReamer1980.**

Developing a safe and error-tolerant system requires that the system contain multiple defenses to ensure that, as much as possible, no single failure or error will result in an accident, and that when a failure or error occurs, it will be recognized and remedial action taken before a sequence of events leading to an accident can develop. The need for a series of defenses rather than just a single defensive layer arises from the possibility that the defenses themselves may not always work perfectly. This design philosophy is called "defenses-in-depth".

For an accident to occur in a well-designed system, gaps must develop in all the defensive layers of the system at the critical time when that defense should have been capable of detecting the earlier error or failure. An illustration of how an accident event must penetrate all defensive layers is in **Fig.2**, **Saudi Aramco,1993.**

5- SAFETY MANAGEMENT PROCESS

Strategies to reduce or eliminate the hazards are then developed and implemented with clearly established accountabilities. The situation is reassessed on a continuing basis, and additional measures are implemented as required.

The steps of the safety management process outlined in **Figs.2-4** are briefly described below:

5-1 Collect the data.

The first step in the safety management process is the acquisition of relevant safety data — the evidence necessary to determine safety performance or to identify latent unsafe conditions (safety hazards). The data may be derived from any part of the system: the equipment used, the people involved in the operation, work procedures, the human/equipment/procedures interactions, etc.

5-2 Analyses the data.

By analyzing all the pertinent information, safety hazards can be identified. The conditions under which the hazards pose real risks, their potential consequences and the likelihood of occurrence can be determined; in other words, *What*can happen? *How?* and*When?* This analysis can be both qualitative and quantitative.

5-3 Prioritize the unsafe conditions.

A risk assessment process determines the seriousness of hazards. Those posing the greatest risks are considered for safety action. This may require a cost benefit analysis.

5-4 Develop strategies.

Beginning with the highest priority risks, several options for managing the risks may be considered, for example:

1) Spread the risk across as large a base of risk-takers as practicable. (This is the basis of insurance.)

2) Eliminate the risk entirely (possibly by ceasing that operation or practice).
3) Accept the risk and continue operations unchanged.
4) Mitigate the risk by implementing measures to reduce the risk or at least facilitate coping with the risk. When selecting a risk management strategy, care is required to avoid introducing new risks that result in an unacceptable level of safety.

5-6 Approve strategies.
Having analyzed the risks and decided on an appropriate course of action, management's approval is required to proceed. The challenge in this step is the formulation of a convincing argument for (perhaps expensive) change.

5-7 Assign responsibilities and implement strategies.
Following the decision to proceed, the "nuts and bolts" of implementation must be worked out. This includes a determination of resource allocation, assignment of responsibilities, scheduling, revisions to operating procedures, etc.

5-8 Re-evaluate situation.
Implementation is seldom as successful as initially envisaged. Feedback is required to close the loop. What new problems may have been introduced? How well is the agreed strategy for risk reduction meeting performance expectations? What modifications to the system or process may be required?

5-9 Collect additional data.
Depending on the re-evaluation step, new information may be required and the full cycle reiterated to refine the safety action.
Safety management requires analytical skills that may not be routinely practiced bymanagement. The more complex the analysis, the more important is the need for the application of the most appropriate analytical tools. The closed loop process of safety management also requires feedback to ensure that management can test the validity of its decisions and assess the effectiveness of their implementation**.Guldenmund, 2000.**

6- SAFETY ECONOMICS
The conference of the International Roundtable on Construction Safety and Health, (Frankfurt 1995) identified four major interventions to affect the risk factors:

- Improved site planning and management
- Improved training of workers and supervisors
- New construction technologies
- Markedly improved performance monitoring and data.

Therefore, to prevent accident, money must be spent. Provisions of safety equipment, planning and design of safe construction procedure need financial supports. One of the objectives in project management is to maximize profit through the safe construction work .Evidently effective safety management is profit maker for construction companies .Accidents are associated which high direct and indirect costs hence, construction and safety professionals should control these cost .Efforts have been made over the years to establish bases on which total losses can be established from measurable costs. But in every instance, it has been found that the total losses exceed by far the amount reimbursable by the insurance companies.**Mirza, 2001.**

The types of losses that can result from accidents injuries or unsafe conditions are shown below.**Mirza, 2001.**Theses include the direct, indirect and hidden costs of injury or fatality all of them may be not applicable for every specific instance, and cost of many are difficult to determine.

- Payments for settlement of injury or death claims
- Cost of rescue operations and equipment
- Expenditures of emergency equipment
- Loss of function and operations income

- Cost for corrective actions to prevent reoccurrences
- Degradation of efficiency of operations because of loss of experienced and trained personnel
- Increased insurance cost
- Loss of public confidence, and bytheir revenue
- Loss of prestige
- Degradation of morale

7- FACTORS THAT IMPROVING THE CONSTRUCTION SAFETY

In their study,**Jaselskis, et al., 1996**, presented the results of a complementary study which tended to be more quantitative in comparison to other prior studies. The results pointed to several project-level factors that are statistically significant in improving safety performance. Further, the study provided contractors, specialty contractors and owners with objective strategies to achieve better safety performance.

- Increase time devoted to safety
- Provide greater detail in the written safety program
- Increase the number of safety meetings between upper management and field safety reprehensive
- Increase number of informal inspection
- Increase number of meetings for safety performance

While, **Sawacha, etal., 1999**, discussed various variables that influence safety on construction sites. The impacts of the historical, economical, psychological, technical, procedural, organizational and environmental issues were considered in terms of how these factors were linked with the level of site safety. The results of research suggested that variables related to organization policy are the most dominant group of factors influencing safety performance in the United Kingdom construction industry.

Evelyn, et al., 2005. presented the results of a postal survey of contractors in Singapore. The findings revealed that site accidents were more likely to happen when there are:

- Inadequate company policies.
- Unsafe practices.
- Poor attitudes of construction personnel.
- Poor management commitment.
- Insufficient safety knowledge.
- Training of workers.

The study recommended that the project managers must pay more attention regarding the factors identified above to help enhance safety performance on construction sites and reduce the frequency of accidents.

8- OWNER'S AND CONTRACTOR'S SAFETY PERFORMANCE

Hancher, et al., 1998, Focused the analysis on four indicators of contractors and owners safety performance, and they were as follows:-

- The Experience Modification Rate (EMR).
- The (OSHA) Recordable Incident Rate (RIR).
- The Lost Time Incident Rate (LTIR).
- The Workers' Compensation Claims Frequency Indicator (WCCFI).

The data presented in this study reveal:

- Different OSHA incident rates for contractors who keep track of accidents versus those contractors who do not;
- Different EMR and RIR for small versus large contractors; and
- A different WCCFI for union versus open shop contractors.

While, **Hinze and Wilson, 2000**, conducted a study on a selected group of large, primarily industrial firms to assess their safety records. The findings revealed that companies with good safety performance can still make improvements through implementing specific safety practices.

A study by **Hinze and Gambatese, 2003**, concluded that specialty contractors and owners safety performance was consistently influenced in part by a number of factors. The factors shown to improve safety performance include:

- Minimizing worker turnover.
- Implementing employee.
- Drug testing.
- Training of workers.

Sang,2006, presented two objectives in his study:

- Identify the role of the safety programs and management's opinions toward safety practices within roofing companies, and,
- Obtain detailed injury and illness types/body parts and determine how this information related to costs.

9- SAFETY REGULATIONS IN CONSTRUCTION PROJECTS IN IRAQ

Many Iraqi local contractors have started works in Iraq since 1930. In 1970 one main state company (The State Construction Contracting Company) had started in execution of very largeimportant projects, then followed in 1987 established many state companies, such as,:**Ali, 2009.**

9-1 Public companies:

These companies working under the Law No. 22 for year 1997 and these are some of their companies are:

- Al-Rasheed General Company for Constructive Contracting and it specialized by (constructive building, foundations and piles).
- Al-Mansoor General Company for Constructive Contracting and it specialized by (constructive building).
- Al-Farouk General Company for Constructive Contracting and it specialized by (constructive buildings, piles).
- Al-Mutasim General Company for Constructive Contracting and it specialized by (constructive building).
- Ashour General Company for Constructive Contracting and it specialized by (roads).

There is a big gap between Iraqi companies and other countries related to:

- The lack of safety culture in companies and their managers and crafts.
- The workers attitudes and behaviors towards the risks not safely.
- The employer does not provide safety equipment such as personal protective equipment (PPE).
- Safety is not one of the priorities of the companies such as cost, time and quality.

Usually all the state and local companies award many of their works of different type to small local subcontractors, then local subcontractor in order to reduce their costs and hence awarded the subcontractors did not follow the safety regulation in the following aspects:

- Firefighting system
- Lighting of the project
- Guarding the projects
- Fencing of the projects
- Concerning the workers in :
  a. Not having toilets which match the number of labors.
  b. Not using the safety clothes (over all).
  c. Not using safety boots (safety shoes).
  d. Not using helmets during the works.
  e. Not using glass and safety measures during welding.
- Concerning the safety measure at the sites :
  a. Not using prepare fence for the working areas and not having warning signs.
  b. Not using guarding signs for the people toward entry into work area.
  c. Not insuring the safety of the works or the third party as this done by the main contractor according to the Contract Conditions for Civil Engineering Works.

The Contract Conditions for civil engineering works in its latest addition has emphasized on the safety measures and regulation as this will reduce accident and hence reduce the cost of the projects and making sure that the project has three main items which are the quality of work, cost of the project, and execution of the project.

In order that the main contractors to have the ISO certificate in the near future they have to follow and execute the safety regulation (OSHA or OHSAS 18001) concerning with safety.

9-2 Private companies:

There are many companies work in private sector and they work under the law No. 21 for year 1997, and these works include (roads, paving and constructive building). These companies suffering such as the public companies above form the lack of safety in construction projects.

10-Filed Work

The field work is defined in three stages:

10-1 Stage one:

Case study (Palace Tower):

(Palace Towers) is one of the largest and beautifulness developments at the Dubai Silicon Oasis (DSO),**Fig.4.** The Palace Towers offer a balance between work and home; in addition to a premier lifestyle of endless opportunities with easy access to business areas of DSO and it's easy to get the maximum out of work and play at the same time.

Palace Towers offer a host of amenities from a fully equipped gym to two separate 20/10mt. pools for residential and office complex to shopping and dining facilities' Every one of the 424 spacious residential apartments is tastefully appointed, with contemporary layouts and designs that combine the convenience of today's lifestyle with timeless elegance. For the business user, the 150 high-tech office suites provide a central and prestigious location from which to work.

The Safety Management Plan of this project means get rid of danger, risk, or injury, while many things that could go wrong are around.

This could happen by being aware, educating yourself and others about safety issues which will not only keep accidents to a minimum, it will help to save lives.

The ultimate goal in accident prevention is "zero" disabling injuries and no lost work-time. However, there are many barriers to achieving this goal, the most important of which is the human attitude.

From this case study (Palace Tower), In addition to full details of project information, location, Stakeholders Profile and safety management plan researcher make a lot of a good information to this research.

10-2 Stage two:

Interviews and Questionnaires;

All people from many levels concerned by the public construction projects ,within the construction contract companies, were chosen to be interviewed and subjected to a well-designed questionnaire.

Questionnaireis the most important work of the research as it enters the details of the safety work directly where they were when the study most of the cases in which possible cause of risk and identify potential risks and negative consequences of her and left the answer on how to avoid those risks and to address the matter to the questionnaire, which included 54 Foundation Inc. government, and is worth mentioning that the response has been received from 42 enterprises and companies only a number is relatively good and is also noted that most of the answers were close, and this convergence by type of case.

10-3 Stage three:

Development the computer safety program:

In this computer safety program, the researchers enter the details of the safety work directly for most of the cases in which possible cause of risk and identify potential risks and negative consequences of it and the answer on how to avoid those risks, which included 46 activity which included many risks and their mitigation action to be taken **Fig.4**, shows the flow chart of the program.

The program is designed in a Visual Basic 6 language, which is a Form of several Forms and all his work shows it. Some of these forms are show in **Figs5,6,7,8,9.** Thus, the rest of the Forms and the art form made the background color of color button it. Project either out of the total of the first Form there is a button to exit.

11- CONCLUSION

This study is a case study for safety construction project, the researcher focus on safety management can best be described as a set of actions or procedures relating to health and safety in the workplace by management to achieve the followings:

1. Preventing environmental pollution and minimizing risks in the activities carried out in the organization.
2. Providing information and training for people at all levels so they can effectively meet their responsibilities.
3. Identification, assessment and control of all workplace hazards and risks.
4. Enhance interested party satisfaction.
5. Incorporate health and safety responsibilities into job descriptions for all workers and encourage workers to identify unsafe work situations.
6. Responsibilities should be assigned for such things as induction training, first aid, emergency procedures and workplace inspections.

7. Ensure that all workers fully understand their responsibilities for health and safety.
8. Construction can be a hazardous business. This is widely recognized by everyone in the construction industry. When accidents happen, the costs are high – in people, profits and productivity.
9. One of the best ways to avoid injuries and minimize costs is through good planning and co-ordination – both before and on the job. This should start when the decision is made to go ahead with the project, and should consider allstages and parties associated with the work.So everyone involved in a construction project is responsible under the act, including: Clients, Designers/ advisers, Main Contractors, Subcontractors and Employees.
   In short, everyone involved with a construction project of any kind from planners, designers and supervisors through to on-site workers have a role to play in the management of health and safety during a construction project. This level of duty for each doesn't go beyond what is reasonable for them to take.

12- RECOMMENDATION

The researcherspropose the following recommendations:-

1. to make a comparison study between this project and other project with similar specifications with fixing for some affecting factors in the project plan.
2. toapply such study on industrial project to obtain the requirement of plan and safety management which may be different than the requirement of commercial and residential projects.

REFERENCES:

- Abdul-Rahman A., 1988,*The health and the Industrial Safety* , Al –Huria publishing Co. Baghdad, Iraq, No .438.
- Ali Mohammed-Hassan Majeed,2009, *Improving Construction Safety Performancefor IraqiConstructionCompanies.* M.Sc.Thesis ,College of Engineering , University of Baghdad.
- B.L. Gupta and AmitGupta ,2005.*Construction Management Machinery and Accounts*. A. K. Jain NaiSarak, Delhi-110006.
- Bush, VivcentG ,1975.*Safety in the Construction Industry*, Reston, Va Reston Publishing Co.
- www.arab_eng .org ,2007.
- DeReamer, Russel 1980, *Modern Safety and Health Technology*. John Wiley & Sons, New York.
- DiBerardinis, Louis J ,1999. , *Handbook of Occupational Safety and Health – Second Edition*, John Wiley & Sons, Inc. , New York.
- Evelyn Ai Lin Teo, 2005. *Florence Yean Ling and Adrian FookWeng Chong, Framework for project managers to manage construction safety.* InternationalJournal of Project Management. 23 (4), 329-341.

- Frankfurt, Germany, 1995.*A Performance Goal for Construction Safety and Health*,International Roundtable on Construction Safety and Health,The Center to Protect Workers' Rights.

- Furey Roofing and Construction Co. 2003, Inc, *Written Safety Program and Hazard Communication Standard.*

- Guldenmund, F.W. 2000*, The Nature of Safety Culture: A Review of Theory and Research. Safety Science, 34.*

- . Jaselskis, E., Anderson, S. and Russell, J., 1996,*Strategies for achieving excellence in Construction Safety Performance*. Journal of Construction Engineering and Management.

- Hinze, J. and Wilson, G., 2000,*Moving Towards a Zero Injury Objective*. Journal of Construction Engineering and Management. 126 (5), 399-403.

- Hinze, J. and Gambatese, J., 2003 *Factors that Influence Safety Performance of Specialty Contractors, (ASCE) Journal of Construction Engineering and Management*. 129 (2), 159-164.

- J.J. Keller and Associates,1998,*Written Safety Plans*. Neenah, Wl-1998

- Mirza ,M,2001, *Safety Assessment in Industrial Construction Projects in Saudi Arabia*, M.Sc. Thesis, College of Graduate Studies King Fahd University of Petroleum and Minerals Dhahran, Saudi Arabia.
- Peterson, Dan,1989,*Techniques of Safety Management*.Aloray, New York,

- Saudi Aramco, 1993 ,*Construction Safety Manual*Fourth edition.

- Sawacha, E., Naoum, S. and Fong, D., 1999,*Factors Affecting Safety Performance on Construction Sites.* International Journal of Project Management 17 (5), 309-315.

- Sang, D. Choi, 2006 .*A Survey of the Safety Roles and Costs of Injuries in the Roofing Contracting Industry*. Journal of safety health and Engineering research (ASSE), 3 (1), 1- 20.

Table 1. Occupational injury rate.

Sa. No.	Industry	% of total injury
1	Finance insurance.	2.0
2	Services	4.9
3	Whole sale and retail trade	7.2
4	Agriculture, forestry	7.7
5	Transportation utilities	8.5
6	Manufacturing	10.2
7	Mining	10.5
8	construction	14.5

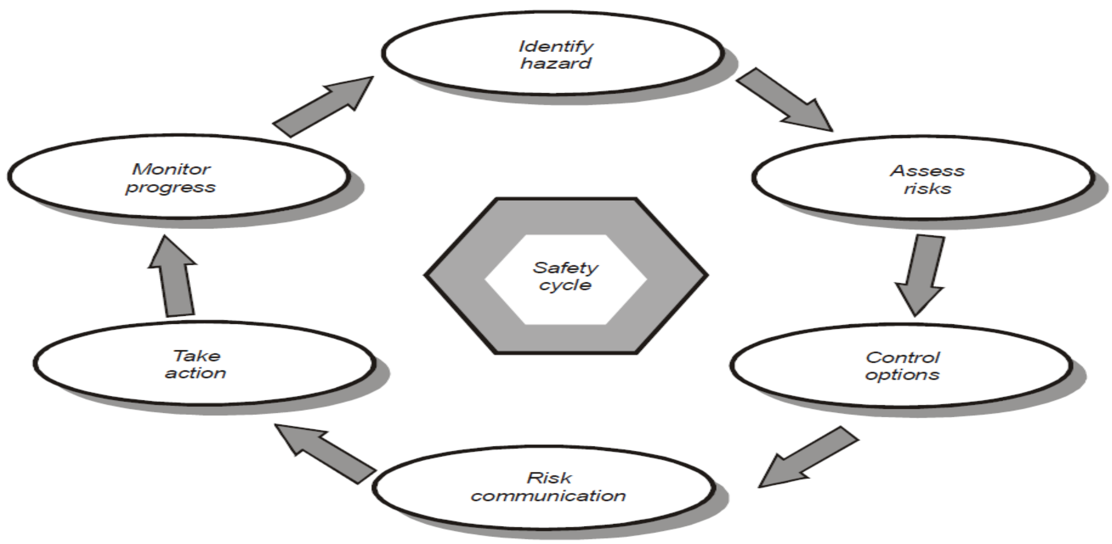

Figure 1. Safety cycle, **Abdul-Rahman A., 1988.**

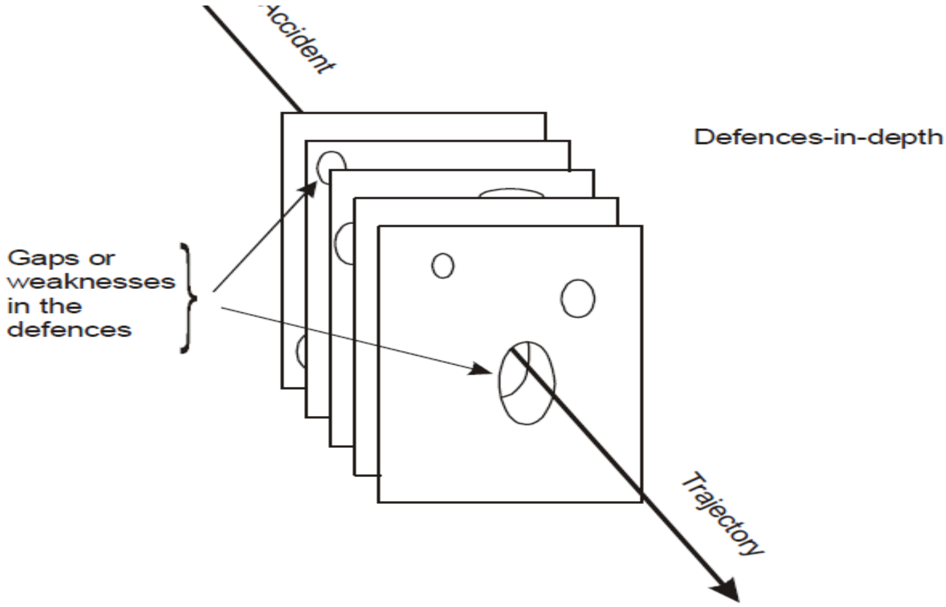

Figure 2. Defensive layers, **Saudi Aramco,1993.**

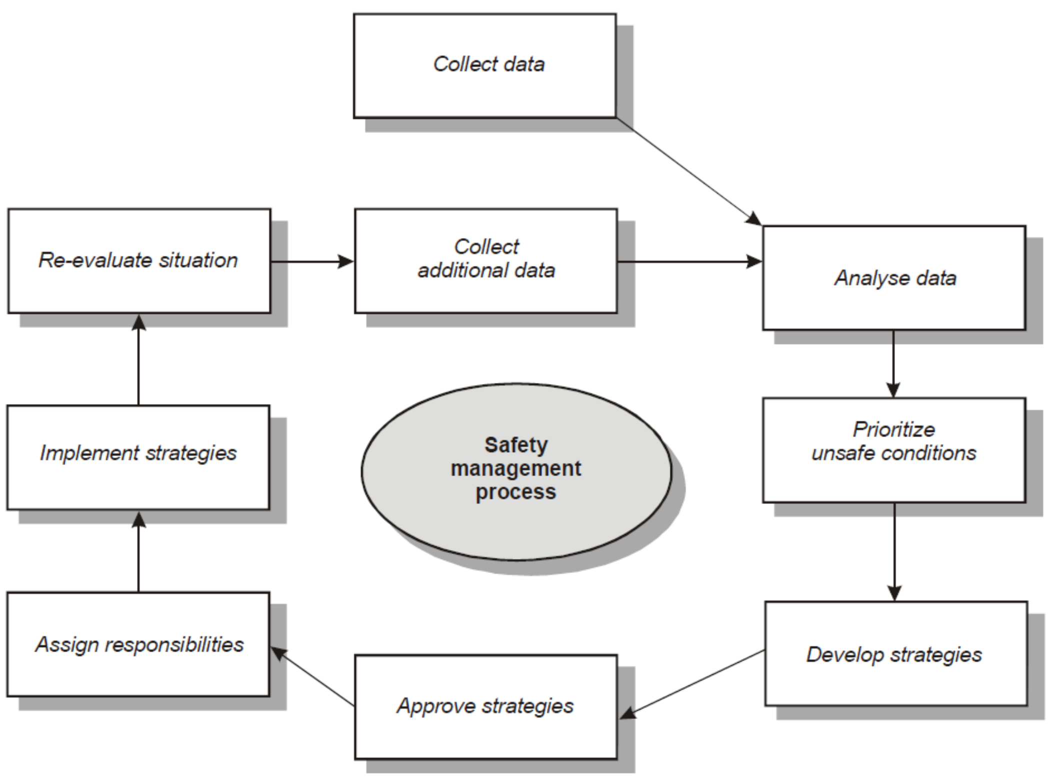

Figure 3. Safety management process, **DeReamer, 1980**.

Figure 4. Palace towers.

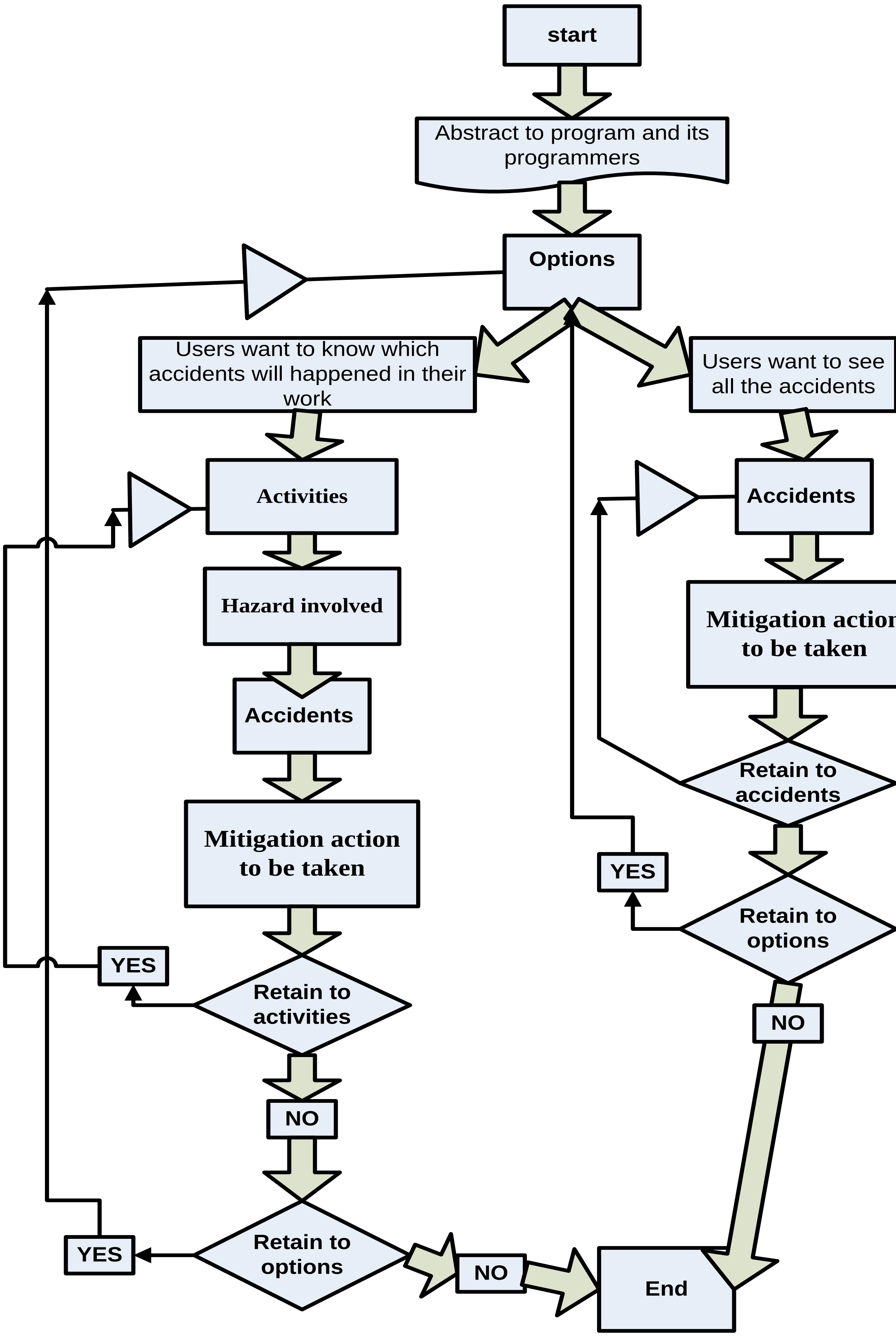

Figure 5. Flow chart for the computer program.

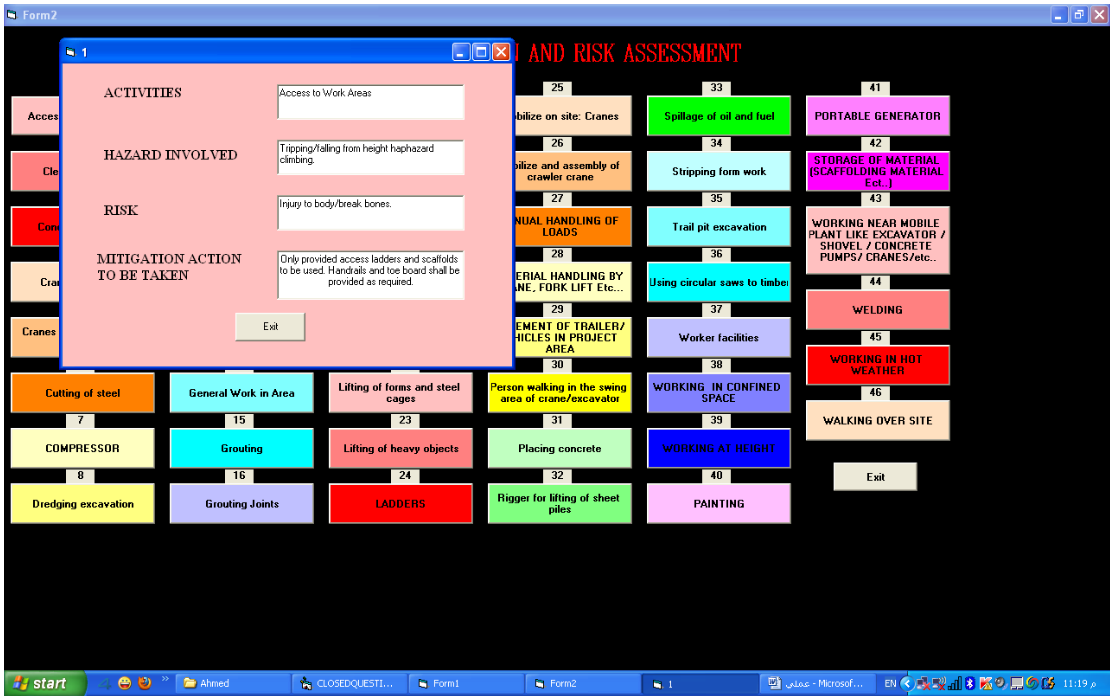

Figure 6.FormNo. 1 of the computer program.

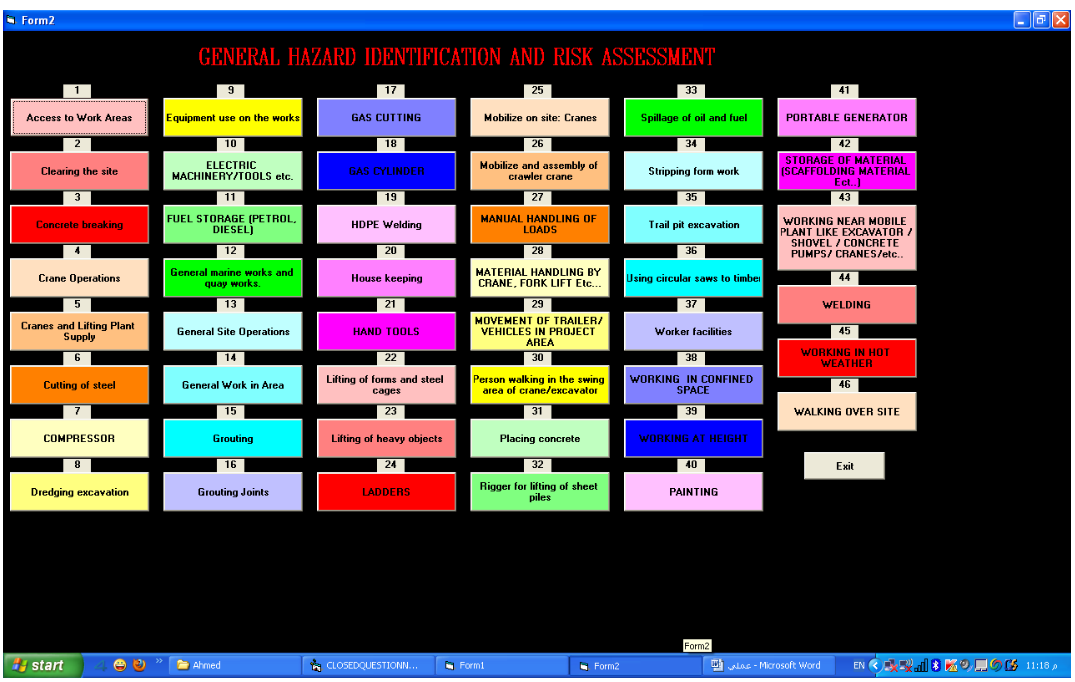

Figure 7.FormNo. 2 of the computer program.

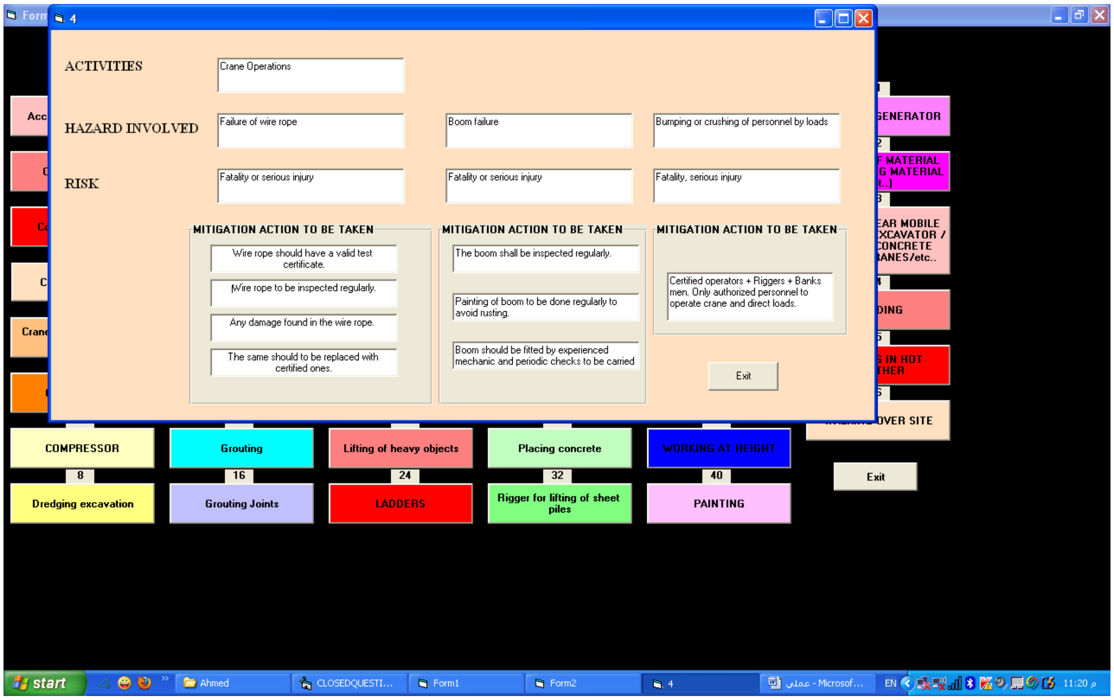

Figure 8. FormNo. 4 of the computer program.

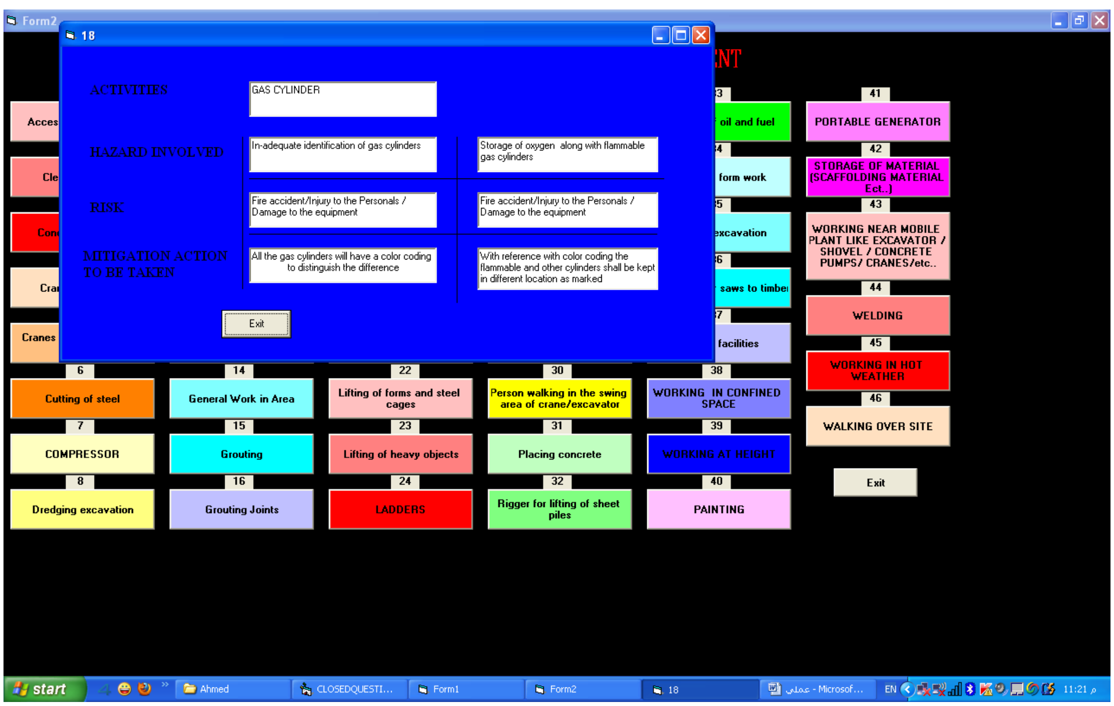

Figure 9. FormNo. 18 of the computer program.

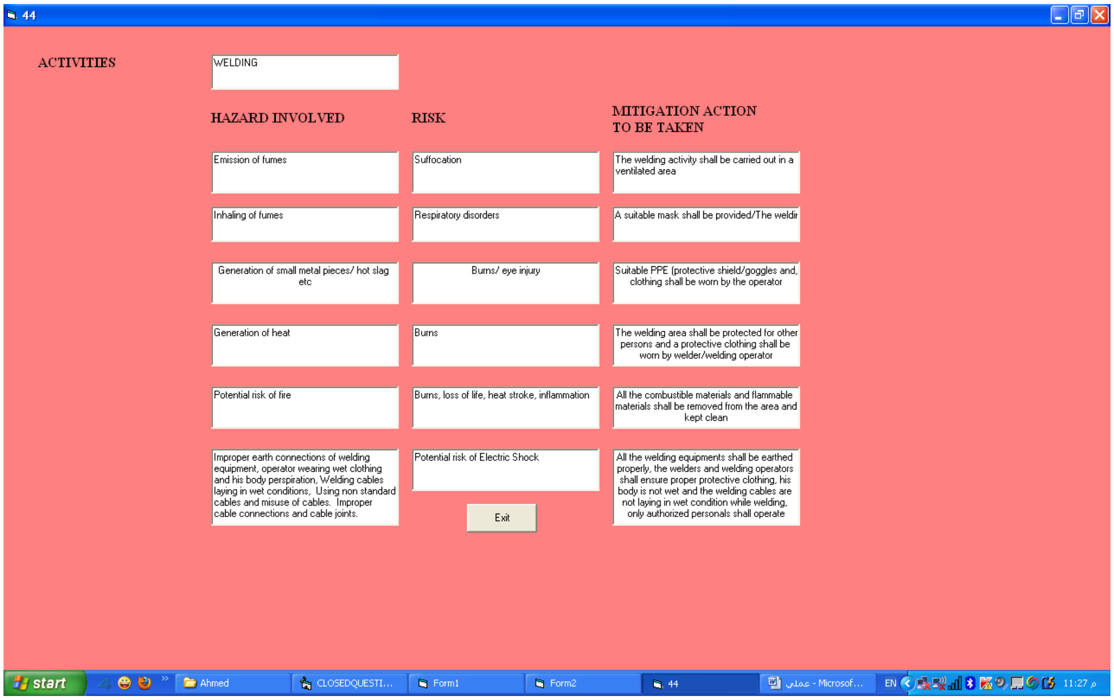

Figure 10. FormNo. 44 of the computerprogram.