

New strategy for Improving Safety Performance of an Infrastructure project in UAE



Engineering

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ABSTRACT

The Crown Prince of Abu Dhabi Emirate issued a Decree no 42 for the implementation of Abu Dhabi Environment, Health and Safety Management System (ADEHSMS) with the support of Higher Committee, The Competent Authority, the Sector Regulator Authority (SRA) and entities. . All entities in the Building and Construction (B&C) Sector shall develop and implement their EHSMS in line with the requirements of ADEHSMS. In this study, challenges that could be encountered for a successful safety management system (SMS) in the B&C Sector in the Emirate were identified and potential opportunities that may arise were highlighted. In this work, we started by collecting a dataset between 2011 and 2013 for the construction of infrastructure project sites. The accident occurred in the period of 2011 to 2013 cause more equipment damage in the construction sector and workshop. The comparison data from 2011 to 2013 shows that the incident rate decreased from 75% to 8.33 % due to the effective enforcement from the Legal authorities and entities.

Introduction

Health and safety is relevant to all types of industry. It is particularly important for the construction industry, which is among the most exposed sectors when it comes to occupational accidents. In spite of the high costs of work accidents, many construction companies adopt their health and safety management strategy as to comply with mandatory regulations [1]. However only being in compliance with these regulations might not be sufficient to guarantee excellence in health and safety performance as they cover only minimal preventive measures. Based on occurred accidents, the technical weaknesses of the designs were reduced by adding new requirements [2]. But after that it became apparent that many accidents still occurred and that the root causes of these accidents were hardly the result of technical failures but much more the consequence of inadequate organizational leadership and commitments. It was evident that these efforts are not sufficient truly to curb the occurrence of unsafe acts on construction sites [3].

Many studies show that health and safety performance will only be achieved if workers change their behaviors; and incentive schemes are implemented to motivate them. Many civil construction companies have experienced the difficulties in managing human resources mainly in the area of occupational safety and health management. These difficulties generally are revealed through research or interviews with company associates [4].

The UAE is a developing country currently enjoying a strong growth in construction activities [5]. According to the Arab World Competitiveness Report, the UAE is the most competitive economy in the Arab world among the Middle East and particularly the Gulf States countries [6]. Due to this rapid growth, the hazardous activities in the construction industry are also increased. Therefore, the country developed and implemented a higher standard EHSMS to establish a positive health and safety culture

Safety performance status

The construction industry has the highest number of work-related fatalities of all industries [8]. For example, the construction industry accounted for 40% of disabling injuries and 47% of fatalities among all industries. These may be due to several factors such as (1) contractors trying to hide their negligence to protect their company, (2) avoid loss of production time, (3) minor injuries not reported to protect self-records, (4) lack of company policy for accident investigation and reporting, (5) avoid blame (self-protection) culture (6) workers' ignorance of their rights, (7) workers belief regarding the accidents that are natural and unavoidable, and (8) construction is a dangerous occupation.

Designers play an important role in ensuring how the health and safety of construction workers are considered during the project design process. Traditionally, designers do not have any obligation to inform the contractors on health and safety risks associated with the design, but nowadays preventative design is the norm. The competent designers reduce the health and safety risks using the hierarchical control methodology [9].

The merits of designing for construction safety are evident, but implementation in practice is minimal to nonexistent. Numerous barriers to its implementation have been cited [10, 11]. These barriers include: (1) weak or absent regulatory safety requirements in design, (2) most regulatory agencies place safety responsibility on the contractor, (3) liability concerns among architects and engineers, (4) narrow specialization of construction and design, (5) limited availability of tools, guidelines, and procedures for preventive design, (6) limited preconstruction collaboration between the designer and contractor, and (7) limited education on health and safety for engineers etc.

Method of data collection and analysis

Data collection and analysis

Using the appropriate variables, occupational injuries, were selected. The data file was reduced by restricting fields to prevention-oriented variables including external causes and type of incident; personal factors of age, sex, nationality and marital status; time of day; occupation and place of injury where available; nature of injury including anatomical location and severity score, and hospitalization duration [12]. Data on the industries in which injuries occurred and on any safety measures employed were not available, nor could traffic injuries during work be reliably distinguished from other occupational injuries. The number of injuries by injury severity score (ISS) was calculated for each main external cause. Category six, superficial injury (external in ISS), was excluded. As another indicator of severity for falls, the number of injuries was assessed together with calcareous fractures of the body [13].

Results and discussion

It is found that the lack of experience, training and unsafe design practices cause the accidents in the construction industries. The poor leadership and management commitment, poor planning, lack of safe working procedure communication and implementation were observed the most significant causes of incidents. This supported the views of Baxendale and Jones (2000) [14].

Also most of the accident cases are in construction places due to the negligence of the employees while driving or not following the safe working procedure. In most of the cases we observed that the heavy loaded vehicle hit others due to the negligence while turning or over taking others vehicles, few cases we noticed that heavy vehicles tilt because of uneven field as well as

some employee fell unconscious due to hyper tension because of not following the medical advice [15, 16].

In the UAE infrastructure development project the major accident occurred due to poor traffic management and most of the time these incidents caused for the property damages in the

construction industries as shown in the table 1. The incidents occurred in between the year 2011 to 2013 were mainly due to the negligence of the worker. In most of the cases the heavy duty drivers did not follow the traffic rules while reversing or crossing the other vehicles.

Table 1: Incidents occurred in an infrastructure project in UAE from 2011 to 2013

Date	Incident Description	Location	ADEHSMS Classification	Incident Causes	Trade	Operation category	Root Cause Individual
19.11.2011	A low bed trailer moved forward and hit a parked double axel trailer	Workshop	Equipment Damage	Failed to engage the hand break fully.	Heavy Driver	Plant & equipment	Failed to engage the hand break fully.
06.12.2011	Heavy Bus hit a saloon car while reversing.	Gate-1	Equipment Damage	Bus driver did not check the rear side while reversing	Heavy Driver	Traffic	Failure to follow basic rule of checking the rear view mirror while reversing the bus.
16.01.2012	Mini excavator slipped in to a narrow trench during excavation works	Asphalt Plant	Near Miss	There was no banks man during excavation works	Operator	Construction	The operator failed to consider the width of the trench and the width of caterpillar tracks.
24.01.2012	3 ton pick up hit one ton pick up while reversing	Workshop	Equipment Damage	The 3 ton pickup driver did not check the rear side while reversing.	Light duty driver	Traffic	The 3 ton pickup driver did not check the rear side while reversing.
25.02.2012	Double axel trailer struck a Prado car while reversing	Workshop	Equipment Damage	Failure to follow reversing protocol.	Heavy Driver	Traffic	Trailer driver Failed to check the rear side of the vehicle while reversing.
13.03.2012	Physical assault	Project Office	Equipment Damage	Un provoked physical attack	Administrator	Administration	Attitude and behavior
12.06.2012	An Fortuner car hit the gate post while entering the access road.	Public road entrance	Equipment Damage	The driver used mobile phone while driving, lost his control and caused the accident.	Senior staff	Traffic	Failure to follow the UAE Road Safety rules whilst driving.
18.10.2012	A triple axel trailer body collapsed during unloading and fell on its own chassis	Asphalt Plant	Reportable dangerous Occurrence	The tail gate of the trailer did not open completely while offloading as it got stuck by the previously dumped heap of aggregate base. The pressure on the hydraulic system was more and the jack came out of the bucket.	Heavy Driver	Plant & equipment	Failure to check the tail gate while offloading.
01.11.2012	A triple axel trailer rolled over to its right during unloading	Asphalt Plant	Reportable dangerous Occurrence	The material got congealed, compacted and did not flow out evenly from both sides as the trailer was lifted. Since the weight on one side of the trailer become more, the trailer tilted to one side and its jack broke causing the trailer fall to its right.	Heavy Driver	Plant & equipment	Failure to check the flow of material and angle of uplifting trailer while offloading.
26.11.2012	3 ton pickup Hiab mounted crane overturned whilst unloading a generator	Asphalt Plant	Reportable dangerous Occurrence	The Hiab crane operator did not fully extended the out riggers before off loading the generator.	Light duty driver	Lifting Operation	Failure to extend the out rigger completely.

11.12.2012	3ton pick up struck with one ton pickup while parking.	Central store	Equipment Damage	One ton driver did not pay full attention while driving	Senior Staff	Traffic	Failure to follow company rules and procedure in relation to driving.
12.01.2013	A water tanker rolled back and struck a parked water browser.	Workshop	Equipment Damage	Water tanker driver did not apply hand brake completely and left the tanker unattended	Heavy Driver	Traffic	Failure to apply hand brakes Completely and left The tanker unattended while loading
14.01.2013	1 Ton pickup struck with 1 ton pickup	Lab	Equipment Damage	The driver did not give indicator before turning left	Senior Staff	Traffic	Failure to follow basic driving and traffic safety rules.

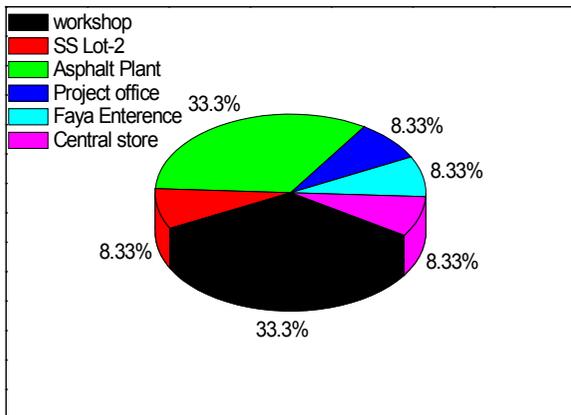


Figure 1 shows the Pie plot of % of incidents occurred at infrastructure project in UAE (Please change the pie chart categories as Lot 2, Faya entrance changed)

Figure 1 shows the Pie construction of infrastructure project in UAE. It is observed that the major part of accident occurs at the workshop and in asphalt plant of about both 33.3 % respectively. Some of the incidents happened near to the project office, central store and project entrance due to the negligence of workers. The major property losses found in the workshop and asphalt plant due to the failure of driver due to breaking of traffic rules. Some time it is observed that the tail gate of the trailer did not open completely while offloading as it got stuck by the previously dumped heap of aggregate base. The pressure on the hydraulic system was more and the jack came out of the bucket. In asphalt plant, it is noticed that the driver failed to check the flow of material and angle of uplifting trailer bucket while offloading. As a result the material got congealed, compacted and did not flow out evenly from both sides. Since the weight on one side of the trailer become more, the trailer tilted to one side and its jack broken causing the trailer fall to its right.

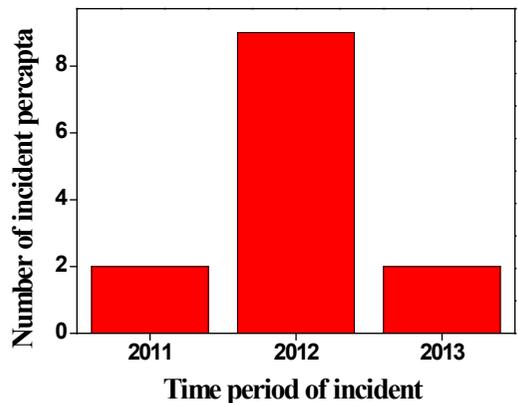


Figure 2 shows the incidents occurred at infrastructure project in UAE from 2011 to 2013

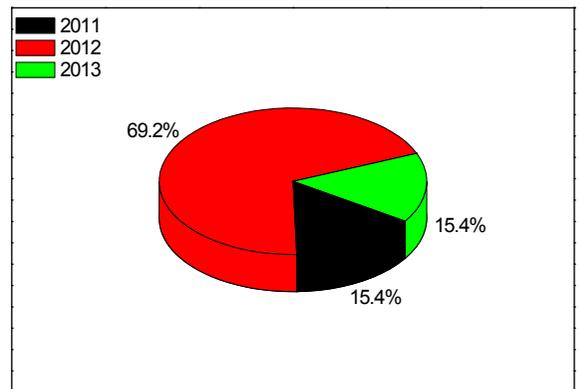


Figure 3 shows the Pie plot of ration of incidents occurred at infrastructure project in Abu Dhabi from 2011 to 2013

Figure 2 and 3 shows that the accident occurred from 2011 to 2013 in the infrastructure project at UAE. On average there are incidents observed in the year of 2011 about 69.2% and minor incidents reported in the year of 2012 and 2013 at construction workshop and the percentage of incident cut down to 15.4 % in the both the years. It is important to notice that the incident reduced in the years of 2012 and 2013 in central store as well as laboratory due to the effectiveness of SMS implementation.

Table 2: shows the accident occurred in various sectors in an infrastructure project of UAE.

Date	Incident Description	Location	ADEHSMS Classification	Incident Causes	Trade	Operation category	Root Cause Individual
16.01.2011	A Prado car hit the rear side of a double axel trailer.	Sector-24	Equipment Damage	The Prado driver did not pay attention whilst driving	Heavy Driver	Traffic	The Prado driver used mobile phone while driving. Failure to follow basic Road Safety Rules.

05.02.2012	Double axel trailer overturned while unloading.	Sector-19	Equipment Damage	The unloading area was not compacted	Heavy Driver	Plant & Equipment	Parked the vehicle in an uncompact area for offloading the material.
08.02.2012	Top of excavation soil fragmentation caused man to fall into shallow excavation	Sector-13	Reportable Serious Injury	Failure to inspect excavation prior to assigning work	Civil Helper	Excavation	Failure to identify the hazards of standing at the edge of excavation.
17.03.2012	Excavator reversed into an earth bunded area and escaped without falling into the excavation	Sector-14	Near Miss	Careless driving. Driver did not check his reversing path	Operator	Plant & equipment	Driver did not check his reversing path
14.04.2012	Double axel trailer struck with Prado car while driving through a narrow access. (The Prado car gave way to the trailer)	Sector-14	Equipment Damage	The access road is not wide enough to allow a car and trailer to pass by safely. Prado car stopped at an inappropriate area.	Heavy Driver	Traffic	Both Drivers did not assess the hazards of the narrow path.
23.04.2012	A one ton pickup drove into an open trench of 60cm depth	Sector-13	Equipment Damage	The excavation was not completely bunded, There was no warning demarcation	General Foreman	Construction / Traffic	Failure to identify the hazards.
02.05.2012	A triple axel trailer overturned to parallel parked trailer while off loading materials	Sector-14	Equipment Damage	The ground was not leveled and compacted	Heavy Driver	Traffic	Failure to identify the hazard.
05.05.2012	A double axel trailer overturned at the bend of the primary road	Sector-19	Left Forehead & Left Shoulder Laceration to left side of forehead and light bruising to left shoulder.	The driver exceeded the speed limit. The excessive speed caused the rear of the trailer to slide to the hard shoulder and keel over.	Heavy Driver	Traffic	The driver did not follow the site traffic rules
12.05.2012	A 3 ton pick up struck with a concrete chamber whilst reversing.	Sector-14	Equipment Damage	The driver failed to follow basic reversing protocol procedure	Light duty driver	Traffic	The Driver failed to check his rear mirrors before reversing.
16.05.2012	An employee sustained a chin / lip injury whilst using an angle grinder.	Sector-14	Lost time Injury	1. The operator was not trained	GRP Fitter	Power Tool	Failed to identify the hazards of unsafe tools and operated the power tool without proper training.
16.05.2012	A heavy duty driver slipped down from the access ladder of a trailer while climbing over it for fixing the tarpaulin cover	Sector-19	Lost time Injury	1. The driver was not wearing safety boots or gloves. 2.The ladder access was wet due to water sprayed for dust suppression	Heavy Driver	Slip, Trip & Fall	The driver was bare footed and without hand gloves while climbing over the ladder.
22.05.2012	A water tanker 's front glass broken while being towed by a Dumper Truck.	Sector-14	Equipment Damage	1.The dumper driver was not trained to carry out towing operation . 2 The method of attaching the towing belt to the dumper towing eye was incorrect.	Heavy Driver	Traffic	The Dumper driver was not trained & experienced to carry out towing operation.
30.05.2012	The trailer part of an articulated dumper overturned on its side as it transverse across an earth stockpile.	Sector-24	Near Miss	1. The stock pile was not designed for equipment access. 2 The dumper operator parked across the slope of the ramp.	Heavy Driver	Plant & equipment	The dumper trailer was parked at the edge of stock pile.
22.08.2012	One ton pick up struck with another one ton pick up while reversing.	Sector-24	Equipment Damage	The driver did not check the rear side while reversing.	Light duty driver	Traffic	The driver failed to check the rear side while reversing.
8.10.2012	Water tanker hit on the centre median of the up down barrier at the gate	Sector-19	Equipment Damage	The driver did not check the rear side while crossing very close to the centre median.	Heavy Driver	Traffic	Failure to identify the hazards.

15.10.2012	An excavator overturned whilst tracking on an uneven loose soil	Sector-14	Reportable dangerous Occurrence	The Operator did not prepare the ground before tracking the excavator to the designated work area.	Operator	Plant & equipment	Failure to identify the hazards.
12.11.2012	A trailer loaded with pipe hit with the gate while making U turn	Gate area	Equipment Damage	The driver did not check the rear view mirror while crossing close to the gate. Poor judgment of the driver regarding his load width.	Heavy Driver	Traffic	Failure to Identify the hazard
18.11.2012	A wheel loader drove over one 600 dia pipe while reversing.	Sector-14	Equipment Damage	The driver did not check his rear view mirror while reversing.	Operator	Plant & equipment	Failure to follow the basic rules of checking the rear mirror while reversing.
24.11.2012	A 3 ton pickup hit the mirror of a six wheel dump truck	Sector-13	Equipment Damage	The 3 ton pickup driver did not check the right side while passing very close to the parked vehicle.	General Foreman	Traffic	Failure to check the sides of the vehicle while driving.
22.01.2013	A 3 axel trailer hit another 3 axel trailer while reversing	Sector-25	Equipment Damage	The driver misjudged while reversing his vehicle	Heavy Driver	Traffic	Failure to identify the hazard while reversing
26.02.2013	A Heavy bus lower body hit the kerb stone while taking left turn.	Sector-24	Equipment Damage	The bus driver failed to judge the width of the road and height of the kerb stone while taking turn.	Heavy Driver	Traffic	Failure to judge the width of the road

In infrastructure project, work was undergoing in different sectors as shown in table 2. It is observed that the most of the incidents occurred may be due to the misjudgment of the drivers while taking turn or reversing the bus or failing to judge the width of the road while driving. The major construction work was going on in two important sectors 14 and 19. This is found that the more rush in the small width road in both sectors with less experienced drivers lead to many accidents. But only one incident was reported in sector 14 when the project was started in 2011 and even throughout the year because only few 3 axel trailers were running on the road for infrastructure development work.

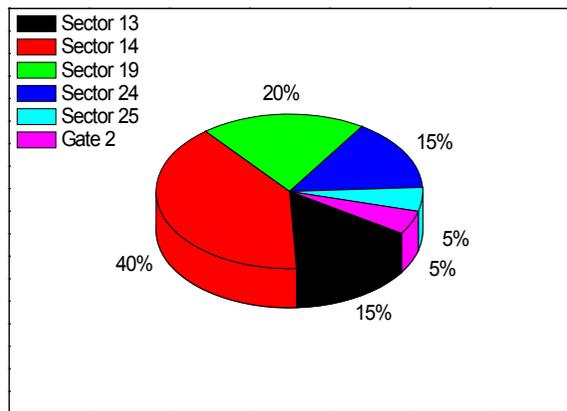


Figure 4 shows the Percentage structure of accidents in various sectors and gate areas of the Infrastructure project.

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In the project the major accidents were reported in various sectors as shown in the figure 4. It is observed that the major accident occurred at different sectors such as 13, 14 and 24 around 15 %, 40 % and 20 % respectively. These incidents were with the heavy 3 axel trailers and a bus while reversing it. The bus driver failed to judge the width of the road and height of the kerb stone while taking turn or sometimes 3 ton pickup driver

did not check the sides while passing very close to the parked vehicle caused these kind of incidents. In most of the incidents equipments were damaged but no injuries reported.

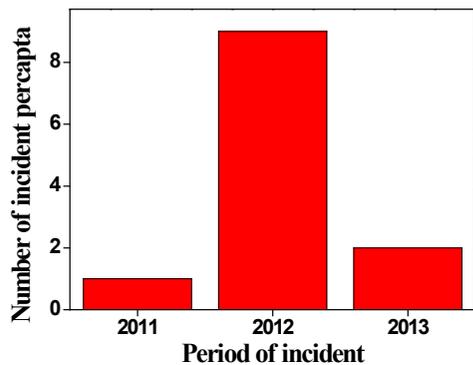


Figure 5 shows the incidents occurred in the Infrastructure project in various sectors during 2011 to 2013

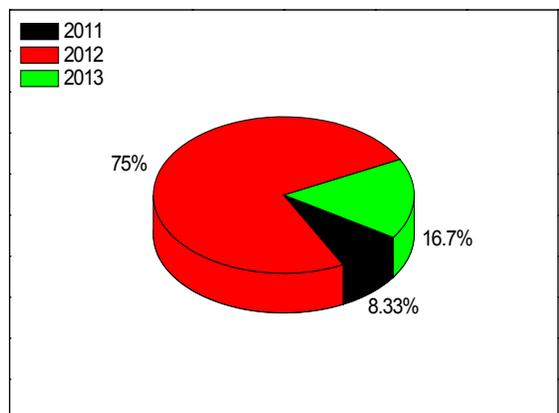


Figure 6 shows percentage of accident occurred from 2011 to 2013 in the infrastructure project

Figure 5 and 6 indicates the decrease in the accident ratio as a function of time period. It is noticed that the accident rate was 16.7 % in 2011 increased to 75 % in 2012 due to the mechanical failure or careless driving on road or working in the field. It is interesting to note that the incident cases are suddenly dropped to 8.33 %, which proves the safety cultural improvement due to the effective implementation.

Conclusion

The improving of a safety system in the infrastructure development project in various sectors of great challenge due to the anticipated enormous economic and infrastructural expansion, together with the prevalence of vulnerable migrant workers from low income countries. It is confirmed from the above

case study that the entities and regulatory authorities took all the necessary steps to ensure the effective implementation of EHSMS as results tremendous changes could be observed from the period of 2012 to 2013. We noticed that inevitable habits of the drivers or violation of the traffic rules caused major incidents in construction project. Since last three years studies revealed that the ADEHSMS properly implemented the traffic regulation and safety management in the construction industries. Therefore, no life losses have been reported. Overall, a successful safety management system in the construction Sector in the Abu Dhabi Emirate outlines the need of leadership and management commitments and provides the tools necessary to implement the Emirate safety policy.

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