

Implementation of Accident Investigation Recommendations in the Construction Industry in UAE: Common Features and Challenges

Suha Khaswan and Hamad Rashid

Department of Industrial Engineering and Engineering Management
University of Sharjah
Sharjah, United Arab Emirates
U17105312@sharjah.ac.ae, hamad.rashid@sharjah.ac.ae

Abstract

Accidents and near-misses frequently happen within high complex human-machine interaction sociotechnical systems. Detailed accident investigation actions usually follow. An accident investigation is a safety-oriented procedure which is conducted by an authorized team to identify root causes and contributory factors that led to an accident or a near-miss. After dedicated evidence collection from an accident site and relevant context, data is usually analyzed, and causal and contributory factors are identified. A set of recommendations together with any needed corrective actions will be issued to prevent reoccurrence as a main goal, thus enhancing the organizational safety performance, and the safety of a given industry in general. In current practice, and especially within poor oversight functions settings, these recommendations may not be honored and carried out to their ultimate value such that organizational learning is adequately achieved, and accordingly more accidents will be lining up. This paper focusses on the construction industry which is one of the mostly known unsafe domains within modern complex sociotechnical industries. The paper investigates challenges that face the construction organizations in United Arab Emirates - as a world leader in construction projects expansion - in implementing previous accidents investigation recommendations, and what obstacles are there that hinder transferring such recommendations into actual changing actions.

Keywords

Accident investigation, Construction industry, Safety recommendations, Organizational learning, Challenges to compliance.

1. Introduction

An accident investigation is the series of procedures and actions that are usually taken by an investigation team in the aftermath of a safety critical event within an operational setting. The overall target of such an investigation is to prevent the re-occurrence of a similar event in future. The investigation team collects evidence and analyzes all available information to determine the causes and contributory factors that led into the event. The investigators then use the collected data and evidence to derive the necessary corrective actions and present them in terms of conclusions and safety recommendations within an organized report. The safety related recommendations mentioned in all accidents investigations reports must be followed – industry wise - by necessary actions and must be implemented within all concerned organizations to improve the overall safety-related practice within the industry. However, the reoccurrence of industrial accidents continues, and this fact indicates that not all lessons from previous accidents are learnt, especially in high risk industries such as construction. This raises concerns regarding how far safety recommendations from accidents investigations are implemented within the UAE construction industry. The current research explores how accidents investigations safety recommendations are received and implemented within the said industry and identifies the challenges that hinder a full compliance with such recommendations.

2. Literature Review

2.1 Industrial accidents investigations

The accident investigation is a safety process that aims to discover the root causes of an accident. It is the first important step in implementing accidents prevention plans and procedures. (Johnson and Holloway, 2003). The importance of accident investigation comes from the need for extracting the prevention benefit from a safety failure.

Therefore, more information needs to be obtained to detect the current risks and to control and manage them efficiently and sufficiently. (Fraile et al., 1993).

Fraile et al. (1993) and Dien et al. (2012) authors confirmed that it is difficult to conduct an accurate and precise assessment of accident investigations results that have been undertaken by numerous and various agents that are working for the occupational health and safety technical advisor, administration or direct managers of an ongoing investigation. However, Fraile and Dien have also shown how analysis conducted by the administration confirm that the protective efficiency of the accident investigation could be significantly increased. Also, other authors have reached to the same conclusion, and they mentioned this in their studies on occupational accidents investigation reports (Goldberg, 1997; Jacinto and Aspinwall, 2003; Lundberg et al., 2009; Lindberg et al., 2010; Jacinto et al., 2011). They have tried to show the essential quality criteria of all accident investigation report.

In 1997, Goldberg defined the accident investigation process into three main phases: Phase 1 which is presented by the initial accident investigation report, phase 2 which is data and information collection and generation phase, and phase 3 which represents the analysis and correction actions phase.

2.2 Aims of conducting accidents investigations

The accident investigation is conducting by investigators who are experts in accident investigation knowledge or in any other knowledge fields that are related to the accident investigation. Investigators aim to reach the following objectives and goals: first, finding the accident circumstances, second, identifying the accident causations and injuries, third, finding out the accident consequences in terms of injuries and injuries outcomes and finally, finding the contributory accident factors or its consequences. However, investigators do not contribute to any legal question or take a stand on responsibilities. Investigators aim to produce recommendations for countermeasures to prevent occurrences of future accidents. (Elliman, R.K. ... et al, 2007).

2.3 Implementation of accident investigation recommendations

In many industrial organizations and companies, an Industrial accident investigation is conducting after major accidents. Following the investigation, a set of recommendations is produced, and the follow-up actions are necessary to improve the safety culture of the organizations. (Cedergren, A.,2013).

The responsibility for the different accident investigation steps and the implementation of remedial recommendations is distributed over various organizations. It is mostly the case of major accidents where many parts are involved in the accident investigation process and the formulation of investigation recommendations, whereas a national safety authority, the affected operators and other related bodies are also involved in the implementation of these corrective actions. This process thus involves different stakeholders. (Cedergren, A.,2013).

Railway Safety Directive of the European Union (Directive 2004/49/EC) states that each member of the accident investigation bodies needs to begin their own permanent and independent investigation body. These actions are taken to improve railway safety and to prevent occurring of future accident. The railway accident investigation must contain safety recommendations raised to the national safety authority and other relevant bodies. (Cedergren, A.,2013).

2.4 Challenges related to the implementation of the recommendation

After a major accident, accident investigation is normally initiated to understand the reasons behind the occurrence of the accident and to know what the needed actions are to prevent similar accidents in the future. The accident investigation is one of the most important elements in the process of learning from accidents, and organizations can improve their safety culture if they implement the recommendations that are presented in the accident investigation report with necessary follow-up actions. However, many researchers found that accidents are re-occurring again, even after the recommendations because many organizations are totally or partially don't implement the recommendations and don't follow-up with the necessary actions. These organizations do usually give limited focus to the investigation recommendation where this process needs more attention (Lundberg et al., 2010; Carroll and Fahlbruch, 2011).

Alexander Cedergren from Lund University in Sweden has conducted a study about the proportion of the recommendations that have been implemented in the Swedish railway sector; he made interviews with experienced investigators, actors, and stakeholders, and he also analyzed the content of the feedback from the safety authority to the investigations board following each recommendation. His study included feedback following 105 recommendations that have been issued between 2004 and 2011. To classify the feedback and to find out if he can identify any challenges that are related to the implementations of the recommendations, Cedergren has divided the feedback for each recommendation into two categories (A and B), where category A represents recommendations

that have been implemented and Category B represent the recommendations that have not been implemented. He had also divided each category into sub-categories to facilitate the classifications. (Cedergren, A.,2013).

3. Methodology

There are four main types of academic research that researchers can use to conduct and complete their various studies. The first type is Action (Applied) Research, where researchers focus on solving real-life problems using scientific methods. The second type is the Qualitative Research, that focuses on collecting and analyzing data from observing people actions and sayings. The third type is the Quantitative Research where researchers focus on developing and employing mathematical models, theories, and hypotheses related to as specific phenomenon as possible thus trying to quantify the problem in order to formulate facts. The fourth and last type is the Mixed Methods approach, where researchers can use qualitative and quantitative research together to conduct their research. In this method, researchers try to capitalize on strengths and reduce weaknesses that stem from using a single research design for an increased reliability and validity of results. The current research applies the mixed method approach; however, this paper only presents parts of the qualitative branch of the conducted holistic research.

For the purposes of conducting this research, a thorough review of the relevant published literature was carried out to identify the gap that implementation of safety recommendations from previous incidents and accidents might not be fully upheld by industries such as the construction, and if so, what factors might have led into such a safety gap. Some dedicated industry-based reports, regulations, and other media relevant to the topic were reviewed to confirm a set of secondary data in the regard. The major activity of this study was then performed via conducting a total of 22 interviews deep semi-structured with experts in the field of safety and accident investigations and general management within the construction industry in the United Arab Emirates, being a globally leading one. The Template Analysis technique was then used to explore the mentioned gap and to prepare a set of construction safety upgrading recommendations.

An illustrative flow diagram of the applied methodology is presented by Figure 1.

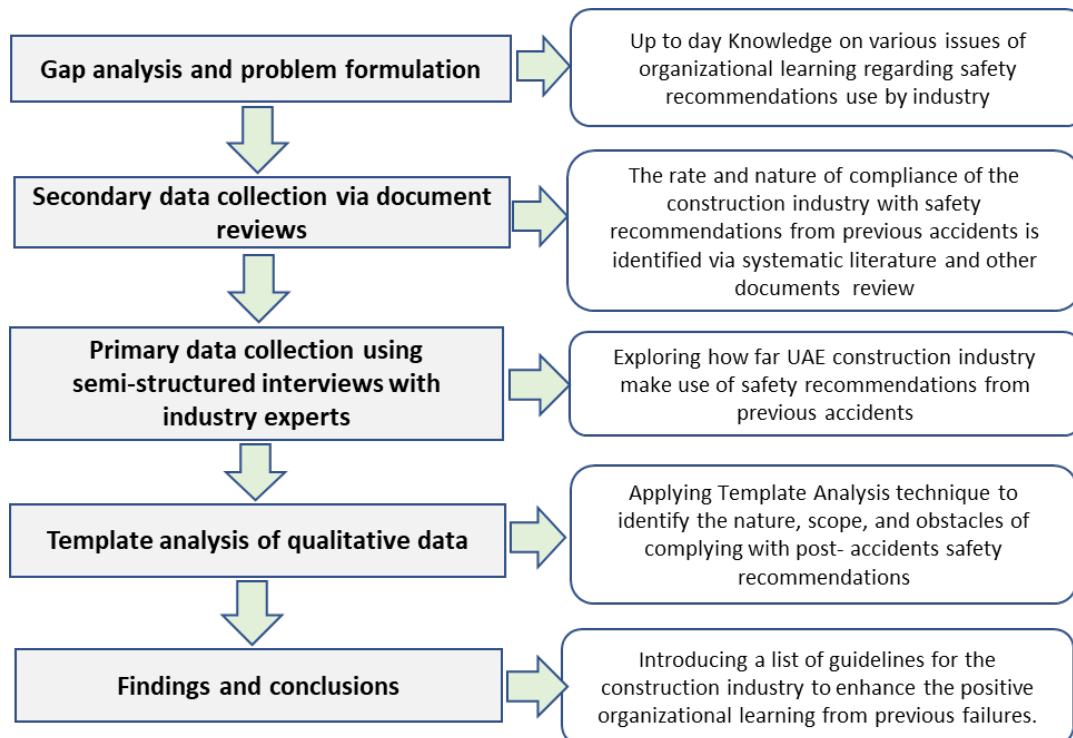


Figure 1: The applied methodology

After transforming the observed gap regarding the adequate implementation and follow up of post-accidents safety recommendations into researchable questions, a qualitative data collection semi-structured interviews questions were prepared as per the plate presented by Table 1.

Table 1: Initial plate of semi-structured interviews questions

Semi-Structured Interview Questions for Informants from the UAE construction industry	
First Question	How does a construction company in the UAE benefit from the experiences or recommendations of previous accidents in the construction field?
Second Question	What types of strategies and procedures does the construction company follow to ensure that recommendations from previous accidents – locally or within the whole UAE industry -have been implemented?
Third Question	What are the challenges construction companies face in implementing accident investigation recommendations?
Fourth Question	What are the factors that may affect learning from Previous accidents?
Fifth Question	How does the safety and investigation teams share lessons learned from previous accidents with all workers in the company and in other companies?
Sixth Question	How does the safety culture -especially of workers- influence their response to guidelines and advice that result from previous accidents in terms of recommendations?
Seventh Question	What are YOUR suggestions to increase the efficiency of the accident investigation recommendations?
Eighth Question	What are the suggestions to improve safety in the construction sites?

The pool of informant interviewees encompasses 22 experts within various safety and safety related functions associated with the expanding construction industry in the UAE. The interviews were conducted face to face with the interviewees individually one at a time and recorded for more accuracy and higher reliability of data. Each interview continued for 45 to 75 minutes and all relevant measures of data collection ethics and objectivity were applied. More details of the informants are presented in Table 2.

Table 2:Plate of semi-structured interviews questions

Participant No.	Participant Role	Participant main Location	Participant Years of Experience in the Field
1	HSE Manager	Dubai	12 years
2	HSE Manager	Sharjah	15 years
3	HSE Manager	Sharjah	10 years
4	Safety Officer	Sharjah	10 years
5	HSE Manager	Sharjah	20 years
6	Regulator	Sharjah	20 years
7	Regulator	Sharjah	15 years
8	Regulator	Sharjah	6 years
9	Regulator	Sharjah	6 years
10	Regulator	Sharjah	20 years
11	Regulator	Sharjah	4 years
12	Regulator	Sharjah	8 years
13	Regulator	Sharjah	10 years
14	Regulator	Sharjah	4 years
15	Policeman	Sharjah	20 years
16	Policeman	Sharjah	20 years
17	Project Manager	Dubai	13 years
18	Electrical Project Engineer	Dubai	7 years
19	Site Manger	Dubai	8 years
20	HSE Administrator	Abu Dhabi	More than 10 years
21	Construction Co. Manger	Sharjah	More than 20 years
22	Safety Officer	Dubai	8 years

4. Results

The well-established Template Analysis technique was then applied to analyze the rich qualitative data reported from the 22 semi-structured interviews. Eight initial templates of answers to the highlighted eight questions used for the interviews were derived from published literature and from the initial analysis of opinions obtained from the first three interviews. After carefully analyzing all the collected data, another eight final templates of answers were obtained to highlight fully detailed answers for the research questions. These final templates are presented in full as per Tables 3 to 10. The answers are so detailed such that these final templates are all self-explaining.

Table 3: The first final template of collective answers

<p><u>How does a construction company in the UAE benefit from the experiences or recommendations of previous accidents in the construction field?</u></p> <ul style="list-style-type: none">• By doing a proper Accident Investigation and finding the immediate cause (unsafe Act & Unsafe condition), and the root cause (personal factor & system factor), to control or eliminate the accident and prevent similar accidents from happening again.• Recommend the corrective actions after the accident investigation done and suggest the recommendation to prevent the reoccurring accident.• Communicate the recommendations and correction actions to all labors and staff.• From the previous accidents, companies can indicate their lack of control measures, through the proper investigation we can find the solution and marking it in our findings.• It helps to develop solutions to potential risks. Records also help to prevent injuries, ill health, and control costs from accidental loss.• Companies can implement better safety measures to ensure workers and site safety to avoid fines from the authorities.• Pervious accident recommendation will lead the company to continuity of the works, which are being stopped by any sort of accident resulting to loss/less profit or to pay in terms of damages etc.• Companies care about their reputation (especially the large companies), so they try to implement the best practices of safety to save their competitive place.• If the accident reoccurred again in the same construction site, the safety team may adjust the safety plan of the project and issue a new circular.
--

Table 4: The second final template of collective answers

<p><u>What types of strategies and procedures does the construction company follow to ensure that recommendations from previous accidents – locally or within the whole UAE industry -have been implemented?</u></p> <ul style="list-style-type: none">• Accident reports are preparing by the safety department, once the Accident report received, HSE manager is reviewing it and if it required suggesting new control measures to prevent the similar accidents. Also, he is instructing the site HSE in charge to conduct the Toolbox Talk (TBT) to labors to inform them accident preventive recommendation points. And they are making it as Record.• The Head of Safety will check whether the recommendations have been properly communicated or not? And normally there will be an action plan in the accident report. So, the head of safety will ensure the compliance level of this action plan. Normally this communication will be limited to inside the company only.• Safety team provides Personal Protective Equipment (PPE) to the workers, also, they ensure that there is a Three-point contact on ladder safety. They ask workers to use safety belts while on high areas and use safety jackets to be visible in dark areas.• Construction companies use to implement safety meeting with workers on a weekly basis to keep them reminding of the safety measures, deploying skilled workers to the sites. deploying well trained safety engineers at site to monitor HSE/PPE for all the workers.• Continuous Follow-up, Training and Drills, Check list, Inspection of equipment and Testing of Staff.• By following the municipality, Occupational Safety and Health System of Abu Dhabi (OSHAD), and Ministry of Human Resources and Emiratization (MOHRE) safety rules and regulations, and other international (OSHA) safety rules and standards.• Police and MOHRE keep following with the injured workers or with the family of the fatal cases.
--

- Safety authorities have the right to withdraw the trade license if the companies did not implement the accident recommendations.
- Safety fines and violations might be issued for the companies that did not implement the safety procedures and investigation recommendations (Safety violations are very expensive and high).
- Municipalities may reject the building clearance if they noticed any safety violations.
- Companies try to avoid any injuries or safety problems to avoid workers high compensations.
- Insurance companies, Consultants, and owners follow up on the implementation of the investigation recommendations.
- Following ERICP Safety Strategy (Eliminate, reduction, Isolation, Controlling, Personal protection equipment).
- Safety team would follow up on the implementation of the recommendations, if they noticed that the recommendations have not been implemented, then they will report the issue to their manager, and the manager will report it to the Chief Operating Officer (COO).
- Companies need to send a safety report to the safety authorities frequently, and the recommendations statuses will be mentioned in the report (closed, under process or implemented).

Table 5: The third final template of collective answers

What are the challenges construction companies face in implementing accident investigation recommendations?

- Lack of training; lack of attention, PTW system etc. In this case there might be a chance of hiding the actual root cause to avoid the legal consequences.
- Most of the time if the recommendations are able to implement without any cost, the companies will be ready to implement it immediately, but once they found that it will need any cost for training or any machinery to purchase or any money has to be spent they will hold it and not process the implementation. So budgeting fund for safety has a crucial role (ex: if investigation team suggest new advanced equipment, manager may search for cheap alternative one).
- Realizing that all the safety measures and cautions had been implemented before the accident happens, whether the accident happens because of a person behavior or a fault in a tool used or equipment
- Difficulties of providing PPE to workers due to the high cost and workers cultural believes.
- Availability of a proper and skilled Trained Staff.
- Recommendations need more time to be implemented and projects have a deadline.
- Lack of manpower and resources for safety at the construction site (example: 450 workers supervised by only 1 safety officer and 2 assistants).
- Workers different cultures and believes, dealing with workers with culture and civilization is much easier than dealing and arguing with workers with poor culture.
- All safety efforts are based on individual efforts, so each company has its own customized safety plan and accident investigation form (they customize the plan based on the national and international safety standards).
- The Weather Conditions may affect the implementation of the recommendations.
- Maintain the correction action and recommendations is one of the hard things for the companies because of the project rushing.
- Language barrier between the supervisor and workers.
- Not all the investigators know the investigation protocol.

Table 6: The fourth final template of collective answers

What are the factors that may affect learning from Previous accidents?

- Organizational Factors that are related to the Structure or Safety Management such as (Incident Registrations and Action Plans), Or the Organizational Safety Culture such as (Transparency, Blame Free Culture, and Feedback on Unsafe Behavior).
- People understanding of safety measures and cautions.

- People commitment towards safety measured and cautions.
- The previous experiences are not shared probably to people working on site.
- Proper investigation for previous accident and find out reason is not compliance with the regulation. A punishment to the responsible of previous accident.
- Effort, money, and time saving.
- Companies and owners worry about their reputations, so they might hide some facts
- Witness and injured people tend to hide the truth to avoid being blamed or being in troubles.
- Workers mentalities and believes.
- Weather Conditions (Temperature, Humidity, Dust, Wind and Rain).

Table 7: The fifth final template of collective answers

How does the safety and investigation teams share lessons learned from previous accidents with all workers in the company and in other companies?

- Through Establishing a Toolbox talk, HSE training section, HSE meeting, and Mail communication to staff. Posters.
- Share the actual investigation reports within the firm only. Will not share the actual report with others.
- Assigning several safety officers to ensure the safety protocols are met.
- Increase the awareness of safety protocols and how it is mandatory for human lives.
- By conducting workshops and explaining the previous accident to the workers by photos and Videos.
- By giving comparison of result for strict compliance of Safety rules and noncompliance of safety rules.
- Implementing Drills and Trainings for all staff repeatedly.
- By conducting a safety induction and conduction meeting (minutes of meeting) frequently.
- By sharing lesson learned and recommendations with all HSE managers and Safety engineers through the company website and portal.
- Safety Officer sends a detailed daily report to the HSE manager, then the manager shares the report with the other safety officers and engineers.
- Companies create a new circular or edit the existing circular to meet the investigation finding, then share these circulars with all workers.
- Organize frequent specialized training and general training in the site.
- Through the annual seminars and meeting, and entertainment events (for workers).
- WhatsApp groups, LinkedIn groups and Telegram groups.
- If accidents occurred many times in different places, safety authorities adapt their safety standards in the way that prevent re-occurring of accident again.

Table 8: The sixth final template of collective answers

How does the safety culture - especially of workers - influence their response to guidelines and advice that result from previous accidents in terms of recommendations?

- Most of the time, after the accidents only everyone will be more vigilant, its human nature. Similarly, if any accident happened in the site at least the same site coworkers will be more alert, and they will be ready to adopt the recommendation which suggested by safety team. So, it is very easy to convey the message to them.
- The accidents happening in the same firm will make big impact in the workforce, they will be ready to follow the accident preventive control measure. Sometimes they will also suggest the recommendation to prevent the recurrent accidents.
- By analyzing the conclusions from the previous experiences, they will try to avoid maximum risks that may affect them and their work.
- By realizing the quantity of loss occurred once the safety protocols are not implemented.
- Routine inspections for safety measures of the site workers will influence their response to guideline, moreover, results of previous accidents to be posted on workplaces which will keep them reminding to take all HSE/PPE to ensure their safety.

- Even if it influences, by implementing the correct measures and with different penalties it will not be a problem.
- By educating them that their safety is important for their families (Money support).
- Ensure that they have a suitable and comfortable accommodations.
- Provide instructions and training in different languages.
- Honor the workers and rewards them when they showed safety behavior (Safety Leaderboard).
- All people, agencies and companies should work together to spread the safety culture.
- Focus on motivate the creativity of the positive safety habits.

Table 9: The seventh final template of collective answers

What are YOUR suggestions to increase the efficiency of the accident investigation recommendations?

- There should be full support from the management to implement the recommendation which suggested by HSE team. When the management is committed towards safety HSE team can recommend the actual requirements.
- There should be fixed safety budget in each project, it will automatically allow to implement all the recommendations.
- All concerned people must be present at the investigation scene.
- Responsible persons should be blamed to ensure that such accidents will not occur again.
- All concern persons to be involved in investigation for any sort of accident including management.
- To consider a separate department in every company for accident investigation with skilled staff.
- By implementing the urgent investigation recommendations immediately.
- By starting the investigation process immediately after the accidents, to save and secure all the evidences.
- By cancelling the violations of the delayed project that issued to companies if they exceeded the deadline.
- To have a separate individual national agency that is responsible for the construction industry, and issues one national safety standards.
- Nurses in the construction sites should be hired by the ministry of health, so they can report the injured and serious cases freely without being afraid to be fired by the managers.
- More safety people and equipment should be involved in the construction project.
- Schedule more safety inspections from the safety authorities.
- Create one formal and unified report or form for the accident investigation.

Table 10: The eighth final template of collective answers

What are the suggestions to improve safety in the construction sites?

- More authority inspection should be carried out to sites. Authority must inform the client to allot the budget for safety and make sure that it is using for it.
- Quarterly training should be conducted for all safety team by authority.
- Safety is everyone responsibility. Provide adequate training for all work force, regular repeated training and awareness training is mandatory.
- Ensure everyone accountability. Conduct regular site inspection, management site walk, Reward the Good, Correct the Bad. Implement reward system. Comprehensive HSE Management System, Enforcement policy.
- Establishing toolbox meetings on weekly basis.
- Inform the concerned persons to always insist the workers to implement the safety measures and cautions.
- Assign a monthly reward for whom who met the safety protocols.
- Provide incentives for people who are meeting the safety protocols in order to be encouraged always and inform others to be implementing the safety measures and cautions
- Rules and regulation HSE/PPE to be implemented strictly without any exclusion for all the workers.

- Safety inductions /workshops to be held weekly base to ensure safety guidelines are being understood and followed by the workers.
- To treat the safety department as a 3rd party and to give full power to take the necessary actions.
- Follow the OSHAD and Municipalities rules and regulations.
- Organize a program that frequently reward and recognize workers with positive safety attitude.
- By studying the design and specifications of the PPE since some equipment does not protect well the workers and their design and specifications have not been improved from a while.
- Involve the Artificial Intelligence in the construction works to decrease the human errors and risk.
- Use advanced, new and smart technologies that sense risks and stopped automatically.
- Give the Safety the Priority especially in the construction industry where the business has the priority.
- Schedule a routine maintenance for machines and tools and replace the damaged the week tools.
- Suggest a company classification system (Platinum, Gold, and silver) so companies with a smaller number of accidents and injuries will be a platinum company and will have more facilities.

5. Conclusions

Implementation of accident investigation recommendations or remedial actions is important as discovering and analyzing the accident causations and conditions. However, some organizations tend to ignore these recommendations, and some of them face difficulties and challenges in implementing them, which means that No corrective actions have been taken after the accident and they will occur again in the future. A multi-methods approach that involved interviews, focus groups, field observations, and databases analysis is taken. The accidents investigation outcomes implementation efficiency – measured in terms of accidents rate reductions and other aspects - in differently sized construction organizations have thus been calculated. It is found that most large construction organizations tend to systematically apply post-accidents recommendations that involve improved training, better physical accidents barriers and safety signs, upgraded equipment, and improved procedures. However, some of these organizations, and a significant number of smaller organizations as well, are less prepared to fully learn from previous failures due to poor safety culture, some shortages in legislations and oversight coverages, as well as lack of financial abilities and internal follow-up audits. Evidence as well showed that these findings are generalizable for the Middle East and North African (MENA) regions due to many similarities and shared cultural, economic, and environmental factors. Based on these and other findings, various suggestions and improvement plans have been provided for the construction organizations to improve their organizational learning capacities, especially those with weak post-accident follow-up performance.

To conclude, there are two main factors that may affect the implementation of accident investigation recommendations which are the company management and the role of safety Authorities. If the construction companies gave the safety enough budget, manpower and materials, workers will work safely, and recommendations will be implemented smoothly. Also, if the safety authorities and regulations focus more on the construction industry and create one unified standards and rules for the accident investigation process and safety procedures in the construction companies, construction companies owner and management will ensure that all the safety procedures have been followed correctly to avoid any safety violations. In other words, Safety should have the priority in the construction industry more than the business.

References

- Salguero-Caparros, F., Suarez-Cebador, M., & Rubio-Romero, J. C. (2015). Analysis of investigation reports on occupational accidents. *Safety Science*, 72, 329-336.
- Pasman, H. J., Rogers, W. J., & Mannan, M. S. (2018). How can we improve process hazard identification? What can accident investigation methods contribute and what other recent developments? A brief historical survey and a sketch of how to advance. *Journal of Loss Prevention in the Process Industries*, 55, 80-106.
- Lundberg, J., Rollenhagen, C., & Hollnagel, E. (2009). What-You-Look-For-Is-What-You-Find – The consequences of underlying accident models in eight accident investigation manuals. *Safety Science*, 47(10), 1297-1311.
- Elliman, R.K. ... et al, (2007). Proposing a framework for pan European transparent and independent road accident investigation. European Transport Conference (ETC) 2007, Leeuwenhorst Conference Centre, The Netherlands, 17-19 October.

- Cedergren, A. (2013). Implementing recommendations from accident investigations: A case study of inter-organisational challenges. *Accident Analysis & Prevention*, 53, 133-141.
- Accou, B., & Reniers, G. (2019). Developing a method to improve safety management systems based on accident investigations: The SAfety FRactal ANalysis. *Safety Science*, 115, 285-293.
- Roed-Larsen, S., & Stoop, J. (2012). Modern accident investigation – Four major challenges. *Safety Science*, 50(6), 1392-1397.
- Cedergren, A., & Petersen, K. (2011). Prerequisites for learning from accident investigations – A cross-country comparison of national accident investigation boards. *Safety Science*, 49(8-9), 1238-1245.
- Wang, B., Wu, C., Huang, L., Zhang, L., Kang, L., & Gao, K. (2018). Prevention and control of major accidents (MAs) and particularly serious accidents (PSAs) in the industrial domain in China: Current status, recent efforts and future prospects. *Process Safety and Environmental Protection*, 117, 254-266.
- Behera, R. K., & Hassan, M. I. (2019). Regulatory interventions and industrial accidents: A case from India for ‘Vision Zero’ goals. *Safety Science*, 113, 415-424.
- Dechy, N., Dien, Y., Funnemark, E., Roed-Larsen, S., Stoop, J., Valvisto, T., & Arellano, A. L. (2012). Results and lessons learned from the ESReDA’s Accident Investigation Working Group. *Safety Science*, 50(6), 1380-1391.
- Lundberg, J., Rollenhagen, C., Hollnagel, E., & Rankin, A. (2012). Strategies for dealing with resistance to recommendations from accident investigations. *Accident Analysis & Prevention*, 45, 455-467.
- Braut, G. S., & Njå, O. (2013). Components of a tool to address learning from accident investigation. *International Journal of Disaster Risk Reduction*, 6, 40-49.
- Elliman, R....et al., 2008. Recommendations for establishing Pan European transparent and independent road accident investigations. IN: Proceedings of 3rd International Conference on Expert Symposium on Accident Research (ESAR) 5-6th September, Hannover, Germany.
- Yellow Pages. (2020). Construction Companies. [online] Available at: <https://www.yellowpages.ae/c/advs/uae/construction-companies.html> [Accessed 17 May 2020]
- Ministry of Human Resources and Emiratization (2020). *Open Data*. [online] Available at: <https://www.mohre.gov.ae/en/data-library/statistical-report.aspx> [Accessed 1 March 2020]
- Al-Kaabi, N., & Hadipriono, F. (2010). Construction safety performance in the United Arab Emirates: *Civil Engineering and Environmental Systems*, 20:3, 197-212.
- Winge, S., & Albrechtsen, E. (2018). Accident types and barrier failures in the construction industry: *Safety Science*, 105:158-166
- Zekri, Michael. (2013) Construction Safety and Health Performance in Dubai.
- Haslam, R. A., Hide, S. A., Gibb, A. G., Gyi, D. E., Pavitt, T., Atkinson, S., & Duff, A. R. (2005). Contributing factors in construction accidents. *Applied ergonomics*, 36(4), 401–415.

Biographies

Suha Khaswan is a master’s student in Engineering Management in the department of Industrial Engineering and Engineering Management at University of Sharjah, UAE. Suha earned B.S. in Nuclear Engineering in 2016 from University of Sharjah. She worked as a research assistant at the Nuclear engineering department at University of Sharjah, then she worked as a Creative Design and Innovation Teacher at the Ministry of Education high school. Currently, she is working as a Creative Design and Innovation and Aviation Maintenance Teacher at public high school.

Hamad Rashid is an Assist. Professor, an aeronautical engineer and a PhD in engineering management holder in the field of industrial safety and accident investigations. Professionally, he is a certified chartered aircraft accident investigator, a lead auditor of the international standard ISO-10015 for quality in higher and vocational education, a member of the Royal Aeronautical Society-UK, and a fellow of the Higher Education Academy – UK. He is experienced consultant engineer and skilled academic with records of achievements in engineering consultancies, teaching, and research. These are manifested through 31 years of experience in aeronautical engineering, engineering systems safety, risk management, quality, performance enhancement, leadership and innovation, teaching and supervision of research at the post graduate level with strong focus towards UK and worldwide industry.