

OHS Standard Evaluation in the Subway Construction in Iran

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Abstract—One of the most important aspects of health and safety approach is called an occupational, health, and safety management system (OHSM), where deficiencies existing in its procedures and policies, especially in the construction industry, may cause negative consequences such as heavy life and investment losses. In this paper, comparison between Alberta's occupational, health and safety system as an acceptable standard and that of Tehran urban and suburban railway company (TUSRC), as a selected Iranian subway construction company, is carried out to identify deficiencies existing in TUSRC OHS policies. For this purpose, 68 basic criteria of successful OHS systems comprising eight categories are identified. This criterion through literature review and interviews with OHS professionals and an auditing tool was established. A questionnaire survey was conducted in selective case studies to find weak points in the current OHS system. Based on these findings, “Hazard identification and assessment” and “Hazard control” were identified as the most important categories. From statistical analysis the two categories which could not get acceptable values in TUSRC are “Hazard control” and “Program administration”. At the end, a list of remedial action plans is recommended in order to enhance the examined OHSM which could be helpful in similar cases.

Index Terms—Construction, auditing tool, OHSMS, hazard.

I. INTRODUCTION

In the industrialized nations of the world, accidents now cause more deaths than all infectious diseases and more than any single illness except those related to heart disease and cancer. Safety should be a major concern in any industry and in construction phase, the need for such concern may be greater than in most other industries. This is caused by the disproportionately high number of industrial injuries incurred by construction workers [1].

In recent years, the construction industry especially infrastructures' activities like underground transportation systems plays a major role in economy development in Iran. However, the construction industry has faced a wide range of challenges; one of the most important of these challenges is the frequent occurrences of accidents at the workplace. The risk of a fatal accident in the construction industry is five times more likely than in other industries [2]. Safety programs, like an occupational health and safety management system (OHSMS), are one of the best proactive approaches in improving site safety performance [3].

The program elements currently found in the partnerships

in health and safety OHSMS standards include management, leadership, commitment, hazard identification and assessment, hazard control, workplace inspections, worker competency and qualifications, emergency response, incident reporting and investigation, program administration, which could be considered as the success criteria of any organization in health and safety.

Although many efforts are accomplished toward implementing the fit system of health and safety compliant to above mentioned elements in most organizations statistics always state many damages and mortality related to health and safety mismanagement, even in organizations that a very high level of standard in health and safety system can be found.

However the implementation of an acceptable level of the required standard is not the only ingredient to have a successful job. Obviously, some requirements should be implemented to control circumstances resulted from incidents in order to survive in a highly competitive market. In this among, action plans to check policies and procedures whether they meet or undergo industry standards in order to keep them up to date are one of those later essential steps after implementing the health and safety system.

The survey was only done in health and safety departments in subway construction, as one of the most hazardous construction job sites in Iran with the aim of finding deficiencies existing in the company's OHS system. Moreover, many reviews have been done in order to list deficiencies found in other cases around the world. The result of the research can help the company to identify the weak points of OHS system with the purpose of improve the safety program implementation.

II. LITERATURE REVIEW

Various definitions have been suggested by different researchers for safety programs and most of them have similar inferences. Reference [4] defined a safety program as “the control of the working environment, equipment, processes, and the workers for the purpose of reducing accidental injuries and losses in the workplace”. Reference [5] identified the objectives of creating a safety program at construction sites as a means to prevent improper behavior that may lead to accidents, to ensure that problems are detected and reported, and to ensure that accidents are reported and handled accordingly.

OHSMS is defined as a model which contains a set of effective themes including management commitment and leadership, written policies, roles, responsibilities, worker participation, training, measurement of performance, and identification of required action to ensure continuous

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improvement [6].

Based on previous studies [7]-[10], some effective safety programs were identified as follows: comprehensive safety policies, safety committees, safety inductions, safety trainings, jobsite inspections, accident investigations, first aid programs, in-house safety rules, safety incentives schemes, control of subcontractors, selection of employees, personal protection programs, emergency preparedness planning, safety related promotions, safety auditing, safety record keeping, and job hazard analysis.

Effective safety management is both functional (involving management control, monitoring, executive and communication sub-systems) and humanizes (involving leadership, political culture sub-systems paramount to safety culture) [11]. Reference [12] claimed that managing safety essentially involves four levels: the company policy, project management, site management, and individual. Failure at each level is the reason for the occurrence of accidents. Failure at the first level will increase the probability of failures at the second level and so on and improper OHS management leads to poor safety records. Overall, OHSMS mainly rely on continual monitoring of indicators of performance of the relevant processes, and continuous improvements in these processes.

In Alberta, OHSMS standards include some basic elements which enable accurate auditing of the systems. These elements are the commitment of the management to worker health and safety, hazard identification and assessment, hazard control, developing a workplace inspection policy, choosing qualified worker by employer, using effective response management system, identifying root causes of the incident and investigating underlying problems that may lead to future similar incident to other workers. Alberta has defined OHSMS as a part of the overall management system of the organization.

The major benefit of good OHS in Alberta is cost reduction and the other benefits are: improved patient safety, increased recruitment and retention of skilled workers, keeping workers at work and also improved morale. Fig. 1 shows the seven elements of the occupational health and safety program in Alberta [13].

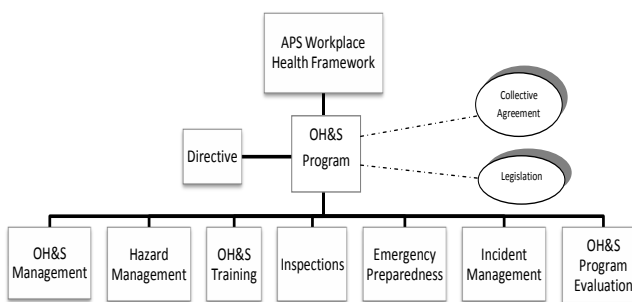


Fig. 1. Government of Alberta occupational health and safety program (Alberta, 2009)

In the international labor organization's (ILO) guideline on safety and health management system, the objective of audit are to determine if the management system can effectively promote full worker's participation; what was the result of previous performance evaluation and audits; whether the

organization achieves legal conformity; and if the system performs the goals of continual improvement and best OHS practice. ILO also declares if OHSMS gets national or international recognition, its implication goes much deeper [14].

Even if the hazards have been identified, system needs to develop a strategy to eliminate or reduce the exposure to the risk, and keep improving OHS procedures by: communicating with people in the workplace about OHS activities, making sure that OHS is integrated into all management procedures, evaluating the success of the control strategies, seek advice from employees to check if they feel the control strategies are working and whether there are any problems with the OHS programs, and strong commitment to OHS from management [15].

In Iran, there have been some research in OHS and the most important concerns to establish OHS management in any organization, are the less commitment of senior managements and other supportive managers. However the most workers are familiar with hazards and standards of their respective industries, but the statistics show that the number of injuries in Iran is high and it is mostly because in most of the time the work does not carried out in a safe manner [16]. Research has shown that in Iran, there is little study in the area of OHS management system in construction industry. The potential of hazard is high and lack of safety and environment management system may cause negative consequences such as human resource and investment loss. In our report, we have to compare the implementation of OHS in one the biggest Iranian subway construction companies and the Government of Alberta in Canada.

III. RESEARCH METHODOLOGY

The research was carried out among tehran urban and suburban railway company (TUSRC) project managers, safety representatives and engineers. Data were collected through a combination of face-to-face interviews and the survey questionnaire.

In this research, the identified criteria of successful OHS system of Alberta's OHS system as an accepted standard were weighed and an auditing tool was provided. At the next level, a questionnaire survey was conducted to gather rate of each criterion in the target company by using this auditing tool. Finally, weak points of current OHS system were identified and relevant action plans for enhancement were recommended.

A. Identify Criteria and Auditing Tool

Basic criteria of successful OHS system are identified from comprehensive literature review and Alberta's OHS standard is used as a benchmark. Ultimately, eight categories and a total of 68 criteria were identified.

In order to perform comprehensive analysis, the weight of each category and the criteria of OHS standard and also minimum acceptable audit scores had to be determined. For this purpose, additional literature reviews and interviews were conducted with five OHS managers and supervisors of TUSRC. The results of an auditing tool determined as a successful achievement when a minimum audit scores of 70% overall and at least 60% in each category and its criteria

were obtained. The most important category based on the panel rate is hazard identification and assessment (weight=17), followed by hazard control (weight=16), incident reporting and investigation (weight=13), program administration (weight=12), management leadership and commitment and also emergency response plans (weight=11), and workers competency and qualification and also work place inspection (weight=10). Categories and their weights breakdown are shown in TABLE i

TABLE II: IDENTIFIED CATEGORIES WITH THEIR WEIGHTS

I D	Categories	W.
A	Management leadership and commitment- components of an effective system	11%
B	Hazard identification and assessment- components of an effective system	17%
C	Hazard control- components of an effective system	16%
D	Work place inspection- components of an effective system	10%
E	Workers competency and qualification- components of an effective system	10%
F	Emergency response plans- components of an effective system	11%
G	Incident reporting and investigation- components of an effective system	13%
H	Program administration- components of an effective system	12%
Total		100%

B. Prepare Questionnaire and Data Collection

Results for this paper were based on a questionnaire survey and quantitative approach in order to achieve better results is conducted to identify and confirm gaps between two systems. A questionnaire was developed based on eight categories and their sub-criteria. A total of 100 questionnaires were sent out for the survey and 48 completed questionnaires were returned after two weeks, representing an overall response rate of 48 percent. Ten out of the total respondents were the OHS experts whereas eighteen were engineers, eight managers, and twelve operators. On average they have nine years experience.

In the questionnaire, the rating of the OHS criteria was done based on standard rating system shown in TABLE iii. For those criteria which had never been implemented in the company, "not applicable" term was used. Such an answer was indicated as a missing point which shows the gap between selected standard and OHS system in the company.

TABLE IV: STANDARD RATING SYSTEM FOR SCORING CONTRACTOR'S PERFORMANCE IN EACH ATTRIBUTE

0	1	2	3	4	5	6	7	8	9	10
Poor		Moderate			Good		Very good	Superior		

C. Data Analysis

For reliability test of the questionnaire, cranch's alpha coefficient is calculated by statistical package for social sciences (SPSS) version 17. Cronbach reliability coefficient of 45% is down low, 75% is acceptable, and high coefficient of 95% is proposed [17].

Based on the number of questionnaires, cranch's alpha coefficient which was calculated in this research is about 0.88 (>0.75) that shows the successful implementation of the

survey.

Furthermore, in data analysis, multi attribute value theory (MAVT) has been used to determine the score of the case study. The values of each category are shown in TABLE v to TABLE vi. The final value of for the eight categories is shown in TABLE vii with the maximum value of 73.44 for emergency response plans category and followed by management leadership and commitment (value=72.2), hazard identification and assessment (value=68.88), work place inspection (value=65.32), incident reporting and investigation (value=61.34), workers competency and qualification (value=60.28), program administration (value=59.37) and the minimum value of 57.16 for the hazard control category.

TABLE VIII: CATEGORY A- MANAGEMENT LEADERSHIP AND COMMITMENT

ID	Criteria	W.	M.
A1	Is there an OHS policy that meets the standard?	13%	9.0
A2	Are safe working procedures for all tasks developed and communicated?	30%	7.6
A3	Are all health and safety policies, procedures and rules enforced?	17%	6.6
A4	Do we have a "safety culture" that places a high value on worker health and safety?	8%	6.2
A5	Is senior management committed to OHS by including OHS goals and objectives in organizational planning and performance measures/ performance appraisals?	12%	7.0
A6	Are workers invited and encouraged to participate in the health and safety program?	8%	6.2
A7	Are adequate resources provided to enable safe work?	12%	6.8
Total		100%	---

TABLE IX: CATEGORY B- HAZARD IDENTIFICATION AND ASSESSMENT

ID	Criteria	W.	M.
B1	Has an inventory been taken of all jobs in the organization?	17%	7.6
B2	Are health and safety hazards identified for all jobs listed in the inventory?	17%	7.4
B3	Have health and safety hazards been evaluated for risk and prioritized based on risk?	33%	7.0
B4	Are workers actively involved in the hazard identification and control process?	5%	5.2
B5	Do workers have access to the hazard assessment records?	3%	6.2
B6	Is training provided for those conducting the hazard identification and assessment process?	5%	7.2
B7	Are the hazard identification and assessment records reviewed periodically or when changes are made to the jobs/tasks?	17%	6.2
B8	Are the results of the hazard identification and assessment records communicated to all workers who perform the job/task?	3%	5.6
Total		100%	---

TABLE X: CATEGORY C- HAZARD CONTROL

ID	Criteria	W.	M.
C1	Are workers actively involved in creating the Job Hazard Assessments (JHAs)?	7%	5.20
C2	Is training provided for those creating the JHAs?	10%	6.20
C3	Is the hierarchy of controls respected?	45%	6.22
C4	Have actions been identified for improving controls, with accountabilities and timelines listed?	7%	5.60
C5	Are the JHAs reviewed periodically or when changes are made to the jobs/tasks?	21%	5.11
C6	Are the results of the JHAs communicated to all workers who perform the job/task?	3%	2.49
C7	Are new workers made aware of the JHAs?	7%	5.60

		Total	100%	---
TABLE XI: CATEGORY D- WORKPLACE INSPECTION				
ID	Criteria	W.	M.	
D1	Is there a policy requiring regular workplace inspection in all areas/ departments?	11%	6.8	
D2	Does the policy include a definition of roles, responsibilities and accountabilities?	4%	6.4	
D3	Does the policy require inspections at a specific frequency?	4%	6.6	
D4	Is an inspection checklist/form used?	7%	8.2	
D5	Do workers play a meaningful role in inspections?	11%	6.8	
D6	Is training provided for those who conduct inspections?	7%	5.8	
D7	When deficiencies are identified, are they classified according to risk?	7%	6.2	
D8	Are corrective actions identified?	11	6.8	
D9	Are accountabilities and timeframes established for corrective action?	7%	6.4	
D10	Is there a mechanism to ensure that corrective action is performed?	12%	6	
D11	Are inspections reports provided to and reviewed by at least the next level of management?	4%	7.2	
D12	Is there a process to report hazards?	4%	6.6	
D13	Does the process include timely correction of hazards?	7%	5.4	
D14	Is there preventative maintenance on equipment to identify and correct any potential problems?	4%	6.4	
Total		100%	---	

TABLE XII: CATEGORY E- WORKERS COMPETENCY AND QUALIFICATIONS

ID	Criteria	W.	M.	
E1	Have qualifications and competency requirements been defined for each position?	13%	6.8	
E2	Does the selection process require verification of qualifications, competence, and reference checking?	13%	5.8	
E3	Is there an orientation program that is required for all new hires prior to their commencing their work?	13%	5.8	
E4	Is there a job-specific orientation provided for all new or transferred staff?	12%	6	
E5	Are training requirements established for all positions? Do they include safety aspects related to the job?	12%	6.6	
E6	Are supervisors and managers oriented to their specific responsibilities related to occupational health and safety?	8%	6.4	
E7	Are training records maintained and reviewed to ensure that employee training is up to date?	4%	5.6	
E8	When new equipment or procedures are introduced, do all impacted workers receive appropriate training?	13%	6	
E9	Do training programs include an assessment of competency or comprehension?	4%	4.8	
E10	Are training needs reviewed on a regular basis?	8%	5.2	
Total		100%	---	

TABLE XIII: CATEGORY F- EMERGENCY RESPONSE PLAN

ID	Criteria	W.	M.	
F1	Have potential emergency situations been identified?	20%	7.4	
F2	Are there written emergency response procedures for each situation?	30%	8.0	
F3	Do the plans include information about communication, procedures, and responsibilities?	13%	7.2	
F4	Are managers and workers aware of their roles in emergency response situations?	13%	6.8	
F5	Are regular drills conducted for various types of emergencies to provide employees with an opportunity to "practice" their responses?	6%	7.4	
F6	Are all employees trained in all facets of emergency response that for which they are responsible?	6%	6.6	
F7	Are reports of emergencies and drills kept and reviewed to identify opportunities to improve	6%	6.4	

ID	Criteria	W.	M.	
responses?				
F8	Are first aid requirements met (provision of required first aid services, supplies, facilities as per the OHS Code, Part 11, and First Aid)?	6%	7.0	
Total		100%	---	
TABLE XIV: CATEGORY G- INCIDENT REPORTING AND INVESTIGATION				
ID	Criteria	W.	M.	
G1	Is there a requirement and a process for all incidents (including near misses) to be reported?	15%	8.2	
G2	Is there a standard form used for incident reporting that promotes root cause identification?	7%	7.8	
G3	Do all supervisors and managers understand the importance of incident reporting and investigation and communicate that this is a valuable prevention tool?	13%	6.6	
G4	Do workers understand the importance of reporting all incidents and report all types of incidents?	6%	6.2	
G5	Are supervisors held accountable for conducting and documenting quality incident investigations that focus on root cause analysis?	13%	6	
G6	Are corrective actions identified in the investigations implemented promptly?	20%	4.2	
G7	Are workers involved in the investigation process and made aware of results of the investigation and follow-up actions?	13%	5.4	
G8	Are those responsible for investigations provided with effective training that includes examples and opportunities to practice the skills?	13%	6.2	
Total		100%	---	

TABLE XV: CATEGORY H: PROGRAM ADMINISTRATION

ID	Criteria	W.	M.	
H1	Is there a mechanism to obtain and provide follow-up to worker suggestions, concerns, and issues?	40%	5.78	
H2	Does the health and safety management system include addressing health and safety issues related to all levels of staff, visitors, and contractors?	5%	6.80	
H3	Does management participate in health and safety meetings and activities?	5%	6.20	
H4	Are OHS records and statistics kept?	9%	7.20	
H5	Does OHS performance data include trend analysis and both leading and lagging indicators?	18%	4.75	
H6	Is the OHSMS audited regularly, with action plans developed and implemented to incorporate recommendations made in the audit?	23%	6.40	
Total		100%	---	

The final value bar chart in all eight categories (A-H) are shown in Fig. 2.

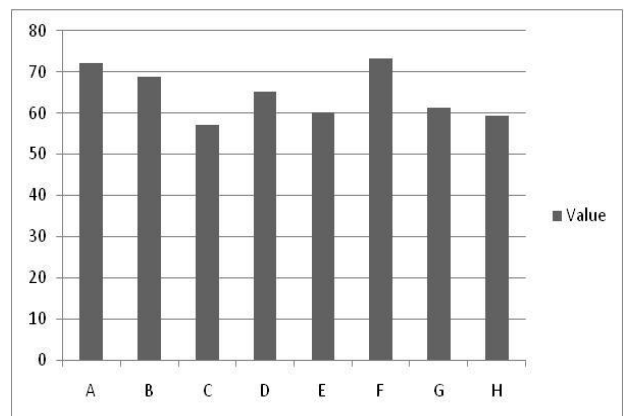


Fig. 2. Categories' value bar chart

TABLE XVI: FINAL VALUE OF OHS SYSTEM IN TUSRC

ID	Categories	W.	Value (Tables III-X)	Score= W.*Value
A	Management leadership and commitment- components of an effective system	11%	72.2	7.94
B	Hazard identification and assessment- components of an effective system	17%	68.88	11.71
C	Hazard control- components of an effective system	16%	57.16	9.19
D	Work place inspection- components of an effective system	10%	65.32	6.53
E	Workers competency and qualification- components of an effective system	10%	60.28	6.02
F	Emergency response plans- components of an effective system	11%	73.44	8.08
G	Incident reporting and investigation- components of an effective system	13%	61.34	7.97
H	Program administration- components of an effective system	12%	59.37	7.12
Total		100%	---	64.56

D. Findings

In this survey, the term of “not applicable” was not selected by any of the respondents which mean all identified criteria were implemented in the company.

Eight categories and total 68 criteria were analyzed based on acceptable minimum score of 70% overall, and at least 60% in each category and its criteria.

- Management leadership and commitment: The overall value of category A is 72.2%. Values of all the criteria of this category are over 60%.
- Hazard identification and assessment: The overall value of category B is 68.88%. Values of almost all the criteria of this category are over 60%. Values of B4, B8 is below 60% which are the weak points of this category.
- Hazard control: The overall value of category C is 57.16% which is below 60%. Values of almost all the criteria of this category are below 60% (C₁, C₂, C₄, C₅, and C₇).
- Work place inspection: The overall value of category D is 65.32% which is acceptable. The weak points of some criteria like D₄, D₆, and D₁₃ are compensated by Values of criteria like D₁, D₈, and D₁₁.
- Workers competency and qualification: The overall value of this category is 60.28%. Five out of ten criteria have value below 60% (E₂, E₃, E₇, E₉, and E₁₀) which other criteria compensated these weak points.
- Emergency response plans: The overall value of this category and all of its criteria is 73.44% which satisfies the assumption.
- Incident reporting and investigation: The overall value of this category is 61.34%. This category has two weak points (G₆, G₇).
- Program administration: Category H has the overall value 59.37% which is not acceptable based on the assumption. The reason of its low value is weak criteria like H₁, H₅.
- Total score: Total score of OHS system in TUSRC based on the above eight categories are 64.56. Weak categories like C and H have considerable negative impact on the total score.

IV. CONCLUSION

In this study, eight categories which are important in

managing OHS system were determined. 68 criteria were extracted from these eight categories. The two most important categories among them were determined based on their weight. These two categories are “Hazard identification and assessment” and “Hazard control”. Based on statistical analysis two categories which could not get the acceptable value of 60% are “Hazard control” and “Program administration” by value of 57.16% and 59.37% respectively. Category E, Workers competency and qualification by total value of 60.28% can be considered as a weak category.

Weak criteria in Hazard control category are defined as C₁, C₄, C₅, C₆, and C₇.

Reasons for weakness of this category can be determined as below:

- Employees are not involved in hazard control process effectively
- Developing controls which includes develop hazard control; implementation, review and revise do not conduct efficiently.
- There is no constructive enforcement policy and consequently it is not communicated to the employees to find noncompliance occur.

Weak criteria in program administration are questioned as H1 and H5. Reasons for weakness of this category can be explained as below:

- Everyone does not involve in the Health and Safety Management System and there is no opportunity to give feedback on health and safety issues at the work site and joining safety committee;
- There is no two-way communication at site for health and safety meetings, training sessions, health and safety committee meetings, field-level hazard assessments, etc.
- All suggestions from workers are not recorded, and there is no recognition given of the worker's involvement and co-operation.

Every safety program should be evaluated periodically to see it meets its defined goals and objectives successfully. According to criterion H₄, all OHS statistic records are kept in organization but monitoring and analysis of these data are not conducted. Reasons for this deficiency can listed as below:

- Leading indicator measurement which identifies the likelihood of an incident and also lagging indicators measurement which analyzes the frequency, severity, and type of incidents are not implemented effectively.
- Comparison between company's health and safety records to those of similar companies in the same industry is not carried out.

V. RECOMMENDATION

A text in TUSRC common continuous improvement cycle of managing OHS system is required. This continuous improvement cycle includes planning what needs to be done (PLAN), doing what has been planned (DO), assessing the work done (CHECK) and performing the work recommended to improve the system (ACT). Fig. 3 depicts OHSM diagram.

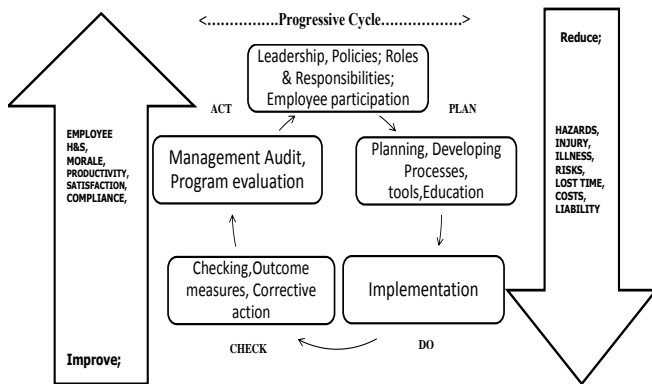


Fig. 3. OHSM cycle

However, existing progressive cycle consists of Plan, do, check, and act stages are not managed acceptably based on the current OHS standards. The deficiencies which extracted during survey are evidence to this fact. According to weak points and defects, it is concluded that the company has problem and weaknesses in do and mainly check stages. Correction actions are not carried out properly and adequately. To enhance OHS management system, it is recommended to revise two categories identified as weak elements based on OHSM cycle and adjust priorities in resource allocation during do and check stages. It is also suggested that the company employ external partnership to improve do and check stages.

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REFERENCES

- [1] H. S. Biggs, "A study of construction site safety culture and implementations for safe and responsive workplaces," *The Australian journal of rehabilitation counseling*, Vol. 11, No.1, PP 1-8, 2005.
- [2] G. Sorock, E. Smith, and M. Goldoft, "Fatal occupational injuries in New Jersey construction industry:1983-1989," *Journal of occupational medicine*, vol. 35, pp. 916-21, 1993.
- [3] R. D. Hislop, "A construction safety program," *Professional safety*, Vol. 36(9), pp 14-20, 1991.
- [4] T. Anton, *Occupational safety and health management*. 2nd ed. Punta Gorda, FL, U.S.A., 1989, pp21.
- [5] S. Rowlinson, *Hong Kong construction - safety management and the law*, 2nd ed. sweet and maxwell asia, Hong Kong, 2003.
- [6] *Different standards*. (2010). (from managment consulting PV Ltd.) Retrieved. 07 07, 2011, available: <http://sntconsulting.com/DifferentStandards.html>
- [7] W. Poon, C.H. Ma, and K. Ho, "Statistical analysis on factors in reducing construction site accident", in *the 6th annual conference of the Australian and New Zealand Association of Occupational Health and Safety Educators*, Hong Kong, 2000, pp. 341-55.
- [8] L. Goldenhar, S. Moran, and M. Colligan, "Health and safety training in a sample of open-shop construction companies", *Journal of safety research*, Vol. 32, pp. 237-52, 2001.
- [9] J. Hinze and J. Gambatese, "Factors that influence safety performance of specialty contractors," *Journal of construction engineering and management*, Vol. 129, pp 159-164, 2003.
- [10] M. Findley, S. Smith, T. Kress, G. Petty, and K. Enoch, "Safety program elements in construction: which ones best prevent injuries and control related workers' compensation costs?," *professional safety*, Vol. 49(2), pp.14-21, 2004.
- [11] A. d. Glendon, "Human safety and risk management," London: chapman and hall, 1995.
- [12] J. B. Hinze, "The causes of trenching related fatalities and injuries," in *construction congress V: managing engineered construction in expanding global markets*, American Society of Civil Engineers (ASCE), Reston, 1997, pp. 389-398.
- [13] "Overview of best practices in occupational health and safety in the healthcare industry", G. o. Alberta, 2009.
- [14] D. Bennett, "Health and safety management systems: liability or asset?" *Journal of public health policy*, Vol 23(2), pp.153-171, 2002.
- [15] "Six steps to occupational health and safety: duty of care in occupational health and safety", WorkCover New South Wales, Sydney, 1996, pp.7
- [16] M. M. Amani, "Health, safety, and environment," presented at the 1st HSEM conference. Iran, 2005.
- [17] L. J. Cronbach, "Coefficient alpha and the internal structure of tests", *Psychometrika*, Vol. 16, pp.297-334, 1951.