Factors affecting Safety Performance in Repair, Maintenance, Alteration, and Addition (RMAA) Projects

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Abstract

Repair, Maintenance, Alteration and Addition (RMAA) works are playing an increasingly important role in developing countries. The accidents and fatalities records of RMAA sector in Gaza Strip have been alarmingly high; however, research in the RMAA sector remains limited. Safety of RMAA works has long been neglected because the project sizes of RMAA are small and only last for a short period of time, which make the working environment of RMAA works more difficult to control than new building works. The aim of this paper is to identify, valuate and rank the most important factors that affect safety performance and the most important causes of fatal accidents in RMAA projects. A questionnaire survey was used in this study. The results revealed that poor safety awareness of managers in maintenance firms and lack of training of RMAA workers for handling multi-tasks were the most important factors that affecting safety performance of RMAA works. The results showed that ineffectiveness of lack of training and certification of competence; immature corporate systems of firms which does not care with safety and health through RMAA works, and lack of leadership from government as a key client are the most significant causes of construction fatal accidents of RMAA projects. The results also indicated that the macro level factor is the most important category that causes fatal accidents in RMAA works. It is recommended to enhance the awareness of construction firms, project managers and workers regarding the importance of safety performance in repair and maintenance works and strengthen site monitoring and supervision system in construction firms. Safety training courses should be organized for workers and project managers in order to improve their safety culture and competence regarding safety performance through repair and maintenance works. Furthermore the RMAA subcontractors should be selected according to their good records of safety performance.

Keywords: *Repair, maintenance, safety performance, construction*

1.0 Introduction

With shrinkage of the construction market and reduced volume of new works, repair, maintenance, minor alteration and addition (RMAA) works are playing an increasingly important role in the local construction industry (Chan et al., 2009). RMAA works refers to those minor works such as construction projects for village type houses in the new territories, minor alterations, repairs, maintenance and interior decoration of existing buildings (Labour Department, 2008). RMAA work involves different types of workers as compared with new building works. Most RMAA contracting companies found in the construction market are subsidiaries of general building contractors or small specialty contractors of RMAA works (Hon et al., 2010).

Most of RMAA contracting companies are small and medium-sized enterprises (SMEs). Poor safety practices are more prevalent in SMEs than the large size ones (Brace et al., 2009).Small companies tend to work in greater isolation. Thus, owing to limited resources, these companies may experience more difficulty in meeting health and safety requirements (Lam, 1997; cited by Hung, 2012).RMAA works involve more small contractors than new buildings works do. Many of these contractors have less knowledge and experience in health and safety. The small project size and short duration of RMAA works tend to make the working environment more difficult to control than new building works (Hung, 2012).The risk of falls is high in RMAA

works because of temporary, short-term, and precarious nature of access to the task. When the task duration is short, workers are tempted to take higher risks (Cameron et al., 2007).Safety of RMAA works has long been neglected because RMAA works have a fragmented nature and only last for a short period of time (Hon and Chan, 2013b).The accident record of the RMAA sector has been alarmingly high; however, research in the RMAA sector remains limited (Hon et al., 2013). With rising importance of the RMAA sector in many developed societies, safety of RMAA works has begun to draw attention (Hon and Chan, 2013a).

Importance of RMAA works to the whole construction industry is expected to increase continuously in the foreseeable future (Chan et al., 2009).Safety performance of the construction industry still needs improvement. Hon et al (2012) conducted an empirical study to investigate the difficulties of implementing safety practices in the repair and maintenance sector in Hong Kong. They concluded that the most common difficulties are: difficult to change the mindset of RMAA workers, difficult to conduct safety supervision due to scattered locations, limited safety resources for RMAA projects undertaken by small/medium-sized contractors, difficult to standardize the operational procedures of RMAA works due to ad hoc site problems, shortage of time to deal with safety issues, high turnover rate of RMAA workers, small scale and short duration of RMAA projects, influx of illegal workers, and difficult to control self-employed workers. These difficulties of implementing good safety practices in the construction industry largely hinder further safety performance improvement and undermine the effectiveness of safety measures. Many RMAA contracting companies are small and medium-sized enterprises (SMEs) which do not have comprehensive safety management systems. Hon and Chan, (2013b) concluded that existing safety legislation and regulations for new construction sites are not fully applicable to RMAA works. RMAA subcontractors with good track records of safety performance should be selected for bidding.

Enshassi (2003) illustrated the factors affecting the construction safety on Gaza Strip such as, the severe competitive tendering methods, the age of the workers, experience, and the concern of management on productivity with the ignorance of safety issues, and the lack of training. But unfortunately, there was a shortage in safety applications in the Gaza Strip construction industry. Statistics showed that more than one third of fatalities among workers were dead during the working in construction site. Falls and excavations were the main factors causes for the death of constriction workers. The main causes of injuries in the RMAA sector in Gaza Strip are classified into five categories, the categories are, falls, struck by falling object, struck by moving or stable object, caught in/between, machines, and others (Hassona, 2005). The absence of a unified set of safety regulations adversely affects the enforcement of safety on the job site (Alaqqad, 2009).For these reasons, more research is needed to be done in the RMAA sector, where small companies dominate the industrial sector(Hung, 2012).

Little studies have been done in this field in Gaza Strip. Health and safety in Gaza Strip is not widely recognized as inherent characteristic of RMAA projects. Contractors consider health and safety a legal requirement that means spending money without any profit. This situation resulted in the increased number of accidents in RMAA sector (Abu Alqumboz, 2007).The objectives of this paper are:

- To identify, evaluate and rank the most important factors that affecting safety performance in RMAA sector in Gaza strip,
- To identify most important causes of construction fatal accidents in RMAA projects,
- To identify the most common personal protective equipment provided by contractors in RMAA works,
- To highlight the adverse impacts of the occurrence of incidents in maintenance projects, identify most types of serious accidents of repair and maintenance projects and propose preventive measures to improve safety practice in RMAA sector in Gaza Strip.

2.0 Repair, Maintenance, Alteration and Addition (RMAA)

As the RMAA sector expands, safety of the RMAA sector deserves greater attention (Hon and Chan, 2013a). Despite research studies on improving safety performance of the construction industry are readily available; most of them are based on new construction projects. There is a very limited research on the RMAA sector, not to mention studies focusing on investigating strategies to curb the worsening safety problems of the rising RMAA sector (Hon et al., 2010). Nature of works, tasks undertaken and workers involved in RMAA projects are entirely different from those in new construction projects. Hence, strategies for resolving safety problems of RMAA projects are also incongruent to new construction projects.

While RMAA sector is expanding in many developed cities; occurrences of fatalities and injuries in this sector are also soaring (Hon et al., 2011). Fatalities in the construction industry are often the highest among all industries in a number of developed countries (Hung, 2012). Statistics indicated that the percentage of fatal industrial accidents arising from RMAA works in Hong Kong was disturbingly high and was over 56% in 2006 (Chan et al., 2009). Fatal accident case analysis in RMAA sector is important in safety research because it can reveal the root causes of accidents, providing valuable information for designing future preventive measures. Hon and Chan (2013a)found that the behavior of contractors who work in RMAA sector on safety management are of grave concern, including the lack of provision of personal protection equipment, regular safety meetings, and safety training. The main factors affecting safety performance in RMAA projects include poor safety awareness of top management, lack of training, poor safety awareness of project managers, reluctance to input resources to safety, and reckless operations (Tam et al., 2004).

Hon and Chan (2013b) concluded that construction safety performances of many developed countries with regard to RMAA sector have been improving. The prevailing challenge of this industry is to find out ways for further safety improvement. By the same token, proper safety knowledge management may be one of the ways to improve construction companies' safety performance in RMAA projects (Hon and Chan, 2013b). Hallowell (2012) asserted that better safety knowledge management can improve the organization's capacity of adapting to changes, resulting in better safety performance. Term contract nature of some RMAA projects makes safety supervision difficult because RMAA work tasks are widely scattered (Hon et al., 2012). Different subcontracting works of new construction projects are likely to be responsible by individual specialty subcontractors of a single trade. However, nature of RMAA works generally requires workers to have multi-skills to perform multi-tasks. RMAA workers may be endangered when performing tasks that they are not as familiar with (Hon et al., 2010 as cited by Hon and Chan, 2013b). Safety knowledge is important to successful safety management and good safety performance (Hallowell, 2012). Safety legislation, regulations, and guidelines provide the minimum requirements of site safety. However, meeting these stipulated standards are not enough to maintain a safe working environment (Hon and Chan, 2013b).

Brace et al.,(2009) have unveiled the causes of fatal construction accidents in the RMAA sector in United Kingdom. They identified three levels of factors: macro, mezzo, and micro. Accidents occur in RMAA projects when these three levels of factors are concurrently aligned. Six out of the nine micro-level factors are related to human behavior: lack of individual competency and understanding of workers and supervisors; ineffectiveness of lack of training and competence; lack of individual competency and understanding of workers and supervisors; ineffectiveness of lack of training and certification of competence; lack of ownership, engagement and empowerment of communication with, and responsibility for workers and supervisors; poor behavior; misuse of equipment (including personal protective equipment); and itinerant workforce. Most macro and mezzo level factors are related to the safety attitudes and safety practices of RMAA organizations.

The exploratory study of Cheng et al. (2004) revealed six root causes of construction accidents in RMAA sector in China. Amongst them, three are related to workers, namely: lack of

attention to personal safety protection by workers, insufficient safety training, and tiredness of workers. Another two are related to organizational management, namely: lack of attention to safety management by main contractors/ project managers, and inadequate setting of safety level. The sixth cause was poor quality of construction materials and equipment. Mullen (2004) has provided an insightful discussion of underlying factors leading to unsafe behavior in a workplace of RMAA projects. He has synthesized the factors into three broad categories: organizational factors, image, and avoiding negative consequences. Organizational factors substantially contribute to unsafe behavior. The organizational factors include role overload production performance over safety, socialization influence, safety attitudes, and perceived risks. Image negatively influences the safety behavior of workers because workers want to be seen as "macho" or tough and competent. To avoid negative consequences, workers want to avoid teasing and harassment from co-workers, and do not want to lose their jobs.

Haslam et al.(2005) have identified a hierarchy of factors leading to accidents in the RMAA sector in United Kingdom. These factors included problems arising from workers or the work team, workplace issues, shortcomings with equipment (including personnel protective equipment (PPE)), problems with suitability and condition of materials, and deficiencies with risk management. They attributed over two-thirds of the accidents to the behavior and capabilities of workers. As in the construction industry, a number of safety researchers have identified human and organizational factors to be the key causes leading to accidents in RMAA projects. Kartam et al. (2000) summarized nine causes of safety problems in RMAA projects in Kuwait construction industry. Amongst them, disorganized labor, extensive use of foreign labor, extensive use of subcontractor, lack of safety regulation and legislation, low priority given to safety, small size of most construction firms and competitive tendering are human and organizational factors contributing to unsafe behaviors.

3.0 Research Methodology

A questionnaire was designed based on previous studies (Abdel hamid and Everett, 2000; Brace et al., 2009; Chan et al., 2008; Cheng et al., 2004; Tam et al., 2004; Haslamet. al., 2005; Brace et al., 2009; Hon et al., 2010; Hon et al., 2011; Hon et al., 2012; Hung, 2012, Hon and Chan, 2013a; Hon and Chan, 2013b; Hon et al., 2013). A set of 23 factors that affected safety performance through RMAA works were identified. A total of 19 causes of fatal accidents through repair and maintenance projects were also identified. These 19 factors were further grouped under three major categories: macro level factors, mezzo level factors, and micro level factors. Five-point Likert scale was used in this questionnaire (1 = very low effect, 2 = low effect, 3 = neutral effect, 4 = strong effect, and 5 = very strong effect). Likert scale was chosen in order to expand the way the respondents would reply.

The target population of the study comprised of: governmental institutions, private institutions and international institutions. A total of 38 questionnaires were distributed to selected respondents and 30 were retrieved which were used for the analysis giving a response rate of 78.94%. Respondents were selected based on their level of education and experience in the construction field. The following formula was used to determine the sample size (Ayyub and Mccuen, 2003).

$$SS = \frac{Z^2 \times P \times (1 - P)}{C^2}$$

Where: SS = Sample size

Z = Z value (e.g. 1.96 for 95% confidence level)

P = Degree of variance between the elements of population percentage

C = Confidence interval (margin of error), expressed as decimal (e.g., .05 = ±5)

Correction for Finite Population

$$SS_{correcte} = \frac{SS}{1 + \frac{(SS-1)}{N}}$$

Content validity test was conducted by sending the questionnaire to two experts in construction to evaluate the questionnaire validity, clarity, comprehensive, readability and reliability and to add more information or delete unacceptable wording if needed. They presented their opinions and comments about content of questionnaire, the degree to which questionnaire paragraphs are relevant to their groups, and lingual clarity of words. In this regard, few paragraphs have been dropped while others have been altered. Two statistical methods were used to analyze the data which obtained from the questionnaires. The first was to obtain percentage values through frequencies of the answers received. The other was to calculate a Relative Importance Index (RII). According to Tam et al. (2000) the RII was evaluated using the following expression.

$$RII = \sum w/A * N$$

where w is the weighting given to each factor by the respondent, ranging from 1 to 5; '1' is the least strong effect and '5'' is the extremely strong effect, A is the highest weight; in this study it is 5; and N is the total number of samples. The RII shall be a variable ranging from 0 to 1.

4.0 Results and Discussion

Table 1 illustrates the institution profile of the study sample.

Table 1: Institution profile

Item	Category	Frequency	Percentage
Types of institution	Governmental	12	40%
	Private	16	53.33%
	International	2	6.66%
Is the institution specialized in maintenance field	yes	12	40%
	no	18	60%
Experience of the institution	Less than 5 years	6	20%
	From 5 years – 15 years	10	33.33%
	From 16 years – 25 years	6	20%
	Over 25 years	8	26.66%
Number of executed projects in the last 5 years	Less than10 projects	10	33.33%
	From 11 – 20 project	5	16.66%
	From 21 – 30 projects	3	10%
	More than30 project	12	40%
Work monetary volume in the last 5 years (USD)	Less than $500000	11	36.66%
	$500000 – less than $1 million	3	10%
	$1 million- less than $5 million	5	16.66%
	$5 million – less than $10 million	10	33.33%
	More than $10 million	1	3.33%
The position of the respondent	Director	4	13.33%
	Project Manager	6	20%
	Site/Office Engineer	20	66.66%
The experience of the respondent	less 5	14	46.66%
	from 5-10	9	30%
	from10-15	2	6.66%
	over than 15	5	16.66%

4.1 Cracking and Failure Patterns – Numerical Observation

Table 2 illustrates the result regarding the safety practices in repair and maintenance projects. As shown in Table 2, the majority of people (83.33%) who worked in repair and maintenance projects are not committed to health and safety. Only 43.33% of companies encourage suggestions on how to improve health and safety in repair and maintenance projects. This means that the awareness of institution and workers with regards to safety in maintenance projects need to be enhanced. The majority of people (63.33%) who worked in maintenance projects haven't received safety trainings courses related to repair and maintenance works. This means that they are exposing every day to injuries and accidents because of the lack of training and experience in the maintenance field. It is unfortunate to notice that only (26.66%) from companies has a good preparedness for emergencies that may happened through execution of repair and maintenance projects. This means that every worker is exposed to death, deteriorating of his health, or aggravation of his injury because of the lack of first-aid in the maintenance projects in Gaza Strip.

However 83.33% of people who are working in maintenance field are fully understand the health and safety risks associated with repair and maintenance projects. Results showed that 46.66% from respondents stated that sometimes it is necessary to take risks to get the job done. This result may appear because of the special nature of maintenance works which differ from new construction works and may have a high level of risk. The findings also showed that 60% of respondent agreed that some health and safety rules or procedures are difficult to follow through repair and maintenance projects. This result can be traced to the special nature maintenance works, which characterized with unclear scope, short duration, and fragmented nature. This results sets alarm of bells that peoples who are working in maintenance field have a more chance to have injuries or accidents.

Table 2: Safety practices in repair and maintenance projects

Question	Response	Frequency	Percentage
I have noticed that all the people who work in repair and maintenance projects are fully committed to health and safety	Agree	4	13.33%
	Disagree	25	83.33%
	Don't know	1	3.33%
I am sure that my company encourages suggestions on how to improve health and safety in repair and maintenance projects.	Agree	13	43.33%
	Disagree	15	50%
	Don't know	2	6.66%
I have received safety trainings courses related to repair and maintenance projects.	Agree	7	23.33%
	Disagree	19	63.33%
	Don't know	4	13.33%
I believe that there is good preparedness for emergencies that may happened in execution of repair and maintenance projects in my company.	Agree	8	26.66%
	Disagree	14	46.66%
	Don't know	8	26.66%
I fully understand the health and safety risks associated with repair and maintenance projects	Agree	25	83.33%
	Disagree	2	6.66%
	Don't know	3	10%
I believe that sometimes it is necessary to take risks to get the job done.	Agree	14	46.66%
	Disagree	15	50%
	Don't know	1	3.33%
I believe that some health and safety rules or procedures are difficult to follow through repair and maintenance projects.	Agree	18	60%
	Disagree	11	36.66%
	Don't know	1	3.33%

4.2 Protective equipment provided by contractors in RMAA works

Figure 1 illustrates the results of personal protective equipment (PPE) provided by contractors through RMAA works in Gaza Strip. The results show that "hard hats, gloves, eye goggles" is the most PPE provided by contractors through RMAA works. Results also showed that "ear plugs" have never provided by any contractor through RMAA works. Tam et al., (2004)

concluded that “Eye goggles, Gloves, and Hard hats” are provided at a percentage 100% by contractors through RMAA works in China. This result reflects the high importance of this equipment's.

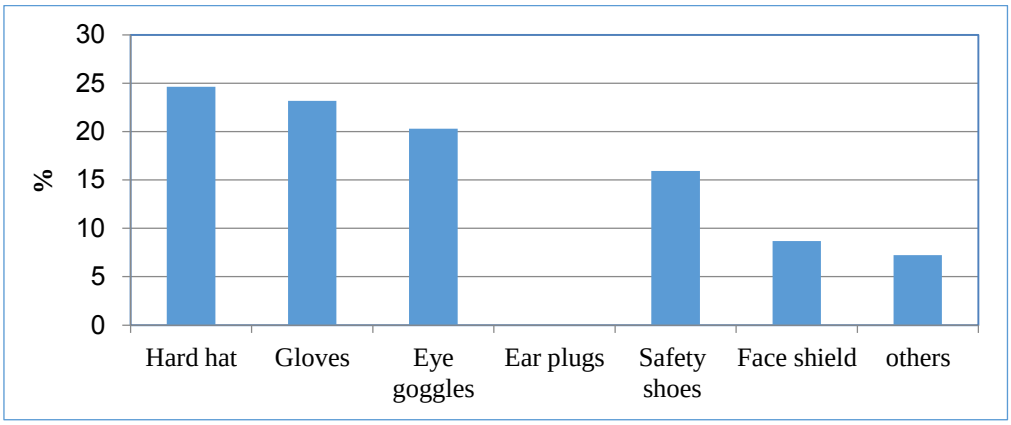


Figure 1: Personal protective equipment provided by contractors in RMAA works

4.4 Most types of serious accidents of repair and maintenance projects

Figure 2 illustrate the results regarding the adverse impacts of the occurrence of incidents in maintenance projects. Results showed that "increase in cost" and "imposing psychological burden on workers" are the most common and important impacts of accidents in RMAA works. It is axiomatic that if any worker has injured or suffers from an accident, the moral of workers will be affected, and they will feel so bad. This means that their productivity will be reduced. Tam et. al., (2004) showed that the majority of respondent (68%) believed that site accidents caused impairing reputation of firms. However this impact is in the least position in the current study. This result may appear because of the poor safety behavior and culture of firms and top leaders in Gaza Strip who don’t care if the selected contractor is from those who have good record of safety performance or not.

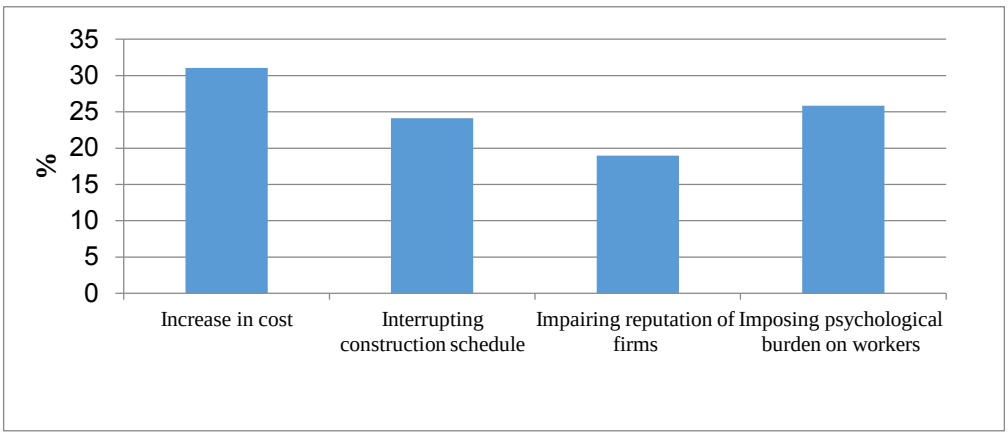


Figure 2: adverse impacts of the occurrence of incidents in maintenance projects

4.5 Most types of serious accidents of repair and maintenance projects

Figure 3 illustrate the results regarding the most types of serious accidents through repair and maintenance projects in Gaza strip. The results revealed that "fall from height" and "slip, trip or fall on same level" are the most types of serious accidents through RMAA works. This result may appear because of the lack of experience, and safety course training of workers. Additionally, most of construction sites are suffering from lack of cleanliness. Nails and toolboxes are sparse

around the sites of most projects in Gaza Strip. Hung (2012) concluded that falling from height is in the first position with parentage (63.1 %) and contact with electric shock is in the second position with percentage (15.5%).

The results of Hung (2012) and this study regard to type of accident in RMAA works are very similar and consistent. This means that these types of accidents is serious, widespread, and have extended roots all over many countries. It is clear that there is a massive need to enhance the awareness of RMAA workers regard to safety performance through RMAA works. Every worker should receive a safety course training to avoid injuries and accidents through RMAA works.

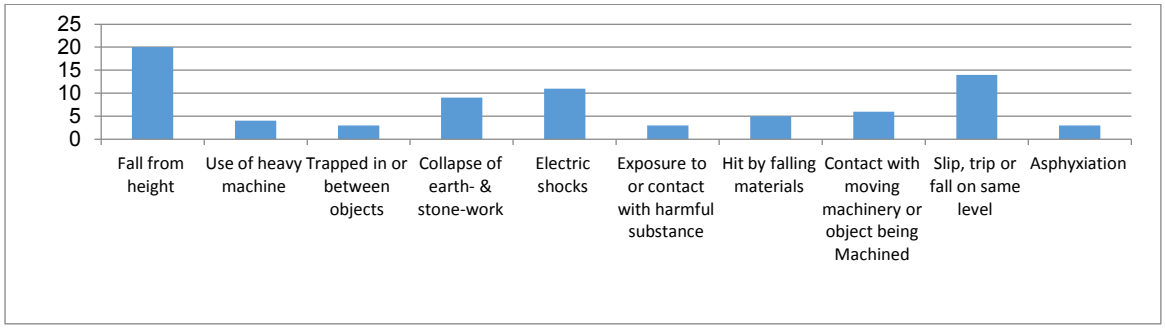


Figure 3: most types of serious accidents of repair and maintenance projects in Gaza strip

4.6 Causes of fatal accidents in RMAA projects

Table 3 illustrates the results regarding the causes of fatal accidents in repair and maintenance projects.

4.6.1 Macro level factors group

As shown in Table 3 the respondents ranked that "Immature corporate systems of firms which doesn't care with safety and health in repair and maintenance projects" in the first position with RII=0.8133. This result may interpret as most of firms in Gaza Strip are suffering from lack of experience, training, and awareness regards to the importance of safety through RMAA projects, which leads workers often to exposing to injuries and accidents.

4.6.2 Mezzo level factors group

The respondents ranked "Lack of organizational learning to avoid injures" in the first position in the mezzo group with RII=0.786.This can be due to the lack of education and concern of workers awareness regard to safety performance through RMAA works. The firms should have an organized learning plan to educate workers how to deal with emergencies and avoid accidents through RMAA works. Every worker should fully understand all the risk associated with repair and maintenance works.

4.6.3 About Micro level factor group

The respondents ranked "Ineffectiveness of lack of training and certification of competence" in the first position in the micro group. This factor is also ranked in the first position in all groups and have the highest relative important index (RII=0.820). This result is due to the lack of training, concerning, educating, and improving abilities of workers through RMAA works. Workers in RMAA field should receive course training to improve their competence regard to how to deal with and avoid injuries through RMAA works

Table 3: Causes of fatal accidents in repair and maintenance projects

No	Causes of construction fatal accidents in repair and maintenance projects	RII	Rank	Rank in total
Macro level factors				
1	Immature corporate systems of firms which doesn't care with safety and health through repair and maintenance projects	0.813	1	**2**
2	Lack of leadership from 'Government's a key client	0.793	2	3
3	Lack of influence of trades unions	0.773	3	6
4	Inappropriate enforcement	0.726	4	11
5	Lack of proper accident data	0.713	5	12
Mezzo level factors				
6	Lack of organizational learning to avoid injures	0.786	1	5
7	Immature project system and process which doesn't care with workers safety	0.746	2	9
8	Lack of proper accident investigation/data	0.700	3	13
9	Lack of understanding and engagement by some of the design community	0.626	4	17
10	Inappropriate procurement and supply chain arrangements	0.593	5	18
Micro level factors				
11	Ineffectiveness of lack of training and certification of competence	0.820	1	**1**
12	Lack of individual competency and understanding of workers and supervisors	0.793	2	4
13	Poor behavior	0.773	3	7
14	Site hazards	0.760	4	8
15	Poor equipment or misuse of equipment (including PPE)	0.740	5	10
16	Poor employment practices	0.700	6	14
17	High Cost of safety requirements	0.666	7	15
18	Lack of ownership, engagement and empowerment of communication with, and responsibility for workers and supervisors	0.660	8	16
19	Itinerant workforce (Wandering the workers at the site)	0.586	9	19

4.7 Factors affecting site safety in repair and maintenance projects

Table 4 illustrates the results regarding factors affecting site safety in repair and maintenance projects. As shown in Table 4, the respondents ranked" Poor safety awareness of firms top leaders " and "Insufficient safety training of RMAA workers for handling multi-tasks" in the first position with same RII=0.806. This result may be explained because most of construction firms in Gaza Strip are suffering from lack of awareness, experience, culture, concern and efficiency regard to safety procedures through repair and maintenance projects. The majority of workers haven't received any safety training course. This means that most of construction workers are exposing every day to injuries and accidents.

Nature of RMAA work generally requires workers to have multi skills to perform multi-tasks. Wherefore, the awareness of firm top leaders regarding safety in maintenance projects should be enhanced. Every worker should receive training courses on how to work safely in RMAA projects, and how to deal with emergencies in RMAA works. Results also showed that "Low educational level of workers" is in the last position with RII=0.56.This result may appear because of the literalism nature of maintenance works. Tam et al., (2012) conducted a survey in china and found that poor safety awareness of firms top leaders ranked in the first position with RII=0.93, and lack of training ranked in the second position with RII=0.90. This result is

consistent with the current study. Hung (2012) concluded that poor safety conscientiousness of workers ranked in the first position with mean (4.64). However this factor was ranked in the eighth position in the current study.

Table 4: Factors affecting site safety in repair and maintenance projects

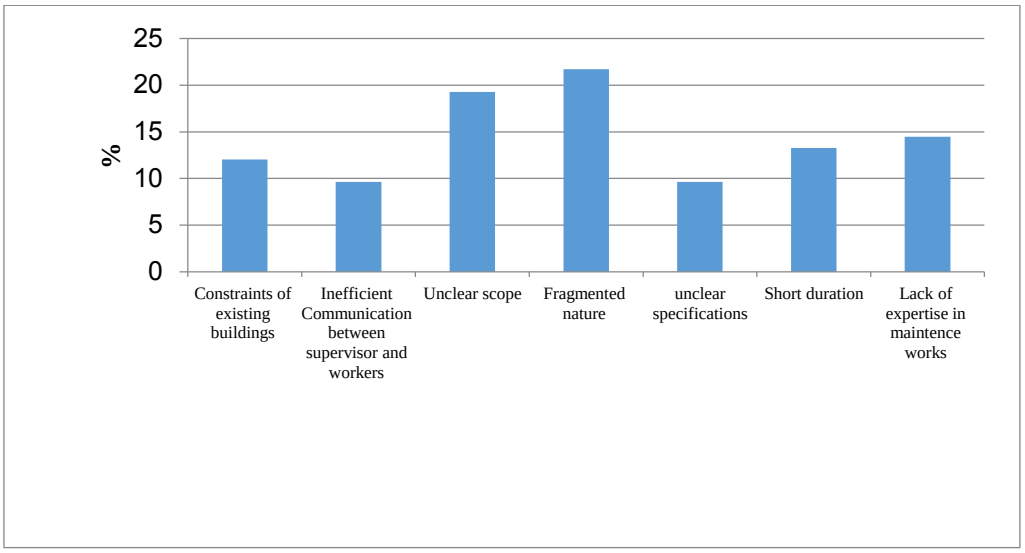
No	Cause	St.Dev.	w	RII	Rank
1	Poor safety awareness of firms top leaders	6.2849	121	0.806	1
2	Insufficient safety training of RMAA workers for handling multi-tasks	6.0415	121	0.806	1
3	Lowest bid tendering method without pricing for safety items	6.7823	120	0.800	3
4	Lack of rigorous enforcement of safety regulations	6.0000	118	0.786	4
5	RMAA workers underestimate potential risks when performing small tasks for a short period of time	5.0497	117	0.780	5
6	Poor safety awareness of RMAA managers	7.2456	115	0.766	6
7	Lack of personal protective equipment	4.6904	114	0.760	7
8	Poor safety conscientiousness of workers	7.3824	113	0.753	8
9	Lack of certified skill labor	6.5954	113	0.753	8
10	Low safety awareness of small/medium sized contractors on RMAA works	4.7958	112	0.746	10
11	Reckless operation	5.0497	111	0.740	11
12	Poor housekeeping and congested working environment	7.3484	110	0.733	12
13	Inadequate safety supervision	7.1063	109	0.726	13
14	Inadequate site safety planning and hazard assessment	5.6568	108	0.720	14
15	Shortage of safety management manual	4.0620	107	0.713	15
16	Lack of protection in material transportation	5.3385	107	0.713	15
17	Poor equipment	6.5192	107	0.713	15
18	Lack of first aid measures	5.2440	106	0.706	18
19	Lack of protection in material storage	5.3385	105	0.700	19
20	Poor information flow	3.0822	103	0.686	20
21	Excessive overtime work for labor	3.6742	102	0.680	21
22	Lack of teamwork spirits	3.7416	100	0.666	22
23	Low education level of workers	3.8729	84	0.560	23

4.8 Problems of running building maintenance projects

Figure 4 illustrate the results regarding to the problems of running building maintenance projects through repair and maintenance projects in Gaza strip. Results showed that "fragmented nature" and "unclear scope" are the most common problems that facing maintenance projects. This result may be explained because of the difference nature between maintenance works and new construction works. New construction projects have a clear and limited scope (tasks and construction activities are precisely defined in time, place and nature of the work), and characterized with a sequent nature compared with the fragmented nature of maintenance projects. This nature of maintenance works forms a lot of problems for workers, and caused confusing and distractibility for them on which element need to be done, and which procedures or methods should be used. Hon et al., (2012) conducted a survey in Hong Kong, and adopted mixed methods approach for the data collection, semi structured interviews and a two-round Delphi survey. Major

problems were identified, including limited safety resources for small and medium enterprises (SMEs), difficulty in changing the mindset of RMAA workers, and difficulty in performing safety supervision.

Figure 4 Problems of running building maintenance projects



4.9 Recommended preventive measures to improve safety practice in RMAA works

Table 5 illustrates the results regarding the recommended preventive measures to improve safety practice through repair and maintenance projects. The respondents ranked "Strengthen site monitoring and supervision "in the first position with RII=0.88. This result may appear because most of projects in Gaza Strip are suffering from poor monitoring and supervision system. Supervisors don't care about the safety methods and procedures used by workers through RMAA works. A lot of supervisors also doesn't care if the workers wear protective equipment or not through execution of RMAA works. There is an urgent need to strengthen the site monitoring and supervision system. The results also showed that "Safety promotion and education towards RMAA sector" was ranked in the second position with RII=0.873. This result appeared because of the lack of experience, awareness, and training of workers regard to safety procedures through RMAA works.

Mahalingam and Levitt (2007) pointed out in their study that education and training can change one's mindset and attitude towards safety and thus enhancing safety awareness but it takes time. Raising safety awareness of RMAA workers and selecting contractors with a good record of safety performance were the two most important strategies to improve the safety performance in RMAA works. However selecting contractors with a good record of safety performance was in the tenth position in this study with RII=0.806; which reflected the poor safety culture in Gaza strip regard selecting the appropriate contractor to perform RMAA works. A technology innovation was ranked in the least important strategy in Hon et al., (2011) study. Their result is consistent with the result of this study which ranked technology innovation factor in the 13th position with RII=0.76. That means that RMAA work are traditional works and innovation region in this area is very limited.

Table 5: Recommended preventive measures to improve safety practice in RMAA works

Recommended preventive measures	Degree of Approval					w	R.I.I	Rank
	5	4	3	2	1			
Strengthen site monitoring and supervision	15	13	1	1	0	132	0.880	1
Safety promotion and education towards RMAA sector	14	13	3	0	0	131	0.873	2
Legislative control.	12	15	3	0	0	129	0.860	3
Improvement of site tidiness and housekeeping.	11	16	3	0	0	128	0.853	4
Implement pay for safety scheme for RMAA works.	15	9	4	2	0	127	0.846	5
Raise safety awareness of RMAA workers.	10	16	4	0	0	126	0.840	6
Relevant safety training for specific trades of RMAA works	9	19		2	0	125	0.833	7
Build up good company safety culture	10	12	8	0	0	122	0.813	8
Clear working procedures and guidance for RMAA workers	8	16	6	0	0	122	0.813	8
Select RMAA subcontractors with good record of safety performance.	15	5	8	0	2	121	0.806	10
Design for safety of RMAA works.	7	14	9	0	0	118	0.786	11
Award and penalty scheme.	7	16	5	1	1	117	0.780	12
Technology innovations for better safety.	8	13	6	2	1	115	0.766	13
A mandatory licensing system for RMAA workers	5	12	10	3	0	109	0.726	14

5.0 Conclusion

The results illustrated the most common and important factors that affected safety performance in repair and maintenance works. The results also illustrated the most important causes of fatal accidents through repair and maintenance projects. Gaza Strip is suffering from a poor safety culture, performance, and awareness regard to safety and health through RMAA works. The site safety monitoring and supervision should be improved, and the awareness of firms, project managers, and workers regard to safety issue should be enhanced. The results indicated that both of "Poor safety awareness of firms top leaders "and "Insufficient safety training of RMAA workers for handling multi-tasks" have been ranked in the 1st position regarding to its high effect on the performance of safety in repair and maintenance works. This result reflect the urgent need to enhance the awareness of firms regarding safety performance through RMAA works, and the importance of improving the workers and project managers safety culture and performance.

The results revealed that "lack of training and certification of competence" has been ranked in the 1st position in causing injuries and accidents. This factor belongs to micro level factor group. "Strengthen site monitoring and supervision" is considered the most important Preventive measures for improving safety practice through RMAA works. The RMAA subcontractors should be selected from those who have good record of safety performance. Results indicated that "hard hats, gloves, eye goggles" are the most equipment's provided by contractors through RMAA works. Results also showed that "ear plugs" have never provided by any contractor through RMAA works. The results revealed that "increase in cost" and "imposing psychological burden on workers" are the most common impacts of accidents in RMAA works.

The results indicated that "fall from height" and "slip, trip or fall on same level" are the most serious accidents in RMAA works. Nails and toolboxes are sparse around the sites of most projects in Gaza Strip. This result reflects the massive need to enhance the awareness of RMAA workers regard to safety performance through RMAA works. Every worker should receive a safety course training to avoid injuries and accidents through RMAA works."Strengthen site monitoring and supervision "is considered the most important preventive measures in improving safety practice. The awareness of workers regard to safety performance through RMAA project need to be enhanced. Safety awareness is intrinsic and incubated by one's mindset and attitude

towards safety. It is recommended that RMAA subcontractors should be selected from those who have good record of safety performance. Technology innovations should be encouraged to obtain better safety performance through RMAA works.

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