



**ELIMINATING THE UNSAFE WORKING CONDITIONS IN THE  
CONSTRUCTION OF A GAS STATION THROUGH A RISK MANAGEMENT  
METHODOLOGY**

**By**

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A THESIS REPORT  
Presented to the Project Management Program in the  
School of Management of  
City University of Seattle  
In Partial Fulfillment of the Requirements  
For the Degree of  
MASTER OF SCIENCE OF PROJECT MANAGEMENT

*This Master Thesis was elaborated in the frame of the collaboration of the City University of Seattle and the Graduate Technological Education Institute (T.E.I.) of Piraeus to fully implement at TEI of Piraeus Campus the CU's MS in Project Management Program approved by the Hellenic Ministry of National Education and Religion Affairs as by decision E5/58291 published in the Hellenic Government Gazette (FEK) B/924/5- July-2005.*



**June/2010**



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To my mother and my wife



## Biography

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His main responsibilities include:

- The Implementation of business plans and case submission to the Greek Ministry of Development for the financing of private businesses by the 3rd and 4th Co-financed Development Programs of the European Union.
- Auditing and recording standard equipment of service stations on behalf of BP Hellas, auditing and evaluating safety and hygiene regulations of the operating contractors of BP Hellas Transport Department and of the construction contractors of BP Hellas Construction Department.
- Project Management for Castrol (provisions and equipment placement, monitoring work timetables and pricing, development reporting and work completion)





## Abstract

Occupational accidents on worksites during the construction of gas stations mainly concern wholesale oil companies which commission to subcontractors their construction while keeping project management to themselves. Subcontractors, taking advantage of this failure due to project managers' lack of knowledge on matters of safe working practices and lack of adoption of the term "safety" in their culture, do not implement any risk assessment methodology but rely on their experience.

Through the present paper, propose a methodology to the project manager and subcontractors which will pivot around risk management, combining it with a successful management model and an effective project team.



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## Chapter 1

### Introduction

#### *Introduction*

Hippocrates said "A wise man should consider that health is the greatest of human blessings". This mere quotation can find application in the present-day business world as the promotion of health and hygiene in the workplace is a concerted effort of employers, employees and society aimed at the enhancement of hygiene and well-being of people in the workplace. Human resources are the most important chapter of a company.

#### *Nature of the Study*

Currently working in the technical service of BP as project manager in the field in the department of Construction Works for BP service stations, I have come to understand that in order to deliver a project such as that of a new gas station or the replacement of partial equipment of the gas station, safety at work constitutes the more important issue and factor for success.

During the construction of a gas station, a lot of occupational hazards and unsafe conditions can occur. In such conditions, the safety of the human life has to be an overriding consideration. In order to eliminate possible accidents, appropriate measures must be implemented without delay. Unsafe practices and conditions should be eliminated through continuous auditing and monitoring. Safety is the result of proper control and planning to ascertain the implementation of planning.



Accidents in the working environment cannot only cause the loss of human life but they can have another serious impact as well. In financial terms, such an incident can make a huge financial dent, as it may lead to the failure or cancellation of the project or, even worse, to the dissolution of the organization.

### *Needs Assessment*

Safety at work is a vital factor for the successful delivery of the construction of a gas station. Hazardous conditions in the course of the construction of a gas station can have a serious impact on all the stakeholders of the project. For my company a serious accident or a death during the construction of a gas station can wreak serious financial damage and incur a huge dent in its reputation. The project may be cancelled and the legal department of my company will be legally locked into a cycle of disputes with the subcontractor, which may lead to the financial disaster of the subcontractor, and to the loss of his reputation. Petroleum company will be loath to trust him again. And, of course, the most important and vital impact of the whole affair is the calamity that will hit the family of the deceased or the injuries that may afflict a poor worker. Money does little to compensate for the loss of a human life, as some matters are of inestimable value. Furthermore, not only could accidents lead to the loss of a human life, but they may also have a serious impact and inflict irrectifiable damage on the surrounding environment. An explosion during the construction of a gas station could lead either to ecological damage or to the loss of human lives or inestimable damage to property.

It is of paramount importance to my company and subcontractors that they promote and ensure safety performance and safety culture in the working environment.

All appropriate measures must be taken to ensure the elimination of accidents and the avoidance of all unsafe practices and conditions prevailing in the working environment.

#### *Purpose of the Study*

The purpose of the study will be to use risk management methods and tools among with effective leadership and empowered teamwork in order to reduce or eliminate accidents and hazard situations at work, regarding the construction of a gas station.

#### *Significance to Your Workplace*

Eliminating injuries and unsafe practices at work it is a great priority for my company. I hope that my thesis will be useful in my company and to other companies in Greece which are active in the petroleum industry and more specific in the construction of gas stations.

#### *Relation to the Program of Study*

The theories that are related to the thesis are listed below:

1. PM 502 Leadership Principles for Project Managers
2. PM 506 Managing Projects with People and Teams
3. PM508 – Project Risk and Decisions

#### *Definition of Terms*

1. Personal protective equipment – includes all equipment and accessories to the equipment that the employee uses to protect him/herself against dangerous conditions during work. Such equipment is helmet, gloves, safety glasses, safety boots, hearing protection, etc.

2. Employer: Any natural or legal entity which employs one or more workers on a worksite.
3. Employee: A person working in construction.
4. Scaffolding: Any temporary fixed, suspended or moveable construction including all its support paraphernalia geared for the support of workers and materials or for allowing entry to some construction part.
5. Workplace: All those places where the workers must be or go to during the conduct of work, coming under the employer's control.
6. OHSAS 18001: A hygiene and safety management system in the workplace.
7. ISO 14001: An internationally accredited standard for corporate environmental management.
8. ISO 9001: A quality management and system for companies.

## Chapter 2

### Problem Statement

According to ILO, the annual death toll from occupational accidents and diseases is approximately 2.2 million people. At the same time, approximately 270 million workers worldwide have suffered a work-related accident that has not cost them their lives. It is also estimated that 160 million people have contracted some kind of occupational disease.

#### *Rationale*

Currently working in the technical service of BP as project manager in the field of budgeting regarding the construction of a gas station, I have come to understand that the safety of human life should be on top of our list of priorities. In fact, with a view to reducing work-related accidents, we are now committed to giving prominence to the overriding issue of safety of worksite and construction workers, not only on humanitarian grounds but also on financial grounds given the fact that work-related accidents and diseases are estimated to be something like 4% of the annual GIP according to ILO.

#### *Objectives or Hypotheses*

Accidents are the result of a series of dangerous activities and conditions that can be eliminated only if they are consistently checked and audited. Safety is the result of proper control and planning to ascertain the implementation of planning.

Proper Planning includes the following:

- Task Programming
- Choice of Technicians, Contractors- Machinery- Tooling-Materials

- Risk Assessment
- Monitoring - Auditing
- Change Management

## Chapter 3

### Review of Literature

This literature review is organized into three sections: project and risk management in the construction Industry, effective leadership and empowered teamwork for safe performance.

#### Project and Risk Management in the Construction Industry

##### Introduction

Generally speaking, the conditions of work in all industry sectors, including the oil sector, have undeniably improved over the past few years mainly in the developed countries, and this has resulted in a reduction in the rate of working accidents (Crichton M. , 2005). This improvement is due to a combination of factors such as improved services of hygiene and safety, new legislation, new labor relations, scientists of various specialties studying the labor environment as well as workers who have come to realize that they spend one third of their life in the working place (Makris, 2003).

##### What is defined as an accident?

On-the-job accidents are violent incidents that occur in the workplace during the conduct of one's job. The consequences can vary from bodily injuries to health damage and even to loss of life of the worker (Safety and hygiene of employees).

A ‘near- accident situation’ is referred to as an accident that did not cause any wound or damage the moment it was caused but created the conditions for a real accident (Safety and hygiene of employees).

Safety is reported in the implementation of work under such conditions with a view to eliminating or decreasing to the absolute minimum the danger of a possible accident for the operators and the environment of installation (viz. probabilistic estimate) (Safety and hygiene of employees).

The term "Hygiene" encompasses a number of things ensuring that workers will conduct their work in a stress-free, drugs-free, risk-free, germ-free and, in a nutshell, a suitable working environment for workers (Safety and hygiene of employees).

### Consequences of accidents

As consequences of accidents are defined examples of direct and indirect consequences arising from on-the-job accidents and occupational ailments (Trola & Roussou, 2002).

#### *Direct Consequences*

- Company malfunction and steady spiraling down of productivity resulting from the absence of employee.
- Lost wages and potential retraining cost for another placement.
- First aid cost including medical care and rehabilitation expenses.
- Insurance cost and likely premium increase.
- Reimbursement cost (Hinze J, Pedersen, & Fredley, 1998) , (Osama, Tycho, Butt, & Shaar, 2005)
- Likely penalties and legal actions as a result of the accident/illness
- Replacement or repair of any damaged equipment

### Indirect Consequences

- Resultant research management time, perhaps in cooperation with the responsible authorities (e.g. Labor Inspection Agency) and other state bodies.
- Retraining cost of another employee or employment of a replacement.
- Long -term diminished possibility of employment of the worker due to injury.
- <<Human cost>> - loss of life quality and of inherent prosperity (Bansal, 2010)
- Work incentive and morale diminution, absenteeism inclination upsurge (Hinze J, Pedersen, & Fredley, 1998).
- Tarnishing of the company's reputation & creation of bad business relations with clients and the general public at large.
- Environmental pollution (e.g. accidents with chemical substances).

### Occupational Accidents

The main hazards that workers face in their daily working reality, in the constructional field (including the construction of a gas station) where a serious wound or, even worse, death of workers can occur are as follows: falls of workers from a height, falls of workers off ladders, falls of workers from the same level, slipping or collapse from falling objects, collision with everyday objects and blows in or from moving objects, impact in or between objects, all-out efforts or labored movements of workers, report or contact with electricity (López, Ritzel, Fontaneda, & Alcantara, 2008), (Reese & Eidson, 1999).



### Small building companies & Subcontractors' unsafe conditions and practices

Small building companies number up to twenty-five workers who stand a good chance of getting hurt or compromising their health through unsafe conditions and practices (Cheng, Leu, Li, & Fan, 2010), (Manu, Ankrah, Proverbs, & Suresh, 2010). The reason is that larger building companies are more favorably disposed to adopting safety practices and have the ability to allocate funds to issues concerning occupational safety and hygiene than smaller ones whose practices are less safe as they strive to sew up

the deal and take part in a construction project, performing only part of it as subcontractors and quoting low prices to contractors, without regard to issues of safety and hygiene (Ling, Liu, & Woo, 2009).

### Greek reality

The Labor Inspection Agency for the years 2000 - 2005 has recorded a total of 33.820 accidents ( Labor Inspection Agency, 2005). Of these, 851 were fatal. With the only exception being 2005, when a slight drop was observed, the total number of occupational accidents shows an uptrend. More specifically, 127 fatal accidents were recorded in 2000, 188 in 2001, 153 in 2002 149 in 2003, 127 in 2004, while the total number of occupational accidents (whether fatal or not) according to recorded data are as follows: 4032 in 2000, 5155 in 2001, 6021 in 2002, 6235 in 2003 and 5984 in 2004 ( Labor Inspection Agency, 2005). See figure 1 & 2 below ( Labor Inspection Agency, 2005).

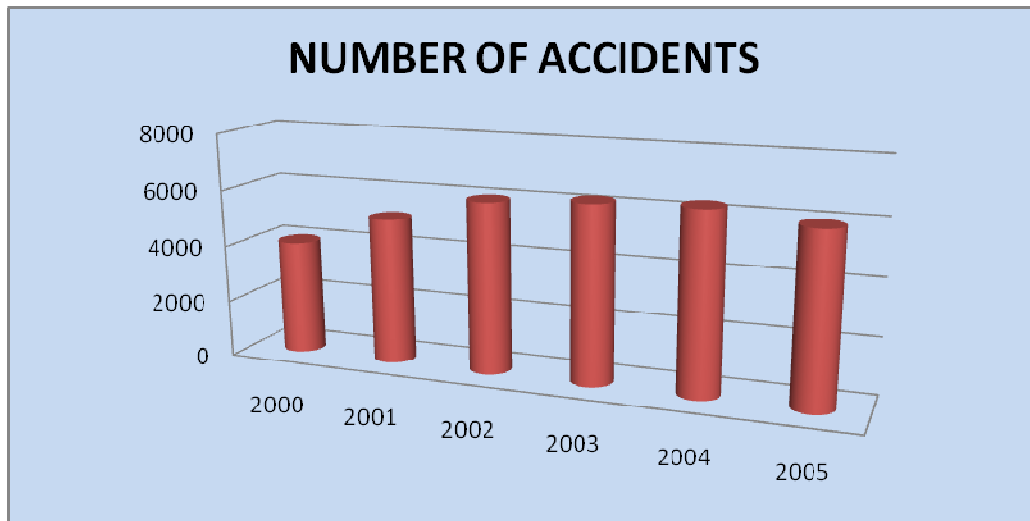


Figure 1: Working accidents in Greece in the period 2000-2005

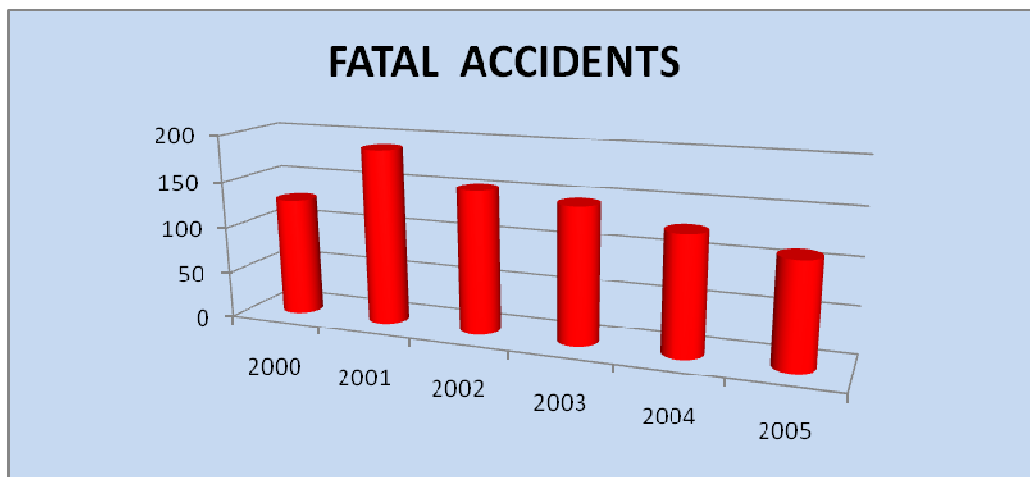


Figure 2: Fatal accidents in Greece in the period 2000-2005

Of the 54 fatal accidents on construction sites for the year 2005 according to records of the Labor Inspection Agency, 20 resulted from falls, 12 from buckling building

constructions, 11 from contact with electricity, and 4 from other causes ( Labor Inspection Agency, 2005).

### Greek Legislation on Safety and Hygiene

The obligations of employers, employees and the state arise from Act 1568/85 (177/A) <<Hygiene and Safety of employees>> and Presidential Decree no 17/96 (11/A) <<Measures for safety and health improvement in the workplace.

According to these statutes (Safety and hygiene of employees):

- The employer is obliged to ensure the health and safety of workers in all aspects of the work and take preemptive measures to ensure the health and safety of third parties.
- For businesses employing fewer than 50 employees, the employer is obliged to use the services of a safety technician while businesses employing over 50 workers are obliged to use the services of a labor physician (Act. 1568/85, Presidential Decree. 294/88), .
- The employer is obliged, within the scopes of responsibilities for ensuring the health and safety of workers, to take all the necessary measures to oversee their correct implementation and readjust them in line with the arising changes. Through the specified measures, the employer ensures the health and safety of workers in the workplace. These measures include, inter alia, the following activities:
  - Occupational hazards prevention
  - Briefing and training

- Necessary organization development
- Provision of the necessary means

#### *Safety technician responsibilities*

The safety technician is obliged to advise the company on matters of safety and hygiene in the workplace and inspect the working conditions within the company (Safety and hygiene of employees).

#### What is defined as Risk?

Risk is an uncertain event or condition that if it occurs it has a positive or negative effect on the project's objectives'' (PMBOK, 2004, p. 373). In addition to that: ''Risk has two primary components for a given event:

- A probability (likelihood) of occurrence of that event
- Impact of the event occurring (amount at stake)

Conceptually, risk for each event can be defined as a function of likelihood and impact; that is:

$$\text{Risk} = f(\text{likelihood, impact})'' \text{ (Kerzner, 2006, p. 709).}$$

#### Risk Management applied to safety and hygiene

Risk management, as a dynamic and complete analysis of the conditions of work, constitutes an absolutely essential & informative means and the basic tool for the planning and organization of safety management in a company (Gurcanli & Mungen, 2009). Risk management is the final result of the continuous and dynamic character of a process, which includes the total of acts of information, documentation and recording of

conditions of work, from the phase of a simple description of the productive process up to the final phases of determination of the harmful factors and unsafe conditions and practices with regard to the effect of the working environment on human health with a view to eliminating possible hazards which could lead to probable accidents and injuries (Teo, Ling, & Chong, 2005). “About 90% of workplace injuries can be traced to unsafe work practices and behaviors” (Teo, Ling, & Chong, 2005, p. 336).

In the sector of safety, risk can only have negative consequences and, therefore, the risk management process and risk analysis is focused on the prevention and mitigation of risks (A Risk Management Standard, 2007).

Risk management is a participative process and is characterized by the element of knowledge, which emerges from a collective process of criticism analysis of the reality of the working environment and constitutes a basic element of consolidation of working opinion and initiative through the active participation of workers in the processes of the determination of risks of the working environment and prevention of risks (Makris, 2003).

“A risk management process is repeated throughout the project and is as follows:

- Identify risks.
- Analyze and prioritize.
- Develop a response.
- Establish reserves.
- Continuous risk management “ (Verzuch, 2008, p. 98)

## Risk management process

### Risk Identification

A continuous process of risk identification will be utilized, (Heerkens, 2002) . A structured identification of all sources of risk and risk classification (likelihood & consequence) permeates the project. The identification of the risk should be approached in a methodical way in order to ensure that all the important activities inside the organization have been recognized and that all the risks that derive from these activities have been determined (Heerkens, 2002).

Risk identification can be achieved as follows:

- Through brainstorming. The project manager and the team hold a brainstorming session, but this technique can also be implemented by a group of experts from various disciplines (Cooper, Grey, Raymond, & Walker, 2005), (Heerkens, 2002), (Verzuch, 2008).
- Choosing as leader a person who will also play the role of coordinator (Verzuch, 2008). These persons can bounce around ideas about likely hazards for the project. Risk detection is strengthened through interviews with experienced and responsible coordinators or experts in the specified field. First, the suitable individuals are identified and then the planning team informs them about the project and the respondents identify the risks based on their experience (Cooper, Grey, Raymond, & Walker, 2005).
- The planning team uses an almost standard checklist as a guide to likely risks, which is usually drawn up on the basis of historical information and accumulated knowledge of the completion of works of various scales and

formulas. Since it is impossible to draw up an exhaustive list of risks, special care should be taken to examine cases that are not included in the checklist, provided they appear relevant to the specific work (Cooper, Grey, Raymond, & Walker, 2005).

#### Assessment of the magnitude of risk

Understanding the overall impact of any risk taking by the company staff is vital. Initially, the risks will be assessed in terms of an absolute assessment of the risk rating, i.e. potential impact (Charvat, 2002). Furthermore, an assessment of the likelihood of these impacts will also be made to differentiate high probability, high impact from low probability, high impact since there is the potential for major or catastrophic impact in all our endeavors (Martin & Tate, 2001).

Risk detection can be achieved in 2 ways: The Quantitative and Qualitative methods (Marhavidas & Koulouriotis, 2008).

##### – Quantitative Method

It is more objective and based on accident probability expressed by figures whose calculation requires a lot of time, effort and costs (Gouta, 2000).

##### – Qualitative Method

The most frequently followed method which requires wide experience and knowledge (Gouta, 2000).

These methods are mentioned below and are as follows:

## Risk assessment methods

### *Checklists*

A “checklist” is a tool of estimate of equipment, materials or processes of hygiene and safety of workers. In other words, it is a list composed of various parameters in regard to labor conditions of safety which the inspector checks off ( if they exist) and remarks upon in case of lapses. It can also be used in each phase of work so that it guides the user on issues of common dangers, by means of standardized processes (Marhaviolas & Koulouriotis, 2008) .

This checklist usually enjoins conformity with minimal models and determines fields that require further estimate. The results are qualitative. The user usually notes ‘yes or no’ with regard to conformity with model processes. Despite intense criticism and reservations expressed concerning their reliability and validity, the lists of evaluation and choice continue unabated (Cheng, Leu, Li, & Fan, 2010) . Their process of completion is easy and does not require much time consumption.

### *Safety audits*

It's a procedure through which safety inspectors oversee working places for the purpose of ensuring professional safety and the observation of regulations for health and environmental safety (Laitinen & Päivärinta, 2010). In other words, they inspect the working places in order to verify that the environment of work, the instruments and the equipment conform to the rules and regulations of safety.

One good example of a safety audit is given to us by Laitinen and Paivarinta (2010) . They present to us The TR–observation method. More specifically, as per this ”



The observed safety aspects of the TR-method are as follows (1) working habits, (2) scaffolding and ladders, (3) machines and equipment, (4) protection against falling, (5) lighting and electricity, and (6) order and tidiness. Each item is scored as “correct” if it meets the safety standards, otherwise the item is scored as “not correct”. The safety index is calculated as a percentage of the “correct” items related to all the observed items. The observer starts the observations from the top floor (or bottom floor if more practical), continues floor-by-floor and then observes the outside area. For the observation each floor is divided into small sampling areas so that the observer is able to oversee the whole area from where he stands.” (Laitinen & Päivärinta, 2010).

#### *Fault tree analysis (FTA)*

FTA is a widely used tool for system safety. One of the main assets and capabilities of this tool is the systematic and logical development of the many faults which constitute an accident. This type of development calls for an impeccable understanding of the system, its operations and various types of faults from the analyst. FTA analyses an accident taking into consideration the contributing faults and human errors (Ferry, 1988). Ergo, this method is nothing short of a technical inversion of thought, viz. the analyst starts with an accident or with an undesirable situation which must be avoided and determines the direct causes of this incident, each of which is examined in turn until the analyst determines the root cause of each incident. The fault tree is a diagram which shows clearly the logical relationships between the main causes and the accident. What follows then is that FTA is a list of combined totals of faults in the equipment coupled with human errors which could constitute an accident. This method usually yields qualitative results but has the capability of being used for

quantitative estimates, integrating each sector's probabilities based on probabilistic indexes of faults from appropriate database.

A fault tree is a flow chart that represents the logical succession of all those basic events that are capable and necessary for the constitution of a specific incident called the culmination event which is usually the critical point in a likely accident scenario such as a toxic material explosion or spillage. A complete fault tree is comprised of the basic events that are combined through the intervening events.

Beneath the culmination event and beneath each intervening event there is a "gate" determining the logic that combines all the events together. The most important gates are the gates "as well as" and "either". The "as well as" gate flows out if all inputs are satisfied simultaneously. The "either" gate flows out if at least one of the inputs is satisfied (Arvanitogeorgos, Probability and risk assessment in the chemical industry).

A simple fault tree is represented below (Arvanitogeorgos, Probability and risk assessment in the chemical industry):

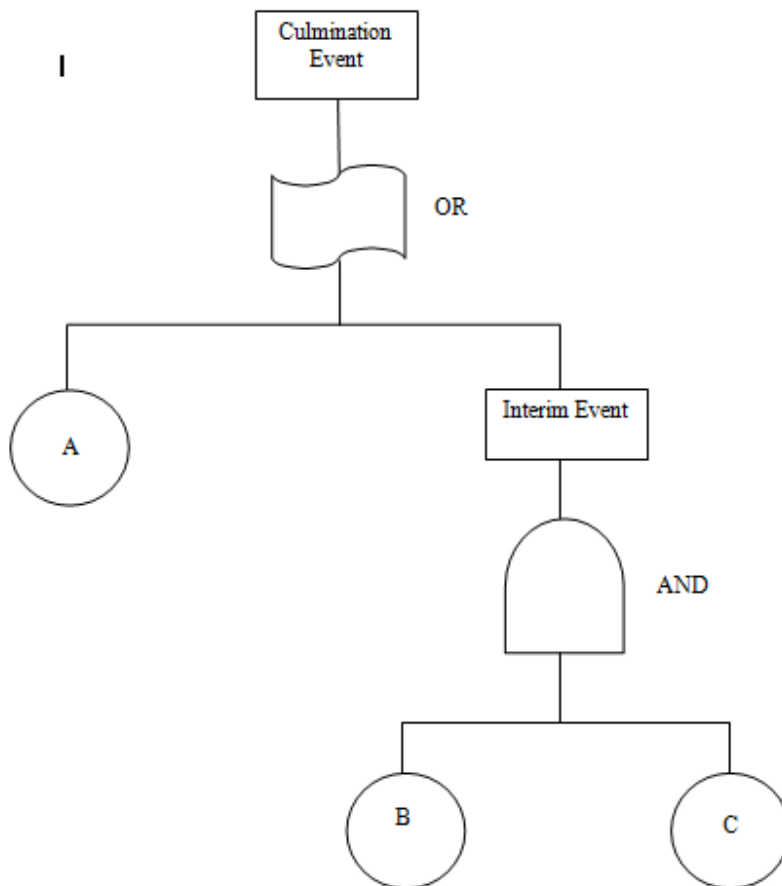


Figure 3: Fault tree

This method falls down in the following (Arvanitogeorgos, 1999):

1. It is impossible to identify all possible causes of failure.
2. The selection of facts in a tree is subjective as there could be unnecessary facts or the opposite.
3. Failure data shortage

*Hazop study*

The HAZOP method is one of the most structured techniques for danger determination, which is aimed at finding and detecting all possible divergences from its programmed operation and the corresponding dangers that can constitute such a divergence (Labovsky, Svandova, Markos, & Jelemensky, 2007). It is used primarily for the determination of the reasons and consequences of divergences by interdisciplinary team during a brainstorming session. For thought provocation and divergence determination a list of guidewords is formed. Should the causes and consequences be considered realistic and significant, then they are registered on a task table for follow-up. These action could either be changes in the study or the equipment e.g. consequences estimates. Usually the results are qualitative lists of hazards and operational.

*What-if analysis*

The process of type "What if" concerns the determination of undesirable consequences which result from the divergence of the forecast regular process of actions and operations. It is not such a strictly structured process as the technical HAZOP. However, when it is used by individuals who are experienced in its use, it can be proved to be user-friendly. The study project team is faced with the question "what will happen if... " (Marhavidas & Koulouriotis, 2008). In order to give an answer to that, the study project team must be experienced and specialized in the respective sector. The results are a list of accident scenarios which are qualitative in nature, including the results and possible measures of attendant risks.

*The risk matrix:*

Nanos (2005), mentioned that a usual methodology that can be used for the analysis of activities is the risk matrix, according to which each department of the company is analyzed in activities and/or sub-processes aimed at:

- the localization of all sources of danger that threaten the Health and Safety of workers,
- already existing measures of protection and confrontation of recognized risks,
- The evaluation of degree of venturesomeness of recognized risks.

It is worth mentioning that for the estimate of degree of venturesomeness of activity, two parameters should be taken into consideration:

- Gravity of the damage of health of the worker from his report in each type of danger (e.g. surface wound, poisoning, serious wound or death)

Weighting	Likelihood
1	Unlikely
2	Almost likely
3	Possible
4	Almost Certain
5	Certain

Table 1: Gravity of the damage of health of the worker (Nanos, 2005).

Likelihood of report of worker in each type of risk, taking into consideration: the frequency and duration of report of worker, the reliability of systems and mechanisms of safety, concerning their frequency of maintenance, the degree of protection from the means of individual protection etc.

Weighting	Consequence
1	Minor accident (minor injury of an employee)
2	Moderate accident (moderate injury, caused a few days absent from work)
3	Grave accident (serious injury)
4	Very serious accident (injury with physical disability)
5	Catastrophic (many workers have serious injuries or deaths)

Table 2: Consequences of accidents at work place (Nanos, 2005).

On the basis of this analysis a “map of” dangers in the organization can result, which connects the various places of work with the corresponding risks that exist or can arise.

Consequence likelihood	Minor accident	Moderate accident	Grave accident	Very serious accident	Catastrophic
Unlikely	1	2	3	4	5
Almost likely	2	4	6	8	10
Possible	3	6	9	12	15
Almost Certain	4	8	12	16	20
Certain	5	10	15	20	25

Table 3: “Map of” dangers at work place (Nanos, 2005).

Risk= likelihood x consequences

Weighting	Risk
1-5	Acceptable
6-12	Monitoring the risk
16-25	Not acceptable risk.

Table 4: Risk response (Nanos, 2005).

Accordingly, it is possible for decisions to be taken on the already existing venturesomeness in the working places, as well as proposed measures aimed at the reduction or obliteration of it.

#### *Job Safety Analysis*

The process of JSA has three steps (Rozenfeld, Sacks, Rosenfeld, & Baum, 2010):

- Risk Identification. Analyze all the possible risks that may occur in each working process separately. The working processes break down into segments and separate parts in order to identify the sources of risks that may lead to an unsafe condition in the working environment.
- Risk Assessment. Evaluation of the impact and consequence of the risks.
- Response to the risks. Take measures and monitor the risk in order to mitigate or eliminate risks.

Every risk is evaluated on the following criteria:

- The likelihood of occurrence of the risk and
- The severity and consequence of the risk if it occurred

*‘‘Fine’s and Kinney’s method’’:*

In this technique Fine 1971 Model (Fine & Kinney, 1971), the risk is given by:

$R = C \times E \times P$ , where

$C$  = undesirable results (the likely results of an accident like bodily injury or property damage)

$E$  = possible repercussions potential (this factor represents the possibility of an accident occurrence),

$P$  = accident probability arising from the occurrence of the harmful event.

*Hammer 1972 Model*

The risk coefficient  $R$  is expressed by the relation:  $R = D \times M \times N$

(Arvanitogeorgos, 1999), in which

$D$  = loss extent per accident (which is usually expressed as the number of people who have been injured or incurred monetary costs)

$M$  = accident rate (expressed as the cause of accident numbers in relation to a unit of time )

$N$  = time period or number of time periods during which accidents can happen of have already happened.

*MORT Method (Management Oversight and Risk Tree)*

In this method, ‘‘an accident is an undesirable ‘‘energy transfer’’ that occurs due to inadequate ‘‘energy barriers or controls’’’’ (Katsakiori, Sakellaropoulos, & Manatakis, 2008). Prevention focuses on energy source identification and then on energy transfer



harmful effects handling. This method resembles FTA, but examines more faults and oversights of the management and organization. It is based on the premise that all accident losses start from three sources. The MORT method identifies the oversights and failures in the accident (S factor) as well as the general failures in the company's management (M factor). In other words, it identifies a large number of measures for safety improvement but lacks a connection between the S- & M factors (Katsakiori, Sakellaropoulos, & Manatakis, 2008).

#### *CTM Method (Causal Tree Method)*

According to this method, ‘an accident results from variations or deviations in the usual process’ (Katsakiori, Sakellaropoulos, & Manatakis, 2008). The probing team must identify and enumerate these deviations and then organize them in a diagrammatic form, defining their interdependencies. This is the causal tree, which shows all those events that lead to the accident, zeroing in on the chronological order and the logical relationships between them. The requirement for the application of this method is to clearly define working conditions so that the deviations that occurred and constituted the accident can be identified (Katsakiori, Sakellaropoulos, & Manatakis, 2008).

#### *OARU Method (Occupational Accident Research Unit)*

It is aimed at the definition of a common framework of accident investigation by all the members of the investigatory department of occupational accidents. The OARU method emphasizes the system's condition and the capability of defining a «normal condition situation» so that the deviations arising from it are deemed pertinent to the

accident. According to this method, the coherence of the accident is divided into 3 phases: “the initiate phase (when there is a first deviation in the system), the concluding phase and the injury phase” (Katsakiori, Sakellaropoulos, & Manatakis, 2008). One of the advantages of this method is that it has checklists for deviation detection and causal factors. In this way, the method guides the probing team to suggestion- making for taking on-the-spot and long-term measures (Katsakiori, Sakellaropoulos, & Manatakis, 2008).

#### *SCAT method (Systematic Cause Analysis Technique)*

According to this method, the accident is described as a chain of incidents. It consists of 5 domino stages in the process of an accident: 1) control loss (safety procedures and standard practices) 2) personal and occupational factors (basic causes) 3) actions and conditions (direct causes) 4) the accident itself (contact with the action or substance) and 5) the consequences (viz. damage to people, property and the environment) (Katsakiori, Sakellaropoulos, & Manatakis, 2008). The prevention philosophy is based on the subtraction of one of the dominos or on the creation of obstacles for the prevention of energy transfer in the sequence, avoiding the ensuing loss stage.

#### *3CA Method (Control Change Cause Analysis)*

As per 3CA, an accident happens in the context of a continuous flow of changes dynamically interrelated with causal relationships (Katsakiori, Sakellaropoulos, & Manatakis, 2008). From this complex mix, the probing team selects the important events and identifies the undesirable change for each event, obstacle, control, failure and cause behind administrative insufficiencies.

### Risk analysis

In this stage, there are three steps to implement:

- Analysis of major risks in order to assess severity of impact and probability of occurrence (Kerzner, 2006),
- Synthesis of all risks to predict most likely project outcome and (Kerzner, 2006).
- Investigation of alternative course of actions (Verzuch, 2008).

### Risk response

All the generic risks identified in the corporate hierarchy have an established response or control (Verzuch, 2008). Some of these may be procedural, others may be discretionary. The progressive process of thorough risk identification and assessment will review whether the level of control is appropriate and how effective it is in managing the risks without impeding the opportunities (Kerzner, 2006).

For any specific risk identified or new nuance of generic risks, the control mechanisms will be similarly reviewed and new response strategies will be developed as required (Gerard M., 2008).

Response Strategy	Information
Risk avoidance	It is only possible to wholly avoid the risks in pursuing an opportunity by taking a different course of action and possibly diminishing the opportunity. If we actively seek to avoid risk, we should identify the opportunities which may be lost
Risk reduction	Either through reducing the likelihood of risks occurring or their potential impact or both.
Risk transfer	Passing the responsibility for the risk (and hence its consequences) to another party. This will almost always result in a 'premium' cost which should be balanced with carrying the risk. It should be remembered that risk transfer is rarely wholly successful; either because <i>all</i> the impact cannot be transferred (such as the effects of a 3 <sup>rd</sup> party's action on our reputation) or because the transfer mechanisms are not wholly watertight (for instance sub-contract forms) When we are transferring risk we have to consider what <i>residual risk</i> we are carrying
Risk sharing	This is an approach which is growing in use throughout construction. It requires a number of partners to work together to manage risk in the interests of everyone. It should be the most effective response since there is no reliance on one party carrying the impact of another's actions. All parties do need to work together and the effectiveness can diminish where the sharing of success is misaligned with the sharing of risk.
Risk acceptance	A risk is rarely accepted without <i>any</i> reduction mechanisms. Usually, risk acceptance occurs when a party has the confidence to manage the risk better than any 3 <sup>rd</sup> party and the residual impacts are therefore lower in that party's estimation than anybody to whom the risk might be transferred. Other considerations may be that the cost of other risk measures actually prohibits what is perceived to be a high profit opportunity.

Table 5 : Risk response strategy (Gerard M., 2008).

### Risk management review

Having identified the risks, appreciated their significance and established a response strategy, there must be a continual process to review the effectiveness of our identification, assessment and response strategy (Verzuch, 2008).

We need to ensure that (to the best of our abilities):

- our initial identification process identifies all risks;

- our appreciation of risk is consistent and accurate;
- we have undertaken the responses that we said we would; and
- our response strategies are effective in managing risk to maximize opportunity.

The identified risks, controls and treatment strategies discussed above are not static (Verzuch, 2008). As new projects arise, activities move into different phases and business environment changes and consequently these risks as well as the appropriateness of their controls/treatment strategies will change (Kerzner, 2006).

The business will be responsible for ensuring not only that, for each risk, the initial control/treatment strategy is in place and working effectively but also for reviewing the appropriateness of this control in future periods. To be effective, this step must be integrated into the company's daily activities (Niskanen & Olli, 1983).

Individual risks shall be reviewed as frequently as is necessary to monitor the development of the risks. A period for review shall be included in the response to each risk.

#### Effective Leadership for safe performance

What is defined as "Safety culture" and "safety Climate"?

The U.K. Health and Safety Commission define Safety Culture as "the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management" (Glendon, Clarke, & McKenna, 2006, p. 364), and "safety climate can be defined as the manifestation of the underlying safety

culture in safety-related behaviors of employees and in employees' expressed attitudes'' (Mearns, Whitaker, & Flin, 2001, p. 771).

More definitions of the safety culture and climate are: "*Safety culture*: The enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety; act to preserve, enhance and communicate safety concerns; strive to actively learn, adapt and modify (both individual and organizational) behavior based on lessons learned from mistakes; and be rewarded in a manner consistent with these values. And *Safety climate*: The temporal state measure of safety culture, subject to commonalities among individual perceptions of the organization. It is therefore situationally based, refers to the perceived state of safety at a particular place at a particular time, is relatively unstable, and subject to change depending on the features of the current environment or prevailing conditions." (Zhang, Wiegmann, Thade, Sharma, & Mitchell, 2002, p. 3).

#### Levels of Safety culture of the organization

Every organization that has a different safety culture reacts in a different way to safety issues. Hudson (2003), divides into five stages the behavior of the organization in front the safety reasons.

The first stage is the "Pathological": the organization imputes all the blames of the unsafe conditions and practices to the workers. The second stage is the "Reactive": the organization starts reacting after the accident or after the unsafe incident has happened. The Third stage is the "Calculative": the organization leaves to the

management and their methods and tools, the safety issues, keeping the overall workers outside. The next stage is the “Proactive”: the organization improves their approach to safety issues. The workers start to involve the safety management of the company. The final stage is the “Generative” where the whole organization and workers of the organization participate in safety. Safety culture is part of the culture of an organization.

Filho et al (2010) move ahead and divide the maturity of the organization into the following stages: “Pathological, Reactive, Bureaucratic, Proactive and Sustainable”. The management of the organization could, with the help of the upper models, identify, which stage of safety culture the organization belongs to and try to improve it (Filho, Andrade, & Marinho, 2010).

#### Organizational culture

The expedient environment for the achievement of safety culture in the organization has the following basic characteristics:

- The stability of values, strategy and objectives concerning the safety climate (Nga & Cheng, 2005).

Augoustakis (2008), mentioned that today the mobility of personnel undertakes high administrative places, much higher than the past. This means that safety and health culture should be corporate values accompanied by analogue strategy and objectives that will be called for to apply to each administrative hierarchy.

- Consequence of the implementation of strategy
- The continuity in the delivery of methods and good practices
- The decisions of administrations

The top-managers of the organization, in order to create this environment - climate, will be supposed to (Augoustakis, 2008):

- Decide that they really wish to create such an environment in order to support it with management hierarchy (Siu, Phillips, & Leung, 2003).
- Commit to this implementation and promulgate a concrete corporate policy (Kartam, Flood, & Koushki, 2000)
- Demonstrates regularly on every occasion their personal interest (Teo, Ling, & Chong, 2005).

#### The effective method of safety management

The method of safety management that brings permanent results to subjects of safety culture, is the one that is based on the (participative principle) Beginning of Attendance (Augoustakis, 2008). Safety culture is not just the legal obligation of the organization, but, mainly, the basic value of life for each one of the workers, who consequently participate in these subjects ipso jure. The body that will exercise the Administration of Safety should, pursuant to the beginning of attendance, be constituted by all front-line Managerial Executives with a suitable choice and distribution of sectors of jurisdiction and analogue support (Sawacha, Naoum, & Fong, 1999).

The appropriate measures:

Augoustakis (2008) indicates that the measures that are needed for company administration so that it could effectuate its strategy are as follows:

- The development throughout the management hierarchy and faculty of leadership to influence individuals in order to achieve their objectives together ,



specifically on subjects of safety management, so that they can instill in personnel the need for safe behaviors (Nga & Cheng, 2005) .

- The development of internal structures of communication that serve and support the attendance of all workers (Nga & Cheng, 2005), (Abudayyeh, Fredericks, Butt, & Shaar, 2006)
- The documentation of the measures taken which concern equipment or processes (Aksorn & Hadikusumo, 2008).
- The education of all workers should be continuous, suitable and aimed at each place and level of responsibility (Jaselskis EJ, Anderson, & Russell, 1996).

The common goal of leadership has to be “safe behavior” (Augoustakis, 2008).

#### Leader

According to Kerzer (2006) a project manager must have the following “ten skills” on a professional level:

- Team building
- Leadership
- Conflict resolution
- Technical expertise
- Planning
- Organizational
- Entrepreneurship
- Administration
- Management support building skills

- Resource allocation skills’’

‘’Effective project leadership involves a whole of skills:

- Clear direction and guidance
- Ability to plan and elicit commitments
- Communication skills
- Assistance in problem solving
- Dealing effectively with managers and support personnel across functional lines’’ (Pinto & Trailer, 1998).

In order to help and motivate his employees to work towards achieving the goals set, a good leader must have the following qualities:

1. The ability to understand that there are certain things that make his employees tick. This understanding can help him apply his expertise to the appropriate circumstances and act in such a way as to bring out in them the desired responses (Pinto & Trailer, 1998).
2. His ability to inspire and boost employees' morale (Pinto & Trailer, 1998).
3. The ability to act in a way that could motivate personnel (Kerzner, 2006) . It is a type of leadership that will be applied and decided by the leader's personality.

#### Leadership styles

Leadership styles usually vary from leader to leader and from situation to situation, which, in essence, constitute a particular type of leadership adopted by a manager. Namely, this combination of factors and behaviors used by a manager defines his leadership style, which is a composite of (a) his attitude toward people (b) the power

wielded and the concern displayed for work completion (goal accomplishment) and for the welfare, development, job satisfaction and working conditions of the workers as well as for their character recognition (Alabakis, 2009), (Goutsos).

No leadership style is effective in all circumstances and suitable for all managers (Crichton M. , 2005). Ergo, the nub of the matter is which leadership style is appropriate for a particular period of time and how as well as under which circumstances. This is determined by the following factors (Alabakis, 2009):

- 1) Personality, education, experience and value system of the manager,
- 2) Character, education, experience, work knowledge and expectations of workers.
- 3) Situation factors: Corporate technology, structure, policies, leadership style of higher-ups.

The following theories about leadership are well-known. Each one of these theories suggests the ideal type of leader for the business world (Pinto & Trailer, 1998).

Table 6: Main categories of leadership styles (Pinto &amp; Triller, 1998).

Name	Description	Type of employee it can be used with
"Autocratic"	The manager wields as much power as possible and exercises the right of decision-making. He operates in an absolute and autarchic way, making decisions without using his employees as sounding boards. He just orders around, expecting unquestioned obedience.	New employees who must learn their job fast.  Difficult to control temps who do not respond to other styles.
"Bureaucratic"	The manager goes by the book and focuses on the completion of work and professional demeanor prescribed by specific rules, policies and standard procedures of work completion. He must rely on higher administrative departments to settle matters not resolved by employees, regulations or directives.	Employees who must go through the proper channels (like accountants dealing with tax return statements or S&P staff who must fulfil purchase contract requirements).  Workers doing hazardous work or handle hazardous equipment or work in special conditions.
"Democratic"	A Participative style of management with reciprocity and discussion on issues concerning all employees. The contribution of employees is required and the decision-making process actively involves them. This leadership style affords them considerable authorization.	Highly skilled and experienced workers who will be asked to make important changes in their workplace (e.g. completion or commission of work). Employees who would like to make their complaints known or work teams facing the same challenges.
"Laissez-faire"	The manager does not intervene. He authorizes his personnel and allows them a lot of leeway, without breathing down their neck the whole time or prescribing the ways of work conduct.	Highly motivated employees, such as expert technical staff and sometimes consultants.

### Safety leader

Each manager, when playing a leadership role, in his department, has a specific productivity goal which he has delegated to his team members. In terms of work safety, the goal of all employers is one:

To achieve the adoption of on-the-job safety conduct from all employees regardless of their department. (Holistic and participative action), (Abudayyeh,

Fredericks, Butt, & Shaar, 2006), (Teo, Ling, & Chong, 2005).

The achievement of this goal creates the «safe delivery to work» for the company which encompasses successfully every newcomer and does not allow the creation of a gap when one leaves the premises.

#### Achieving safety behavioral patterns objectives

The leadership technique, which should be followed by those managers whose aim is to influence staff to adopt safety behaviors in the workplace, includes the following steps:

Step 1: Observation of the set of attitudes towards safety and reporting the actions and situations which are safe or hazardous (Teo, Ling, & Chong, 2005).

Step 2: Approach with specific «explicit» behaviors of individuals, reward for safety actions and probing of hazardous actions and situations causes (Kartam, Flood, & Koushki, 2000).

Step 3: Discussion on hazardous acts και situations. Managers must inform the staff and ask their opinion about safety issues to facilitate their participation in the framework of all safety-cum-health related issues during the conduct of work (Dea & Flin, 2001). This open door policy between management and employees on issues of Health & Safety are conducive to the company's productivity and employee self-satisfaction level boost, thus increasing the management's feedback effect and helping in development of culture around the organization's health and safety which ultimately ameliorates safety conditions for the organization (Abudayyeh, Fredericks, Butt, & Shaar, 2006).

Step 4: To ensure that each worker will receive sufficient vocational training regarding occupational safety and health (Abudayyeh, Fredericks, Butt, & Shaar, 2006), (Kartam, Flood, & Koushki, 2000).

Step 5: To influence opinions with a view to eliminating the possibility of unsafe acts repeating and adopting permanent safety-oriented behaviors (Teo, Ling, & Chong, 2005).

Prentanou (2007), Indicates that more specifically a safety leader must:

- oversee regularly working positions from a health and safety perspective, report to the manager any oversights detected during inspection in terms of health and safety, process and suggest measures to deal with the detected oversights and oversee their implementation.
- oversee the correct use of personal means of protection.
- examine the causes of occupational accidents, analyze and evaluate the results of his studies and suggest measures for the prevention of similar accidents in the workplace.
- oversee the execution of fire drills and security alerts for ensuring that employees will be ready to respond promptly to emergency situations and deal with hazards.
- care about employee compliance with health and safety rules in the workplace by informing and guiding them towards occupational hazards prevention associated with their work.

- participate in the training and implementation of employee vocational program on occupational health and safety issues.

#### Team motivation through recognition of safe work conduct

Due to the fact that safety programs through incentives can get stuck in a rut and become inefficient and irrelevant as time goes by, experts thought of a better way to ensure safety and this could be achieved through management training and encouragement. The companies which instill in their managers the value of recognition of safe work conduct ultimately have the best safety mindset (Andriessen, 1978).

The one-size-fits-all approach is recommended for certain safety program through incentives but recognition is a far more personal issue.

The managers who are actively involved in this safety operation management can exert the most positive influence compared to any other factor (Teo, Ling, & Chong, 2005).

#### Five main alternative incentives

A manager would be better off using an incentive-based safety program than trying to buy off his staff. This could ensure safety of work and could be achieved by implementing incentives that bind each employee to take the responsibility to make safety happen.

#### Making safety a real value.

- Safety must be as important as productivity rate and profits. Staff must be aware that no job is worth risking one's health and life (Teo, Ling, & Chong, 2005).

- When executives, managers and officers are actively involved in ensuring safe working conditions, this effort will be noticed and appreciated by the staff (Teo, Ling, & Chong, 2005). Managers can show their commitment to safety in the workplace by simply following the safety working procedures and by listening attentively to concerns voiced by workers (Abudayyeh, Fredericks, Butt, & Shaar, 2006). By acting upon them and participating actively in conferences on safety issues in the workplace, managers can show their interest in staff safety and welfare during their conduct of work in the workplace (Dea & Flin, 2001).
- Inclusion of staff in safety procedures. Encouraging staff to participate in efforts aimed at changing the workplace into a space safe for the conduct of work through participation in safety committees, accident investigations and program for occupational safety proposals (Abudayyeh, Fredericks, Butt, & Shaar, 2006). This could be done during their regular daily hours of work with due recognition of their efforts. Realizing what helps them work in safety works toward its achievement (Aksorn & Hadikusumo, 2008).
- Employees work hard in order to come up to their managers' expectations. It is necessary that it be clear that safety procedures be followed by everyone and suitable gear be worn by all employees (Teo, Ling, & Chong, 2005). Managers and supervisors should also expect their staff to define and report any obstacles that may be around their workplace (Teo, Ling, & Chong, 2005).
- Employees must also set their own goals. Most safety program coupled with the use of incentives is developed around safety tools cooperation. Workers could oppose to managers' proclamations should they feel that management is



detached from their daily occupational challenges. Conversely, workers will respond more favorably if they set their own goals of personal safety (Abudayyeh, Fredericks, Butt, & Shaar, 2006). Autonomy is necessary because it will give them the latitude to ensure that daily work will be free of occupational hazards which could prevent them from returning safely home.

#### Incentive investment

Even the most creative incentive-based safety program can fail to ensure occupational safety. Investments of money do not always yield the expected returns. Instead of focusing on such a program, executives, managers and supervisors should make employee motivation a shared priority. They must be committed to ensuring occupational safety through hard work and effort (Teo, Ling, & Chong, 2005). This would instill the value of ensuring safety in workers who would be encouraged to work towards achieving it. The realization of the importance of occupational safety will make employees strive personally to achieve it because this could ensure not only their own personal safety but also the safety of their co-workers (Burt, Sepie, & McFadden, 2006). This is another way of eliminating occupational accidents and ensuring workers' safe return home.

#### Empowered Teamwork for safe performance

##### Define Teamwork

Heller (1998, p. 6) , indicates that “A true team is a living, constantly changing, dynamic force in which a number of people come together to work. Team members discuss their objectives, assess ideas, make decisions, and work towards their targets together.”

Main co-efficients of effective team work development.

Effective team work development is a must have for many corporate or at least for those striving to be at the forefront of development.

Lamentably, during the developmental process of these teams, the organization's management may ignore the fact that work teams are not only part of the organization but social teams as well. Like families, teams are comprised of a number of members who live together 5 days a week and spend 8 or more hours each day. Unlike families, teams consist of members with different mindsets, value systems and background. Due to this diversity, it takes time, effort and patience for the members of the team to learn to work together.

In the process, management and team members would benefit from learning the main team development factors/indices so as to create effective work teams. The most important of these factors or co-efficients are the ones cited herein and their description presupposes the complete development of the team.

- Commitment

The team members view themselves as part of the team rather than autonomous individuals. These individuals are committed to the goals of the team, brushing aside any personal goals (Heller, 1998).

- Trust

The members of the team trust each other and are expected to keep their pledges, maintain mutual trust, support each other and generally act in way that is thoughtful, predictable and acceptable by the team (Heller, 1998),.

- Goal

The team realizes its contribution to the smooth operation of the company. Its members understand their role and have a sense of active participation which ultimately helps in the achievement of the goals set by the company (Meredith & Mantel, 2006). Work safety is a common goal for all employees.

- Communication

Communication refers to the place and degree of interactivity within the members of the team and between them and the outer world. It also includes the manner in which likely conflicts are handled, the decision-making process as well as their daily interaction (Heller, 1998), (Hwang, et al., 2009).

- Team members' motivation

Each member of the team has a role to play and, irrespective of differences, all members must feel like real colleagues who muck in before an important action takes place so as to ensure that there is true convergence of opinion (Heller, 1998).

- Procedure oriented drive.

Since the team understands its purpose (the reason for its existence and where it is headed), what it now must have in place is an appropriate procedure and a way to achieve this goal. This procedure must include tools of problem resolution, appropriate steps planning techniques, frequent meetings, proper organization of these meetings with lists of subjects and minutes keeping about the actions decided and the acceptable ways of confronting and resolving the problems if and when they arise (Meredith & Mantel, 2006).

### Stress as an occupational accidents factor

The workplace nowadays requires high productivity and efficiency, thus putting employees under considerable pressure to come up to the employer's expectations (Niskanen & Olli, 1983). Moreover, in the current climate, work is a way of getting accepted and recognized that is why it plays such a prominent role in people's lives. The importance of work is easily perceived when one thinks about the high unemployment rates prevailing and the devastating consequences ensuing (Iliadou, 2008).

Work parameters such as working hours, night shifts, occupational and vocational insecurity, salary docking probability and possible demotion lead to stress (Iliadou, 2008).

The most notable occupational stressors are the following:

- Heavy workload (Rundmo, 1992). It has been shown that workers obliged to work longer hours and carry out many duties at the same time resort to harmful habits such as smoking, alcohol abuse and so forth and run greater risk of falling sick in comparison with workers who have a lighter workload.
- Attention distraction, agitation, errors, muddled thinking, constant negative thoughts, decision-making difficulty, bad dreams or nightmares, diminished intuition and sensitivity, poor judgment, short-term and rash decisions leading to an increase in unsafe occupational tactics (Makin & Winder, 2008).
- Conflict and vagueness of roles (Makin & Winder, 2008). As role conflict is defined the mixed signals the employee receives from various people each time in regard to his work duties. As vagueness of roles is defined the condition in

which the worker is unable to understand what his supposed duties are in the framework of his work as well as the assessment criteria for his work.

- Factors that relate to interpersonal relationships in the workplace. Workers who are unable to interact with their co-workers, due to the nature of their work, are usually individuals disenchanted with their job (Niskanen & Olli, 1983).
- Stress has an adverse impact not only on work quality but also on the productivity and safety level as well as on the health of workers (Tsokou, 2008). It can also result in conduct problems, such as absenteeism, increased smoking, increased alcohol and mind-altering substance abuse, aggressive attitude towards co-workers and heightened propensity towards accidents (Tsokou, 2008).

#### Other accident factors

Specific employee propensity to accidents: Studies bear out the fact that there is a specific subgroup of people in the general population who are more accident prone than others due to inborn traits found in their personality which predispose them to accidents (Donald & Canter, 1993).

Human behavior, especially if under pressure, is observed to be based more on social conventions and perceptions than on specific and occasional work orders and instructions which could come in conflict with them. In these situations, the employee follows these ingrained behavioral standards which could lead to dangerous situations in the specific workplace (Makin & Winder, 2008).

Siu, et al (2003) mentioned that, it must also be pointed out that as an individual grows up, some occupational capacities, whether it be physiological (cardiovascular function, musculature, endurance) or mental (e.g. sensory and motor performance, decision-taking time, memory span) gradually degenerate. This fact alone diminishes a person's ability to deal with work demands. However, there is a countervailing fact as most aged workers are better able to reduce difficulties in responding to work demands due to their long experience and effective resource utilization. Many studies showed a diminished frequency of accidents as workers get older. Conversely, several studies found that the older one gets, the greater the accident consequences whether it be death-causing or crippling or just leading to multiple days of lost work per accident.

Trola (2002) indicates that the employee must:

- Abide by the commands and instructions that have been established and implemented by the company or the employer.
- Implement hygiene and safety rules in the workplace.
- Correctly use machinery, appliances, tools, dangerous substances, transportation means during the conduct of work (Teizer, Allread, Fullerton, & Hinze, 2010)
- Not render inoperative, alter or relocate arbitrarily machinery, tools, appliances, facilities and buildings safety mechanisms
- In cases when he faces health, personal or job-related problems (e.g. because of attention distraction) that could lead to an accident, the worker must discontinue work or do easier jobs.

### Aliens in the constructional sector

The percentage of foreign workers working in building companies is extremely high (Kiriazi, 2010). They work, in the main, as simple workers or technicians. Managerial posts, however, are filled by Greeks. Especially, small building companies, playing the role of subcontractor, are engulfed by foreign workers, who come from Balkan countries like Albania, Romania, Bulgaria and Asian countries like Pakistan (Panagiotopoulos, 2010). All these aliens speak a different language and do not speak very good Greek. They also have a different work culture και and the way they deal with hygiene and safety in the workplace is almost non-existent. According to Social Security Institution figures, most of the aliens working in Greece are not insured, thus creating a huge gap in the hygiene & safety sector not only in terms of the company's work culture but also in terms of occupational accident records ( Labor Inspection Agency, 2005).

## Chapter 4

### Description of Methodology

With a view to achieving the objectives defined, I have decided to choose the qualitative research methodology as opposed to the quantitative one as I intend to determine the rate at which gas station construction companies actually apply and promote safety culture at work.

The company I am working for specializes in providing technical support for BP Petroleum Company. The construction and maintenance of gas stations is outsourced to subcontractors while my company is in fact conducting the supervising. In other words, the employees of the BP technical department are working as project managers. Such projects can include the construction of a gas station or the partial construction of a gas station part such as the replacement of tanks or pumps or canopy. These subcontractors are not only cooperating with BP but also with the rest of all petroleum retail companies actively participating in Greece such as Shell, Eco, Avin, Jet Oil and so forth.

In order to assess the occupational hazards in the course of the construction of a gas station, I have conducted twenty spot audits in the past three months. More precisely, I paid on-the-spot visits to gas stations and assess as well as check if the subcontractors abide by the rules governing safety at work. These audits are conducted on the basis of the information obtained by reading risk related literature.

As a matter of fact, I visited and audited 20 different subcontractors in the field of gas station construction. During my audit, I conversed with the supervisor and some employees on matters of safety at work with a view to grasping the perception of



employees concerning safety at work. In fact, you will find attached an example of a site audit form in the appendix A. I have already been granted permission by the safety supervisor of my company to conduct these audits and been promised his unconditional cooperation regarding the furnishing of all necessary facts and data which would enable me to complete successfully my thesis.

Because there is a code of ethics, I would like the names of the subcontractors to remain confidential. Thus, these subcontractors will remain anonymous in the course of conducting these audits.

In the course of the audits and evaluation, I played an active part in the safety procedure, came into contact with the subcontractor's labor force, initially observing the state of facilities and the ways tasks are carried out. I identified the working conditions, behavioral patterns, skills and idiosyncrasies of people and the likely causes of hazards.

During my discussion with the head and workers of the worksite, which had to be bilaterally honest, the hazardous occupational situations, likely risks and hazards arising from them were identified and underlined.

Also, the way in which the subcontractor dealt with these situations and parlous working conditions and practices as well as the possibility of coming up with a hazards estimate plan came up for discussion. Another topic that came up was the gravity that both the company and the workers give to safety issues including the training of workers regarding these issues. The checklist is a valuable tool in my hands since it greatly helped me to gain a deeper insight into the way each subcontractor personally perceives and implements the term occupational safety.

The questionnaire for the subcontractors' evaluation on hygiene and safety issues is divided into 10 modules, each of which raising questions related to each subcontractor's safety policies. All module questions include safety requirements and present a qualitative estimate in the form of ratings. On a scale of 0 to 10, I have assessed the extent to which the subcontractor abides by workplace safety rules. The 10 modules are analyzed below.

#### 1) Licensing

Electricians, plumbers and machinery operators working in worksites and performing dangerous jobs must be holders of the respective degree or certificate and possess the knowledge and training required to perform each of these jobs.

- Does the staff hold all the appropriate work licenses (operators, electricians, plumbers, etc.)
- Has a licensed Security technician been appointed?

#### 2) Personal Protection Equipment (PPE)

Main requirement for PPE: It must always be in good condition, fault-free, clean & ready for immediate use.

- Is there a PPE policy in place?
- Is PPE provided?
- Are instructions given to the staff regarding the time and place that they can make use of it?
- Is PPE maintained in good condition?
- Is an inspection system implemented for the detection and replacement of worn-out equipment?

3) Emergency situations management scheme

- Is there an emergency situations management scheme?
- Is it understood by the workers?
- Are roles and responsibilities for emergency situations clearly defined?
- Has there been preliminary testing to check the emergency situation management scheme?

4) Risk Management

- Is there a potential risks detection system?
- Have the relevant risks been assessed?
- Are hazards reviewed at regular intervals?

5) Management systems

- Is the contractor certified according to the accredited standard of quality management (e.g. ISO 9001)? If not, does it manage quality issues?
- Is the contractor certified in conformity with an accredited standard of environmental management (e.g. ISO 14001)? If not, has it detected and manage environmental issues?
- Has the contractor been certified in compliance with the accredited Health and Safety Management standard (e.g. OHSAS 18001)? If not, has he identified and managed health and safety related issues?

6) Subcontractors' control

- Does the contractor use subcontractors?
- How is subcontractors' suitability evaluated?

- Which method of continuous safety assurance does the Contractor use to check subcontractors' work?

7) Contractor's experience

- Does the contractor do similar tasks within the framework of petroleum field activities?

8) Accident reporting and investigation

- Is there a system that can ensure the reporting, investigation, follow-up and recording of all accidents and incidents?
- Is the contractor willing to exchange knowledge and experiences which he acquired through accidents and events?

9) Safety issues education

- Is there an educational program in place for the contractor's and subcontractor's workers?
- What kind of education is offered and by whom?

10) Alcohol, drugs and mind-altering substances abuse control

- Is there a system that can ensure the absence of alcohol and drugs or other mind-altering substances abuse in the workplace or during the operation of machinery?

The majority of the questions contained in the above audit which I conducted arise from the contractors' obligations according to Greek legislation on safety and hygiene which is compliant with the respective legislation of ILO. Personally, I selected a part of these obligations and I turned them into questions. More specifically, I am referring to questions 1-4 and 8 - 10.

Question five refers to whether the contractor has some management system certification and it was asked for the purpose of drawing conclusions about the company's organization and the importance that it attaches to it. Question six is asked to ascertain that the contractor selects a subcontractor on the basis of the criteria related to safety and hygiene. Question seven is posed to discover how many years of experience in gas station construction the contractor has which will inevitably give a greater significance to the results of the audits.

## Chapter 5

### Results

The results of the conduct of assessment of adequacy and ability of contractors to discharge their duties for the purpose of ensuring safety in conformity with the standards on hygiene and safety of the company.

The contractors' assessment which was conducted, led to the following findings

#### 1. Work licenses:

All contractors have employed a safety technician for their business so as to conform to the proposed legislation. On the contrary, it has been observed that a fairly large number of contractors do not employ certified skilled staff, but go for empirical workers, a case in point being foreign electricians who just know how to do the job but lack certification. The contractor feels that there is no cause for concern as his workers are experienced enough to the job.

The average rating obtained is 7.3 with 10, being the maximum rating. In percentage terms this works out at 73%. See appendix B & C.

#### 2. Personal Protection Equipment:

It has been observed that the majority of contractors have not recorded any specific PPE policy system. On the contrary, a segment of them uses PPE in part and according to each occasion and replaces it when it is damaged. The crushing majority of workers do not properly use PPE as most of the time they prefer not to use it even if it is at their disposal. In the course of the discussions held, they seemed to realize that PPE could protect them from a possible hazardous situation and injury but the importance of

its use has not sunk in. The worst of it is that simple workers, who are aliens in their majority, do not even ask from the contractor to give them this personal protective equipment, let alone replace the worn-out PPE. All they care about is keeping their job and do not pay any heed to PPE.

The mean score of the rating obtained is 2.4 with 10 being the maximum score and a proportional representation of 24%. See appendix B & C.

### 3. Emergency situations management plan :

No contractor has drawn up a detailed emergency situations management plan nor has he conducted any drills on it. A segment of contractors that have assigned a safety technician have proceeded to the development of a general plan. Workers are not aware of what should be done if an emergency situation arises. The emergency situations management plan includes a detailed description of actions in case such an incident occurs like personal injury, overflowing, fire, road accidents e.t.c. For example, there has been no identification of workers' muster stations or roles among workers as regards what each should do in the event of an accident. Also, the types of fire extinguishers and ways in which they can be used have not been identified. Workers have not done any alert drill and as a result they are not acquainted with what should be done in the case of real accidents. The contractors responsible told me that they will act accordingly should there be an accident.

The mean score of the rating obtained is 0/10 viz. 0%. See appendix B & C.

### 4. Risk management – venturesomeness assessment:

No contractor has put into practice any system to identify likely risks nor has he assessed them. Most contractors rely solely on their experience. Work is conducted under the guidelines and instructions of the worksite manager. Risk identification and assessment, safety methods planning and execution to prevent likely hazards, and measures development in the event of additional risks arising during the conduct of work are issues that sound like music to the ears of contractors but make them cringe as they find the whole process costly and time-consuming. This lamentable fact makes contractors loath to even consider risk management as a possibility.

The mean score of the rating obtained is 0/10 namely 0%. See appendix B & C.

#### 5. Management system:

Four in 10 sub-contractors are certified with the accredited quality management standard ISO 9001. No contractor is certified with the management standards of ISO 14001 and OHSAS 18001. The ISO 9001 certification is deemed sufficient both by those and those certified and by those who are not.

The mean score of the rating obtained is 2/10 viz. 20%. See appendix B & C.

#### 6. Sub-contractor inspection:

Contractors who use sub-contractors do not evaluate their performance in terms of hygiene and safety. Their evaluation is based on their experience and quality of work. They also set great store by the price quoted by sub-contractors.

The mean score of the obtained rating is 0/10 viz 0%. See appendix B & C.

#### 7. Contractor's experience:



The contractors' experience in the petroleum field is considered to be very satisfactory as most of them have been collaborating with other petroleum companies such as SHELL & EKO for many years.

The mean score of the rating obtained is 9.6/10 viz. 96%. See appendix B & C.

8. Report and investigation of accidents :

The overwhelming majorities of contractors employ a safety technician and keep an accident record. The problem is that it is not certain if there is a recording of any accidents that will happen in the workplace as most of the workers are not insured.

The mean score of the rating obtained is 9/10 viz. 90%. See appendix B & C.

9. Training on safety issues:

Contractors do not have in place a training program on safety issues since the presence of a safety technician in companies is purely cosmetic. Many petroleum companies offer safety training to their contractors who are obliged to attend them. The problem is that these seminars are attended by worksite engineers and contractors who are also owners but not by their workers who lack any skill. The contractors feel that they do not need to train their workers as this is costly. They also believe that they can impart the knowledge they have accumulated from safety seminars they have attended themselves and from their long years of practice in the sector to their workers.

The mean score of the rating obtained is 0/10 viz.0%. See appendix B & C.

10. Alcohol consumption, drug and mind-altering Substances Control:

No system is in place to guarantee that alcohol abuse drug or other substances abuse does not affect the performance of those contractors and workers who are involved in operations which require the utmost safety. Contractors rely more on their expertise and say that such an incident is highly unlikely as it would be instantly come to their attention.

The mean score of the rating obtained is 0/10 viz. 0%. See appendix B & C.

### Conclusions

Although, as aforesaid, 9 in 10 contractors have a safety technician (the contractors themselves in their majority have the capacity of safety contractor), their presence is purely cosmetic. This can result in repeated slippages into hygiene and safety. More specifically, no contractor has proceeded to the drawing-up of a detailed plan for emergency situations nor has he developed a possible risks detection system, nor is there any educational program in place on issues of safety for workers. In addition, there is no provision for any system that could attest to non-consumption of alcohol and zero drug abuse in the workplace.

### Suggestions-Solutions

Personally I feel that non-conformity with the expectations and dictates of contractors regarding issues of hygiene and safety can be attributed to 3 main reasons:

1. The sketchy training of contractors who could, for example, find the drawing-up of a detailed emergency situations plan a cumbersome and time-consuming process.

2. Their lack of understanding of the significance of hygiene and safety in the workplace.
3. The fallacious misconception and mentality that whatever comes up in the workplace will be solved on the spot based on their long experience.

This situation is reversible as long as some necessary measures are taken which could lead to a reconciliation of the policy and culture of contractors regarding Hygiene and Safety issues.

#### Staff training for safe execution of work.

All workers and executives must be given assurances that training on preventive measures and regular briefings on potential occupational risks will be provided for by the company so that they can carry out their duties in risk-free working environment without putting in danger their own life as well as the life of their co-workers. It is vital that access to information be provided for workers about the general hazards lurking in the workplace. Demands for training are crucial for understanding and using safely production processes which are notoriously complicated. Good training program do not only inform us about WHAT we do but also WHY we do it. These training program must assess performance and effectiveness by means of results recording.

### Standard safety work processes policy Development

Safety is the result of proper monitoring and planning

Once the audit data collection is complete, with the help of the professional literature review, I am going to develop a methodology through which accidents will be reduced and eliminated in the workplace. It is common knowledge that accidents are the result of a series of dangerous activities and conditions that can be eliminated only if they are consistently checked and audited.

Proper planning includes:

- ◆ Planning of work
- ◆ Choice of technicians- subcontractors- machinery-tools- equipment
- ◆ Risk Assessment
- ◆ SMS
- ◆ Implementation Monitoring and auditing
- ◆ Change management

### Work timetables and planning

To make sure that the progress of work can be known at any time, work timetables and planning succeed in doing so by utilizing the best means and workforce possible. In this way, safe work completion is assured within the specified constraints of timetable and cost budget.

Work timetables and planning to minimize the number of workers who could sustain potential injuries e.g. tasks that involve noise should be programmed in such a

way that could expose the minimum possible number of workers. The correct way of tasks programming of a project leads to:

- ◆ Timetable development and conformity - (Time linked to safety)
- ◆ Avoidance of multiple parties
- ◆ Better management of processes
- ◆ Easier work completion follow-up.
- ◆ Better hazardous situations management.

#### Choice of Technicians – Subcontractors – Machinery

The correct choice of personnel according to work demands is a necessary requirement for a safe working environment. The same goes for the choice of partners-subcontractors that must be inextricably linked to their policy on hygiene and safety matters. A correct choice includes the following:

- ◆ Certified technicians
- ◆ Technicians specializing in the required field.
- ◆ Subcontractors with a good safety record
- ◆ Certified subcontractors (e.g. OHSAS18001)
- ◆ Sub-contractors – «partners»
- ◆ Subcontractors with a permanent collaboration
- ◆ Contemporary subcontractors – not necessarily the cheapest
- ◆ Machinery– certified machinery operators

◆ Machinery of suitable potentiality

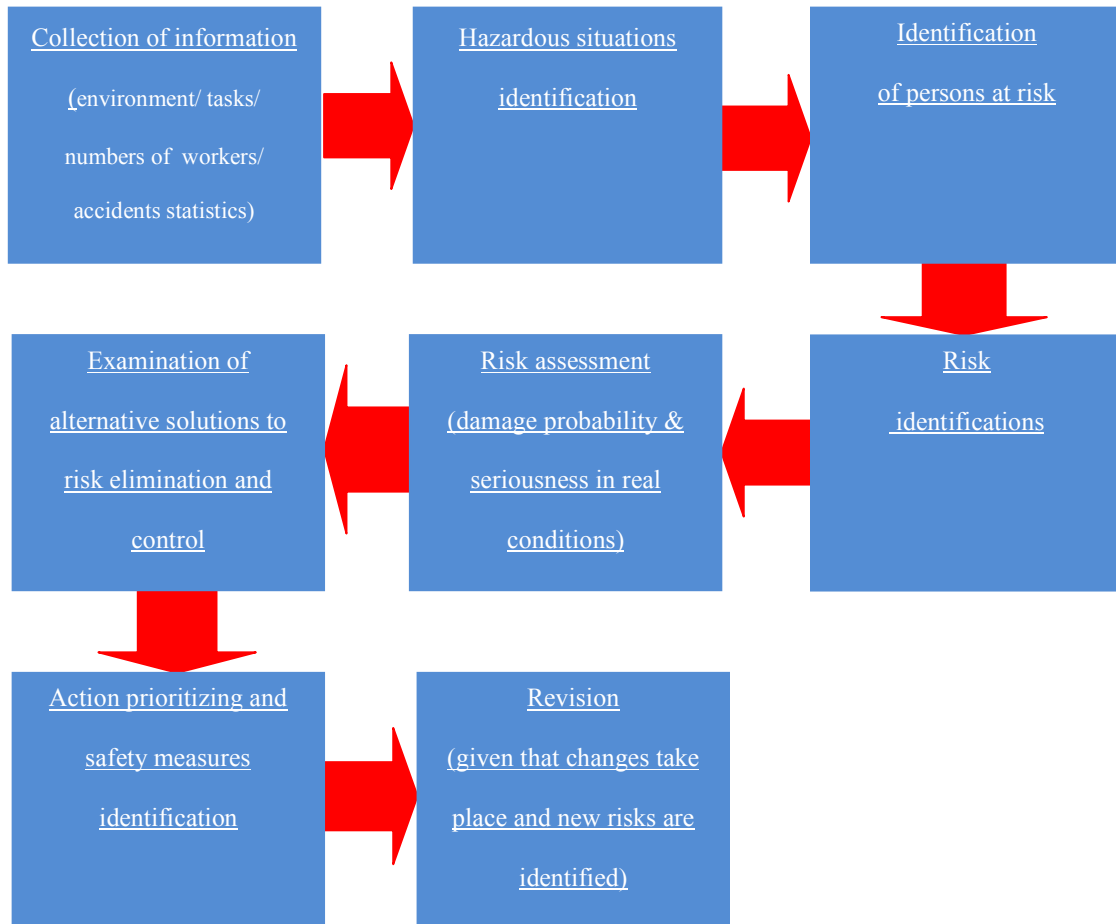
Risk Assessment

The methods of risk management identify, prevent and assess risks in order to institute positive measures for their control and reduction.

To ensure that Risk assessment is done properly and the risks and necessary risk management measures are identified for a risk-free work completion there must be:

- A careful examination of the working environment and data.
- A recording of unsafe conditions and hazards during the conduct of work.
- Measures for the avoidance of accidents to workers and third parties.
- A user-friendly method leading to quantitative assessment of risk with the use of numerical co-efficients assigned to factors affecting safety.
- A resulting rating giving a risk size assessment and defining the respective safety measures to be taken.

Figure 4: Flowchart: Risk assessment and management



Factors to consider		Weighting	Potential result
a) <b>Injury Severity</b> (Consider health, property damage, environment, program loss, as well as injury)		3	First Aid
		6	Lost Work Injury
		9	Major
		12	Fatal
		15	Multiple fatal
b) <b>Number of Persons exposed to hazard:</b>		2	1 person
		4	2 - 5 persons
		6	6 - 15 persons
		8	16 - 25 persons
		10	100+ persons
c) <b>Potential for harm with obvious controls used</b>		4	Happens rarely
		8	Happens regularly
		12	Happens once or twice on most jobs.
		16	Happens regularly on most jobs.
		20	Certain to happen.

Enter the appropriate weighting number in the relevant column of the risk assessment. Calculate the risk rating as follows:

**Risk Rating = a x (b + c)**

When, R is:

< 60	risk rate is minuscule
60 ≤ 90	risk rate is low
90 ≤ 130	risk rate is moderate
130 ≤ 450	risk rate is substantial
> 450	risk rate is high

0	60	90	130	450	1000
Minuscule	Low	Moderate	Substantial	High	

Table 7 : Risk assessment “map”



### Example

If 6 workers are working on applying a layer of insulation on a flat roof of a 3.5m height ==>

Gravity = 12 (mortal injury)

Number of workers at risk = 6

Accident occurrence probability = 12

$$(R) = A \times (B + C)$$

$$R = 12 \times (6+12) = 216$$

Ergo, the venturesomeness rate is substantial and significant preventive measures must be taken.

- Risk assessment is completed and agreement is reached before the commencement of work providing for the presence of a supervisor from the first day of commencement of work.
- The contractor is legally obliged to inform his personnel about the recognised risks and the measures to be taken.
- Risk assessment is not static but dynamic every time a serious risk is identified and assessed and the appropriate measures are taken.

### Safety working method:

This defines the manner in which jobs are carried out to the maximum degree of safety, after all likely risks have been assessed before the commencement of work, so that all the the appropriate measures and actions will be taken. The safety working method is drawn up before the commencement of any work, identifying the possible risks and selecting those ways of execution of work that minimize the possibility of risk occurrence. Safety working methods are inextricably linked to the work timetable and risk assessment.

As working method release manager could be appointed one of the following : the Project Mgr or other certified company member, the factory owner, the safety technician or the subcontractor..

The working method is issued and approved after visiting the place wher the work is carried out and prior to the commencement of any work. This release of working methods is done based on a work timetable so that all prompt measures can be taken, the proper equipment can be selected and the workers can be informed.

### How a working method is developed:

- Work- Think about work completion step-by step.
- Risks- Think about all those things that could go wrong and how likely this is.
- Planning-There should be thorough planning of the way in which workers can enter the worksite and carry out their work with safety.
- Personal Protection Means- There should be thorough explanation of how workers can use personal protection means correctly.

### Monitoring of work – Implementation follow-up

**Monitoring of work:** In order to effectively protect the workers, qualified persons must visit, oversee and monitor the worksite regularly and methodically to ensure that work execution directions are implemented and optimum practices are developed. Inspections guarantee conformity with legislation and with the risk management's system requirements from accidents resulting from processes. Following inspections, corrective actions must be taken based on the findings of failures and oversights. A reliable system should be in place that could monitor the effective execution of all the suggested corrected actions.

### Change management

Tasks that relate or arise from temporary or permanent changes :

- A. in organization,
- B. in personnel,
- C. in systems,
- D. in processes,
- E. in planning,
- F. in equipment,
- G. in rules and regulations,
- H. in the land-planning of the project
- I. in the timetable

Actions for proper change management:

- Identification of the results arising from the change.

- Re-evaluation of those risks which are affected by the change.
- Development of a project plan which spells out the timetable for change and every control measure required for its proper management.
- Briefing of all those involved in changes on all levels.

#### Preventive medical checks

Preventive medical checks at least on an annual basis to preempt any incidents of drugs and mind-altering substances abuse.

Alcohol and drugs are prohibited on the worksite as they endanger the life of the abuser and his co-workers, affect the team's concentration span and coordination, given that even the slightest quantity begins to affect the corporeal and mental performance of the abuser.

### Conclusion

It is an indubitable fact that our country clearly lacks a safety and hygiene culture not only among its employees (who are equally responsible) but also among the managers of many Greek businesses. Lifelong learning, also known as LLL, and open channels of communication between employees and management are the sole instruments of adopting a hygiene and safety culture in the workplace.

It must also be noted that most construction companies are not sensitized to issues of hygiene and safety and focus on satisfying the standard requirements prescribed by law which consequently do not require the effective implementation of risk management, which not only reduces hazards but also conduces directly to the enhancement of company productivity.

The overwhelming majority of construction companies, whose main concern is gas stations' construction, in conjunction with the hygiene and safety state agency connive at the laxity of safety and hygiene rules and show a flagrant ignorance of risk assessment methodology, which they paradoxically consider to be a powerful tool in the hands of a project manager and construction companies to pre-empt unsafe working practices and conditions. What an irony! Zero tolerance for accidents and unsafe working practices can be realized through the successful implementation of risk management coupled with an effective model of management and teams of workers which are imbued with safety culture. Following the proposed methodology, construction companies can eliminate occupational accidents at gas stations thanks to the proper and strict implementation of risk management.

First and foremost, both employers and employees must unquestionably incorporate the term safe work into the philosophy and culture of their company and adopt it. The development and maintenance of a "national hygiene and safety prevention policy culture" could mean the creation of a general hygiene and safety consciousness, risk awareness and understanding with an early start from primary education and continuity throughout people's professional life. Such a culture can substantially be improved by a dynamic policy with substantive commitments abiding by high standards of occupational health and safety. It can also contribute to the development of decent work, fostering respect for workers safety and dignity. It is a one-way street for whole-sale oil companies to put pressure on and collaborate only with subcontractors whose philosophy is inextricably linked to safety.

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APPENDIX A

Checklist for Safety Audit				
A/A	Requirement	Yes	No	Comments
1	<b>Licensing</b>			
	Do the staff hold all the appropriate work licences (operators, electricians, plumbers, etc.) ?			
	Has a licensed Security technician been appointed?			
	Score:			
2	<b>Personal Protection Equipment (PPE)</b>			
	Is there a PPE policy in place?			
	Is PPE provided?			
	Are instructions given to the staff regarding the time and place that they can make use of it?			
	Is PPE maintained in good condition?			
	Is an inspection system implemented for the detection and replacement of worn-out equipment?			
Score:				
3	<b>Emergency situations management scheme</b>			
	Is there an emergency situations management scheme?			
	Is it understood by the workers?			
	Are roles and responsibilities for emergency situations clearly defined?			
	Has there been preliminary testing to check the emergency situation management scheme?			
Score:				
4	<b>Risk Management</b>			
	Is there a potential risks detection system?			
	Have the relevant risks been assessed?			
	Are hazards reviewed at regular intervals?			
Score:				
5	<b>Management systems</b>			
	Is the contractor certified according to the accredited standard of quality management (e.g ISO 9001)? If not, does it manage quality issues?			
	Is the contractor certified in conformity with an accredited standard of environmental management (e.g ISO 14001)? If not, has it detected and manage environmental issues?			
	Has the contractor been certified in compliance with the accredited Health and Safety Management standard (e.g. OHSAS 18001)? If not, has he identified and managed health and safety related issues?			
	Score:			
6	<b>Subcontractors' control</b>			
	Does the contractor use subcontractors?			
	How is subcontractors' suitability evaluated?			
	Which method of continuous safety assurance does the Contractor use to check subcontractors' work?			
Score:				

7	<b>Contractor's experience</b>		
	Does the contractor do similar tasks within the framework of petroleum field activities?		
	Score:		
8	<b>Accident reporting and investigation</b>		
	Is there a system that can ensure the reporting, investigation, follow-up and recording of all accidents and incidents?		
	Is the contractor willing to exchange knowledge and experiences which he acquired through accidents and events?		
	Score:		
9	<b>Safety issues education</b>		
	Is there an educational programme in place for the contractor's and subcontractor's workers?		
	What kind of education is offered and by whom?		
	Score:		
10	<b>Alcohol, drugs and mind-altering substances abuse control</b>		
	Is there a system that can ensure the absence of alcohol and drugs or other mind-altering substances abuse in the workplace or during the operation of machinery?		
	Score:		
<b>Total score (%)</b>			

Safety auditor (Name / Signature):

Date:



Appendix B

AGGREGATE TABLE OF TOTAL RESULTS								
SUBCONTRACTORS ACCREDITATION FORM		Safety Audit 1	Safety Audit 2	Safety Audit 3	Safety Audit 4	Safety Audit 5	Safety Audit 6	Safety Audit 7
CHECK		Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis
No	CATEGORIES	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE
1	Licensing	7	8	8	6	7	8	8
2	Personal Protection Equipment (PPE)	4	2	2	3	2	2	4
3	Emergency situations management scheme	0	0	0	0	0	0	0
4	Risk Management	0	0	0	0	0	0	0
5	Management systems	3	3	3	3	3	3	0
6	Subcontractors' control	0	0	0	0	0	0	0
7	Contractor's experience	10	9	10	10	10	10	9
8	Accident reporting and investigation	9	9	9	9	9	9	9
9	Safety issues education	0	0	0	0	0	0	0
10	Alcohol, drugs and mind-altering substances abuse control	0	0	0	0	0	0	0
TOTAL SCORE		33	31	32	31	31	32	30
PERCENT OF TOTAL %		33%	31%	32%	31%	31%	32%	30%

AGGREGATE TABLE OF TOTAL RESULTS								
SUBCONTRACTORS ACCREDITATION FORM		Safety Audit 8	Safety Audit 9	Safety Audit 10	Safety Audit 11	Safety Audit 12	Safety Audit 13	Safety Audit 14
CHECK		Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis
No	<u>CATEGORIES</u>	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE
1	Licensing	7	8	7	8	8	6	6
2	Personal Protection Equipment (PPE)	2	2	2	3	2	2	2
3	Emergency situations management scheme	0	0	0	0	0	0	0
4	Risk Management	0	0	0	0	0	0	0
5	Management systems	3	3	3	0	0	0	0
6	Subcontractors' control	0	0	0	0	0	0	0
7	Contractor's experience	9	9	10	10	10	9	10
8	Accident reporting and investigation	9	9	9	9	9	9	9
9	Safety issues education	0	0	0	0	0	0	0
10	Alcohol, drugs and mind-altering substances abuse control	0	0	0	0	0	0	0
	TOTAL SCORE	30	31	31	30	29	26	27
	PERCENT OF TOTAL %	30%	31%	31%	30%	29%	26%	27%

AGREGATE TABLE OF TOTAL RESULTS							
	Safety Audit 15	Safety Audit 16	Safety Audit 17	Safety Audit 18	Safety Audit 19	Safety Audit 20	
	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	Hatzivasilis	
<u>CATEGORIES</u>	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	RECEIVING SCORE	AVERAGE SCORE
Licensing	6	8	8	8	7	7	73%
Personal Protection Equipment (PPE)	3	2	2	2	3	2	24%
Emergency situations management scheme	0	0	0	0	0	0	0%
Risk Management	0	0	0	0	0	0	0%
Management systems	3	0	3	3	0	3	20%
Subcontractors' control	0	0	0	0	0	0	0%
Contractor's experience	10	9	9	9	10	9	96%
Accident reporting and investigation	9	9	9	9	9	9	90%
Safety issues education	0	0	0	0	0	0	0%
Alcohol, drugs and mind-altering substances abuse control	0	0	0	0	0	0	0%
TOTAL SCORE	31	28	31	31	29	30	
PERCENT OF TOTAL %	31%	28%	31%	31%	29%	30%	30%

Appendix C

