Civil and Environmental Research
ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online)
Vol.6, No.5, 2014

Safety Concept, Value and Cost in Construction Projects in Jordan

Mohmd Sarireh (m.sarireh@ttu.edu.jo) and Sultan Tarawneh (dr.sultantarawneh@yahoo.com)

Abstract
Professional safety is critical and urgent value for construction projects in Jordan. Safety should be adopted by all project parties (clients, consultants, and contractors). The use of under-specified materials or not following a plan in construction will result in safety problems and finally in unpleased accidents. The aim of this study is to test the existent aspects and rules of safety in construction projects in Jordan. It will focus on source of dangers and hot spots in construction. In addition to that the expected cost of accident and delay in project due to worker accidental leave for injury, and the cost fatality, and the loss of experienced and skilled workers will be examined. A safety questionnaire was designed and audited through consulting contractors and consultants in construction in Jordan. After that it was directed to a random sample of construction parties in Jordan. Data were collected through 160 copies of the questionnaire filled by project parties and their teams and personnel in construction projects. The response rate is 29% therefore, 46 questionnaires were received and analyzed. Responses include information about companies and projects. Furthermore, availability of safety instruments, the roles of project parties in safety, existent conditions of safety, and types and causes of accidents in construction sites were investigated. The study indicates that the construction accidents are due the break of safety rules and regulations. Others causes are missing of training programs, lack of safety coordination, lectures and improper construction conditions. Low quality of equipment used and the absence of testing by a specialized safety team in project site were seen as other causes of accidents. The results show that in 69% of cases contractors pays for safety cost, and in 68% of cases safety tools are available but not used in 44.4% of cases. Excavation is the most danger work in projects. Collapse happened in 68% of cases reported. A simple accident can result in JD520 as cost, and a worker leave of 1 week at least. Construction companies in class 2 has good safety performance (80% safety tools are available and used, 60% training program is provided), followed by 1st class, 4th class, and 3rd class companies. The paper results are helpful for construction sector and construction parties are urged to give safety a high priority to avoid additional cost and delay and critical injuries, disabilities or fatalities for their workers.
Keywords: Construction safety, Safety rules, Project safety, Safety cost, Safety regulation

I. INTRODUCTION

The number of construction firms and companies increased from 1,531 in 2006, to 1,697 in 2007, and to 2,023 in 2008. Construction companies employing about 80,000 of Jordanian labor force and about 300,000 of foreign labor force. They are supporting the national gross product of 4% of total economic activities [1]. Safety of construction in Jordan is an important aspect of sector like everywhere in the world. Institutes such as Ministry of Labor, Vocational Training Cooperation, Department of Statistics, and National Center for Human Resources Development, Social Security Corporation, Ministry of Education and Ministry of Higher Education have access to guide and organize and have partial control on labor market.

Human resources and construction operations have insufficient concentration on safety provision and practice. Upon years safety issues has improved as construction sector showed an investment incentives and beneficial outcomes for clients and operators. Governments started to put new regulations and rules for safety practices responding to the development of construction sector. By the law enforcing, construction companies started taking safety action plans on their own sites and projects, in addition to measures for pro protections and on time protection when accidents happen at project site. No period or term of construction is free from accidents that have injuries at least, especially in civil building projects as they are less controlled than contractors building projects. To distinguish between two types of construction in safety provision, a questionnaire was developed and directed toward contractor's civil builders to answer questions on safety issues and successful safety practices. The results came in the form of recommendations that constructions sector needs to adopt safety practices and measures to keep its competency and profitability [2]

In United States, construction safety is more organized to have the control on occupational health and safety in construction sites and production plants by the Occupational Health and Safety Administration (OSHA). OSHA has the right to inspect and test against any violation for any rule or regulation covered and enforced by law. In addition all sites have to report any accident case happens in site for the record and analysis by OSHA. What is found in United States in safety rules and practices are not found in developing countries and are not sensed by all project parties (contractors, sub-contractors, client or owner, and operator). The construction sector has no permanent and safe opportunities of employment for workers. Especially for workers they do not have skills or less skilled or employees has no secure jobs or at permanent basis with well paid periodical income. In this

working environment, employees will not have any chance for training or application of any safety provisions in site, which obligates project parties to have responsibility for safety practices and self inspection by workers and superintendents for job sites against any hot spots or hazards [3].

Contractors has the willing to adopt a qualified safety system for work environment (QES), as this system include practices that increase their profit and competency by encouraging accident-free work zone. Also, customers and operators (clients and owners) will be encouraged and satisfied in investing in construction sector as it does not have any violation for the environment and safety rules and regulations. The adoption of successful QES will result in an accepted quality with lesser cost and larger productivity. The supervision that employs qualitative and quantitative measures for safety will enhance the safety practice in project site and work environment. Six features that should be defined in safety provision include quality and performance expected, involvement of employees in decisions and solutions, definition of unsafe work environment, defining goals of safety system and get feedback, providing self confidence in worker behavior for safety plan and actions, and finally defining and enforcement of good safety practice and activating of reward system. By applying such as safety system considering the rank of company and size of work, safety performance will be enhanced to reach accident-free condition or environment [4].

Existing safety regulations need to be evaluated in order to decide if it is sufficient or not, and to decide to describe and implement successful procedures and rules to enhance work environment. Owners, contractors, and designers are usually the target for any improvement process for safety in construction. The roles of different parties in the project and their responsibilities should be well defined; also problems may show up during implementation of these regulations, so cost and time efficiency (productivity) in construction operation will be affected. Contractors and owners should adopt safety regulations regardless problems and obstacles that may show up during implementations. These problems may produced by the lack in organization among workers, lack in recording and reporting accidents happen in project site, the preference for employing foreign workers and subcontractors, lack of safety regulations and rules enforced by law, safety is not priority for different parties, size of construction companies is very small, contract competency, and weather conditions [5] Figure 1 illustrates the organizing features for the safety system in construction process.

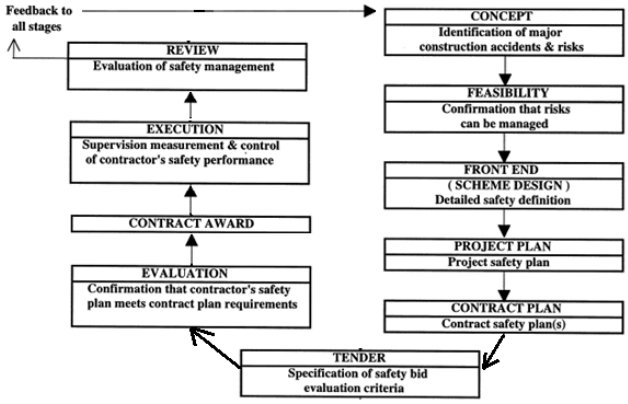


Figure 1 Organizing Structure for Successful Safety System [5]

Safety of construction especially in industrial plants and operations deserves improvement by contractors and contractors' personnel for safety. 20 main factors were identified in addition to 85 sub-factors for safety. Site planning, welfare facilities, emergency and disaster planning and preparations, signs, signals and barricades, handling, storage and use of materials, welding and cutting, concrete and concrete framework, crane and lifting equipment, chemical handling, electrical equipment, handling, transportation and disposal of hazardous material and waste, personal protective equipment, fire prevention, transportation, excavation, trenching and shoring, scaffolding and ladders, hand and power tools, mechanical equipment, ionization radiation, management involvement are the factors and items that were considered in studying safety effect and importance in construction and industry [6].

Construction safety in project site is a priority for a successful management process. So safety issues should be managed in a process, has stable and continuous policy, satisfying for personnel, and has incentives for well-oriented workers and personnel in safety performance. This commitment requires a framework for safety action plan on company and project level. When inadequate company policy exists, accidents will happen more as company records will show. Low-quality in policy, practices, commitment, attitude of personnel, management, safety knowledge and training, all these will form causes for terrible accident or unsafe condition. It is required by the project management to concentrate more on these hot causes for accident to avoid the occurrence of accidents or to reduce their frequency and intensity, and to enhance the performance of construction operations in project sites [7] Table 1 represents the increase in temporary and permanent disablement cases, and fatal cases from 1994 to 2003 in construction.

Table 1Accident Cases in Construction [7]

Sector	Case Class	1994	2003	% Increase
Construction	Temporary Disablement	798	1133	142
	Permanent Disablement	26	29	112
	Fatality	32	31	97 Decrease
Total		856	1193	139.4

Hazards are found in construction sector more than in any sector because of the interrelated jobs and activities in one site through different levels and zones. It is important and prior to the management staff to predict the source of risk or hazard, and to define the factors that can be critical for construction safety in site. Safety equipment provided for personnel, regular safety meetings, and safety training are the most effective means in enhancing safety in construction sites and improve work environment. Late awareness of project management, lack of training, poor knowledge in safety for project managers, unwillingness to safety resources, and irresponsible operations are the most effective factors for poor safety performance in site. Governmental organizations and institutes have critical roles in ruling and enforcement of legislations and safety programs in construction sites to reduce accidents' frequency and intensity [8]. Figure 2 illustrates the framework of safety follow up and roles of project parties.

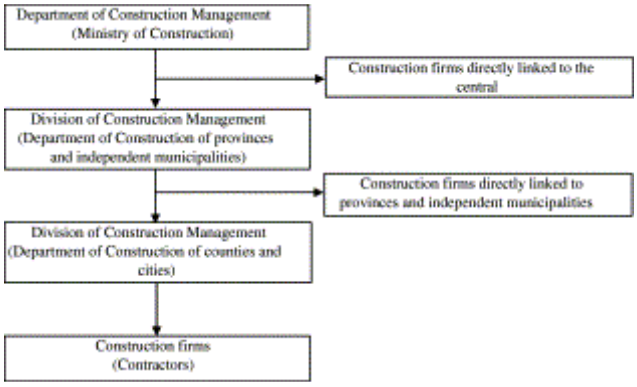


Figure 2 Safety Framework and Roles of Project Parties [8]

Accidents that have causations and injuries that considered fatal and serious should be reported and studied carefully to put successful corrective means and measures to decrease fatality cases and provide safe work environment. The process of safety in private firms should be similar to that followed by governmental firms and companies in order to define the problems and solutions and to predict the cost of accident. Table 2 represents total disabling injuries and fatalities in construction sector in Kuwait in the years 1994, 1995, and 1996.

Table 2 Disabling Injuries and Fatalities in Construction in Kuwait [9]

Case	Year		
	1994	1995	1996
Disabling Injury %	48	38	34
Fatality %	62	38	42

The rates of disabling and fatality in table 2 are considered very high compared to cases reported in USA in 1993. Disabling injuries came into 9% and fatality came in 14% in the same year 1993. Falling from height is the major cause for injury and fatality cases in construction in Kuwait. The lack in accidents' records and weakness in reporting system are parts of the problem of safety. Project managers should be aware for the cost of accident and delay in total project plan, schedule and cost, so they can adopt a safety program to reduce the cost of project by avoiding of accident related cost (Kartam and Bouz, 1998).

Safety risks are very crucial for construction in project site. The successful safety planners and managers should define the direct and indirect cause for accidents. It is essential to define the risk period and location in project to avoid critical accident occurrence. Accident history from previous reports can help in putting successful emergency and usual action plan for safety. This process will help in reading distribution of risk in project, so that risk can be predicted and moderated on the schedule of the project that accident situation can be avoided or reduced to a considerable degree [10].

II. METHODOLOGY

The research focuses on studying the safety in Jordanian projects, current conditions of applied safety, the roles of project parties (consultants, contractors, and subcontractors), expected hazards in construction operations and their cost in case of accident. A questionnaire for safety was sent to experts in construction via email and by interviewing project personnel. The received data were classified and analyzed to determine the current performance for safety in projects, and expected hazards in construction jobs, in addition to the roles of project parties in applying safety plan.

III. RESULTS OF QUESTIONNAIRE

The results of the safety questionnaire were able to describe the target sample (respondents) by determining their role in the project, their level of education (Ph.D., Master, Bachelor, Diploma, or secondary school), also the rank of company, and the procedure in adopting safety plan and its implementation schedule. The results also, focused on the role of project parties: consultants, contractors, and sub-contractors and their responsibilities in the safety process. Source of dangers on job level in construction such as excavations, erection of steel reinforcement, pouring of concrete in slabs, masonry work, plastering, and white stone work were addressed through the questionnaire. Cost of unsafe condition (accident) in construction is another item that was covered through the questionnaire.

III.I Size and Features of Collected Data

Around of 160 copies of the questionnaire were forwarded to contractors, consultants, and engineers involved in construction operation. A 46 responses were received and analyzed. Table 3 represents the features of safety questionnaire sample including educational level, role of respondent, and rank of construction companies.

Table 3 Sample Features for Safety Questionnaire

Sample Feature		
Educational Level	**Role of Respondent in Project**	**Rank of Company**
Ph.D. 2.2%	Prj. Mngr 48%	1st Class 49%
Master 11%	Site Engr. 46%	3rd Class 18%
Bachelor 78.3%	Superintendent 3%	2nd Class 15%
Diploma 6.5%	Consultant 3%	4th Class 15%
High School 2.2%		6th Class 3%

The discussion and preparation of safety plan in construction is very important in time frame and volume of finance available for plan implementation on time and properly. Table 4 represents the level of discussion and the stage of the implementation of the safety plan according to questionnaire data.

Table 4 Level and Stage of Implementation of Safety Plan

Features of Safety Plan in The Questionnaire	
Level of Discussion of Safety Plan	**Stage of Implementation of Safety Plan**
Project Preparation 27%	Construction Phase 72%
Daily Level 27%	
Company Level 23%	Bidding Phase 9%
Company and Daily Level 7%	Preliminary Study 7%
Prj. Preparation and Daily Level 5%	Preliminary, Design, Bidding, and Construction 7%
Company, Daily, Weekly, and Project Level 6%	Preliminary and Construction 5%
Weekly Level 5%	

III.II Cost of Safety and Responsibility of Project Parties

The cost of construction safety is still not documented in project price, but project parties (mainly general and sub- contractors) find them selves responsible to include the cost of safety in their price for the work tends to be implemented. Figure 3 illustrates that 73% of cases see that cost of safety included in project price, while 20% see that cost of safety is not included in project price, the rest of sample is not sure about this argument.

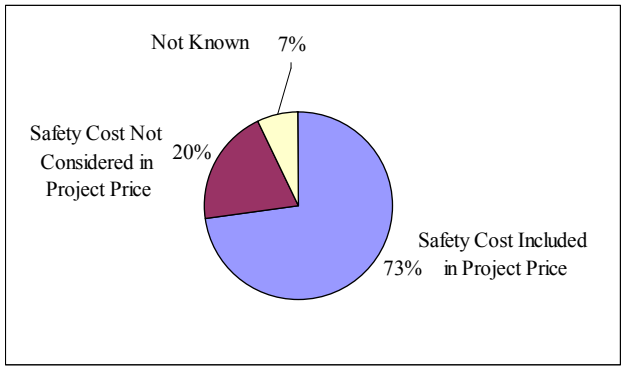


Figure 3 Cost of Safety in Project Price

The unanswered question is who pays the cost of safety? Figure 4 illustrates that in 69% of the cases, general contractor pays for this cost. While, general and sub-contractor pay in 5% of cases, and also sub-contractor is responsible for paying in 5% of the cases. 15% of cases is not paid by any one, in this case workers and employers find themselves responsible for paying for their safety. The rest of the sample 7% are not sure about who pays for this cost.

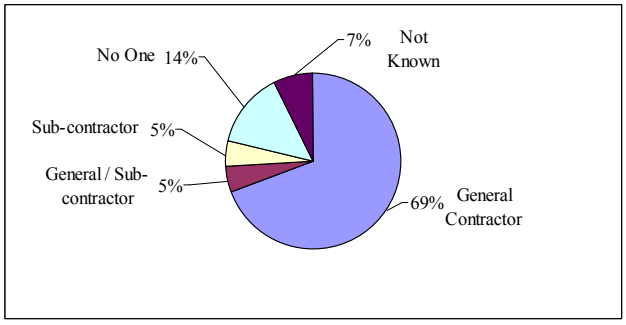


Figure 4 Responsibility for paying the Cost of Safety

Even though there is an argument about the responsibility of project parties for safety in construction, safety equipment and tools must be available in project area or site. Figure 5 illustrates this issue clearly. In 68% of cases the equipment is available for direct usage by workers, while in 23% of cases these tools are not available, while it is not known in 9% of cases.

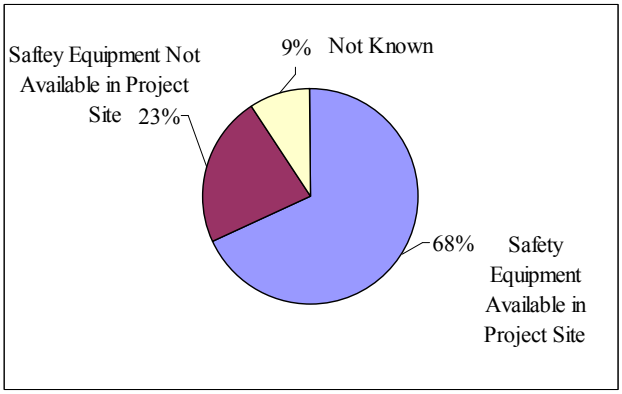


Figure 5 Availability of Equipment of Safety

III.III Roles of project Parties against Safety Hot Spots

In each project, the spots for dangers and hazards must be defined and determined clearly in project's zones and levels, so procedure and action plan can be put ahead to work commence date. Table 5 represents how consultant defines and follows the spots of dangers and hazards. In 86% of cases, consultant follows these spots, while in 14% of cases consultant does not follow these spots. Also Table 5 represents the role of consultant in following the usage of safety tools, in addition to the role and responsibility of contractors and sub-contractors in this field.

Table 5 Roles of Project Parties in Safety Process

Project Parties	Roles of Project Parties					
	Usage of Safety Equipment			Following of Spot Hazards		
	Yes	No	Not Known	Yes	No	Not Known
Consultant	86%	9%	5%	86%	14%	0%
General Contractor	68%	23%	9%	N.A.	N.A.	N.A.
Subcontractor	53%	36%	11%	N.A.	N.A.	N.A.

III.IV Source of Dangers and Hazards in Construction

Construction work has dangers everywhere and in different levels. Sources of dangers in construction operations are variable in type and potentiality depending on type of work, environment, preparations, regulations and rules, and training and level of education of workers. Table 6 represents dangers and hazards in construction and will be commented and analyzed in the following sections separately.

Table 6 Source of Dangers and Hazards in Construction

Construction Operation	Dangers and Hazards in Construction					
	Collapse (Falling) Parts	Fall of Worker	Breath. & Dust	Electric Lines	Injury	Not Known
Excavation	68%	19%	6%	2%	2%	3%
Reinforcement	11%	11%	2%	0%	60%	16%
Foundation Concrete	16%	41%	0%	0%	34%	9%
Slab Concrete	34%	41%	0%	0%	14%	11%
Masonry	38%	27%	0%	0%	4%	31%
Plastering	0%	43%	0%	0%	27%	30%
Stone Work	35%	25%	2%	0%	11%	27%

III.IV.I Expected Hazards in Excavations

Excavating activities are the most danger in construction. Collapse of sides, vibration, excess movable vehicle load, water collection, and melting of snow or heavy rain are common reasons for collapse and falling parts to happen. Also, hazardous atmosphere and dust result in breathing problems for workers that requires inspection and protection equipment. Table 6 illustrates source of hazards in excavation, collapse has 68% to happen during excavating, and secondly the fall of workers has a chance of 19% to happen, while breathing problems have opportunity of 6%.

III.IV.II Expected Hazards in Erection of Steel Reinforcement

Source of dangers in erection of steel reinforcement differentiate from fall of worker, injuries by sharp tools or by falling of loose materials and tools, eye injuries, and breathing problem as illustrated in the second row of Table 6.

III.IV.III Source of Danger in Pouring Concrete in Foundations

The 3rd row in Table 6 illustrates source of dangers in pouring concrete in foundations. Injuries, falls, collapse of formwork and soil are the most common dangers that frequently happen.

III.IV.IV Source of Dangers in Concrete Slab Casting

Source of danger in slab casting (casting of concrete on slab) is more complicated than casting concrete on ground. The usage of machines and moving equipment makes the operation more complicated. The 4th row in Table 6 illustrates the source of danger in pouring concrete on slabs.

III.IV.V Source of Danger in Masonry Work

Masonry work has many causes for dangers. Unsafe scaffolds and falling of workers from heights, falling of loose parts, collapse of walls are the usual accidents that may happen in this work. Collapse and falling from scaffolds is the most frequent accident as illustrated in the 5th row of Table 6.

III.IV.VI Source of Danger in Plastering

Similar to masonry work, fall from scaffolds is the most frequent accident that usually happens during plastering activity as illustrated in the 6th row of Table 6.

III.IV.VII Source of Danger in White Stone Work

The 7th row of Table 6 illustrates the dangers that may happen in white stone work in projects. Collapse of stones is the most frequent accident, then fall of workers from scaffolds, and injury and fracture because of dealing with cutting machine and heavy stones.

III.V Direct Cause for Accidents in Project

In construction projects in Jordan, generally accidents to happen are referred to the following causes as illustrated in Figure 6.

1. Unsafe scaffolds and fences are responsible for 17% of accidents. Scaffolds are used in most of the works in construction projects such as concrete works, masonry, plastering, stone works, and rest of construction.
2. Unclear areas and routes for machines and materials in the project. This can be the cause for 16% of the accidents in projects in Jordan.
3. Hitting of power lines buried underground or at heights also is responsible for 16% of the accidents.
4. Ignorance for safety rules and regulations and careless of workers for rules and accident areas (hot spots). This is considered as the cause for 11% of the accidents in projects in Jordan.
5. Collapse of concrete and crane accidents have the chance for 7% of accidents that may happen in projects in Jordan.
6. Handling of reinforcement in many works such as for foundations, walls, and slab is responsible for 5% of cases in projects.
7. Slippage on smooth surface, lack of lights, unfenced excavations, slab formwork, and collapse of concrete all these have an equal opportunity for accident to happen of 2%.

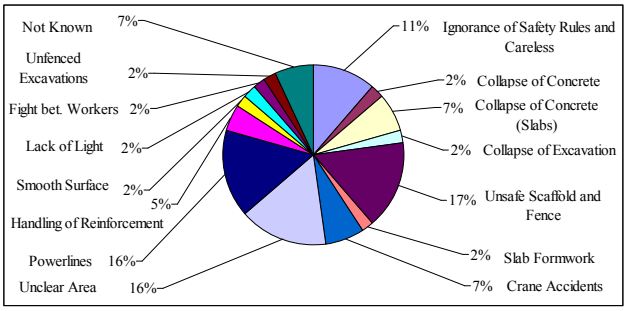


Figure 6 Direct Causes for Accidents and Dangers

III.VI Accident Cost and Delay of Work

Accident cost and delay in work are the direct results of the accident that will affect the project progress and cost. Figure 7 illustrates the projected cost of different cases of accidents in a construction projects. These costs were divided into the following costs:

1- Accident Direct Cost: the cost which is directed to the health treatment at project (simple accident using first aid box), preliminary health station, center, or hospital is called the accident direct cost. This cost ranges from 20-10,000 JD.

2- Accident Damage Cost: the cost which is referred to the damage in materials and/or machines in the project as a result of the accident is known as the accidental damage cost. Accidental damage cost is ranging from 0-2,500 JD.

3- Accident Compensable Cost: the cost paid for workers as compensable cost against a temporary or permanent disabling case, or for his/her family against fatality case is known as the compensable cost. The compensable cost ranges from 500-37,000 JD.

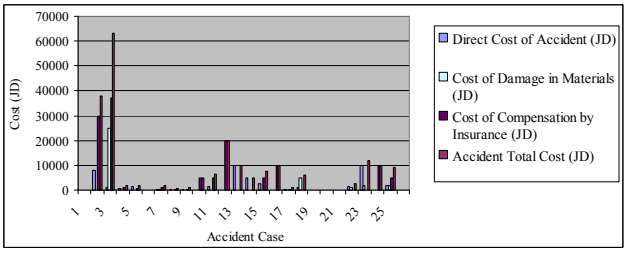


Figure 7 Accidental Costs (JD) in Construction Projects in Jordan

Figure 8 illustrates the worker leave after accident depending on his healthy case. Worker leave ranges from 1 week to 96 weeks. Usually short leaves are related to temporary cases while long leaves are related to deep injuries/fractures and permanent disabilities that are resulted by accident.

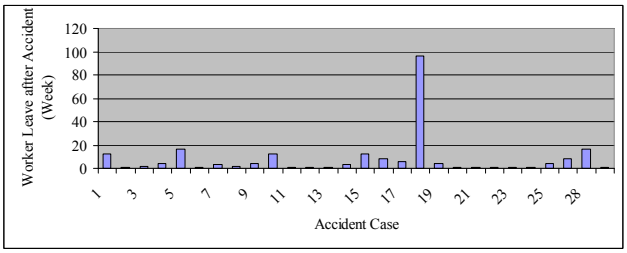


Figure 8 Worker Leave after Accident (Weeks)

Table 7 represents the features of fatality cases because of accidents in construction projects in Jordan, fatality happened during 20.5% of cases reported by project management in the questionnaire. In 33% of fatality cases, safety tools were not available, in 44% of cases safety tools were not used, and in 56% of cases worker didn't receive any training program. Also, in all cases, there is a break for the safety rules at personnel level (safety tools not available and/or not used) and at job level (poor construction process, machine error, and insufficient materials such as formwork or supporting system and required fencing.

Table 7 Features of Fatality in Construction Projects in Jordan

Type of Construction Work	Cause of Fatality	Safety Tools Available	Safety Tools Used	Worker Received Training
Brick Wall Removal	Careless of Worker for Safety Rules	Yes	Yes	No
Concrete Pouring / Dam	Collapse of Concrete Mass	Yes	No	No
Finishing on Top Floor	Falling from Top Floor	Yes	Yes	Yes
Pouring Concrete Slab	Crane Error	Not sure	Not sure	Not sure
Pouring Concrete Slab	Unfenced Edge	No	No	No
Reinforcement Downloading	Falling of Reinforcement from Truck Deck on Worker	No	No	No
Elevator Room Construction	Falling in Elevator Room	No	No	No
Road Construction	Unsafe Working Area (Traffic Accident)	Yes	Yes	Yes
Slab Forming	Collapse of Slab Formwork	Yes	Yes	Yes

Table 8 represents cases of fractures in construction projects in Jordan that happened in 34% of accidents in Jordanian project sites. In 28.6% of cases, safety tools were not available. In 43% of cases, safety tools are not used by workers and/or checked by contractor/subcontractor team or supervisor. In 57% of cases, workers didn't receive any training programs.

Table 8 Fracture Cases in Construction Projects in Jordan

Type of Construction Work	Cause of Accident	Safety Tools Available	Safety Tools Used	Worker Received Training
Front Gate Construction	Slippage from Scaffold	No	No	No
Drop Beam Construction	Careless Worker	Yes	Yes	Yes
Pouring Concrete Slab	Slippage	Yes	Yes	Yes
Pouring Plain Concrete	Falling in Unfenced Dig	Yes	Yes	Yes
Outside Plastering	Week Scaffolds	Yes	Yes	No
Excavation	Collapse of Excavation	Yes	Yes	No
Pouring Concrete Slab	Careless Worker	Yes	No	No
Elevator Room	Lack of Light	Yes	Yes	Yes
Survey	High Electric Power Line	No	No	No
Pouring Concrete Slab	Unfenced Edge	Yes	No	No
Slab Work	Fighting	No	No	No
Brick Work	Unsafe Scaffolds	No	No	No
Pouring Concrete	Poor Cable in Crane	Yes	Yes	Yes
Pouring Concrete	Poor Cable in Crane	Yes	Yes	Yes

Table 9 represents accidental cases of injuries in construction in Jordan that happened in 18.2% of cases. In 25% of cases safety tools are not available. In 37.5% of cases safety tools are not used. And in 75% of cases workers didn't receive any training programs.

Table 9 Injury Cases in Construction Projects in Jordan

Type of Construction Work	Cause of Accident	Safety Tools Available	Safety Tools Used	Worker Received Training
Renewing Plaster	Cutting Machine	Yes	No	No
Formwork Removal	Falling	No	No	No
Slab Work	Low Electric Power Lines	Yes	Yes	Yes
	Unclear Site	Yes	Yes	No
		Yes	Yes	No
		Yes	Yes	No
		No	No	Yes
		Yes	Yes	No

Table 10 represents other accidental cases such as burning, electric shock, and handicapped cases that represent 6.8% of accidents in construction in Jordan. In 33% of cases safety tools are not available in site, and workers didn't receive any training programs. While in 67% of case safety tools are not used by workers.

Table 10 Special Accident Results in Construction in Jordan

Type of Work	Cause of Accident and Results	Safety Tools Available	Safety Tools Used	Worker Received Training
Excavation	Electric Power Lines – Handicapping	No	No	No
Concrete Compaction	Compactor Power Line – Electric Shock	Yes	Yes	Yes
Electric Transformation Plant	Ignorance for Safety Rules	Yes	No	Yes

Table 11 represents the safety performance (availability of safety tools, the usage of safety tools, and the existence of training programs for workers) related to the class (grade) of company in Jordan.

Table 11 Safety Performance with Class of Construction Companies in Jordan

Class of Company	Safety Tools available	Safety Tools Used	Training Program
1st Class	Yes 43.75%	43.75%	Yes 43.75%
2nd Class	Yes 80%	Yes 80%	Yes 60%
3rd Class	Yes 43%	Yes 43%	Yes 0%
4th Class	Yes 40%	Yes 40%	Yes 20%
6th Class	Yes 0%	Yes 0%	Yes 0%

Figure 9 illustrates the data represented in Table 7 above more clear considering class of construction companies. It is obvious that 1st and 2nd class companies give a sensible trend in providing or obligating workers to use safety tools, and in giving safety training for workers, especially for 2nd class companies. Training is not provided in 3rd class companies. In 6th class companies neither training tools are available or used, either training is provided for workers.

Figure 9 Percentage of Safety Performance in Construction

IV. CONCLUSIONS

Safety of construction is a priority for all project parties including project clients, consultants, engineers, workers, visitors, and neighbors. Cost of safety in construction projects should be included in the cost of projects during planning, bidding, and construction.

Most of the accidents are caused by insufficient safety tools provided and construction equipments such as scaffolds and fences, unclear sites and routes in the project, and the ignorance of project parties including workers for the safety rules and regulations.

The violation of safety rules or regulations could cause a high additional cost for the project in terms of accident direct cost, insurance and compensation, and damage in materials, and delay of project, and this not is compared to the injury, fracture, disability, or unfortunately the fatality of workers.

All project parties have to make safety tools available for worker use in project site and obligate them to use it properly and organize and hold the appropriate training programs, and consultants should have their roles in following up the existence and usage of safety tools and defining the accidents' hot spots.

It is necessary to employ a safety team (engineers and superintendent) to put a safety program, provide training, and test safety of site and accessibility and clearance of routes, tools, equipment, and materials.

AKCNOWLEDGEMENT

The authors is directing their great thanks for the following personnel and companies; great thanks are granted to Mohammad Tarawneh, Tareq Dardasawi, Rani Sawalqa, Ma'an Rsheidat, Zeyad Al Tal, Zaid Al Qaisi, Sami As'ad, Emad Al Amaireh, Ra'fat Al Qaisi, Hassan Al Sunna', Marwan Kasasbeh, Abduljaber, Hani Al Taieb, Fawaz Al Razim, Zeyad Zaidan, and Khalid Ramadeen for their help and time in collecting data by the questionnaire. Great thanks for the departments of Civil Engineering at Mu'tah University and Tafila Technical University, for colleagues for their help and best wishes for authors.

REFERENCES

[1] Ministry of Labor, 2010 Report for Jordanian Labor Market, accessed on 27th of April, 2013. Available at: http://www.mol.gov.jo/LinkClick.aspx?fileticket=itpOLbpsI9k%3d&tabid=356

[2] Ahmed SM, Kwan, Weiming FY, Pui Ho DC., (2000). "Site Safety in Hong Kong" Journal of Management in Engineering, Vol. 16, No 6, November/December 2000.

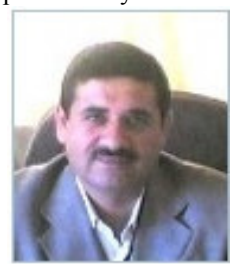
[3] Koehn, E., Kothari, R., and Pan, C. (1995). "Safety in Developing Countries: Professional and Bureaucratic Problems." *J. Constr. Eng. Manage.*, 121(3), 261–265.

[4] Koehn, E. and Datta, N. (2003). "Quality, Environmental, and Health and Safety Management Systems for

Construction Engineering." *J. Constr. Eng. Manage.*, 129(5), 562–569.
[5] N.A. Kartam, I Flood, and P. Koushki "Construction safety in Kuwait: issues, procedures, problems, and recommendations." Safety Science, Vol. 36, Issue 3, December 2000, P 163-184.
[6] O.A. Jannadi and M.S. Bu-Khamsine (2002). "Safety factors considered by industrial contractors in Saudi Arabia." Building and Environment, 37 (5), May 2002, P. 539-547.
[7] Evelyn Ali Lin Teo, Florence Yean Yng Ling, Adrian Fook Weng Chong, Framework for project managers to manage construction safety, International Journal for Project Management, Vol. 23, Issue 4, May 2005, p 329-341.
[8] C.M. Tam, S.X. Zeng, Z.M. Deng, Identifying elements of poor construction safety management in China, Safety Science, 2004, Vol. 42, Issue 7, August 2004, p 569-586.
[9] N.A. Kartam, Rami G. Bouz, Accident Analysis and Prevention, Fatalities and injuries in the Kuwaiti construction industry, Vol 30, issue 6, November 1998, P 805-814.
[10] Yi, K. and Langford, D. (2006). "Scheduling-Based Risk Estimation and Safety Planning for Construction Projects." *J. Constr. Eng. Manage.*, 132(6), 626–635.

AUTHORS' BIOGRAPHIES

Mohmd Kh. Sarireh is a full-time lecturer in Civil Engineering Department, Tafila Technical University. He received his B.Sc. in civil engineering from Mu'ta University, Jordan, and he received his M.Sc. in Civil Engineering from The University of Jordan, Jordan. He got his Ph.D. in Construction Engineering from Civil Engineering Department at The University of Texas at Arlington in August 2011, Arlington, Texas, USA. His Ph.D. Thesis was in modeling of productivity for horizontal directional drilling and factors affecting HDD productivity.



Dr. Sultan Tarawneh is a full time Associate Professor in Civil and Environmental Engineering Department, Mu'tah University. He received his B.Sc. in Civil Engineering from Yarmouk University, Jordan in 1986, and he received his M.Sc. in Civil Engineering – Construction Engineering Management – Risk Analysis in construction projects from Sheffield, U.K. in 1995. He got his Ph.D. in Construction Engineering Management from Leeds, U.K. in 1999. Dr Sultan had worked for Al- Habtoor Leighton group – UAE from 2007 to 2012 as Coordination and Engineering Manager at one of their largest projects in Abu Dhabi.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Recent conferences: http://www.iiste.org/conference/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar