

Challenges in the Adoption of Unmanned Aerial Systems (UAS) for Health and Safety in Construction Industry of Pakistan

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Abstract

The rate of accidents, fatality & injuries in construction industry are more frequent than any other profession, which causes time delays and cost overruns in the project due to the compensations paid to the injured workers. As there is no authority or organization which monitors health and safety e.g. OSHA in the construction industry of Pakistan, the conditions of health and safety for the well-being of labours are not satisfactory. Adoption of new technology can reduce the number of accidents that occur on construction sites but the rate of adoption of new technology in the construction industry is very slow paced and even slower in area of health and safety. This study provides an insight to the challenges faced by the construction industry of developing country like Pakistan, by promoting innovating technology like unmanned aerial system (UAs) for the purpose of health & safety. Technology such as Unmanned Aerial System (UAS) is being used to identify, report hazards to make zero-accident jobsite & the access the inaccessible areas but this technology is not being adopted in developing countries like Pakistan. A conceptual framework was developed for the adoption of UAS in the construction industry of Pakistan to improve health and safety.

Keywords: Unmanned Aerial Systems, Technology adoption, Health and Safety

1. INTRODUCTION:

Construction industry is an important part of the economy for both developed and developing countries. It contributes about 14% of gross national product and 8% of total employment in the United States (Jochen Teizer 2015) . Developing countries like Pakistan has yet to adopt changes and improvements made in this field. The construction industry of developing countries like Pakistan and India is 2.5-10 times more labour intensive than developed countries (Enno “Ed” Koehn, Rupesh K Kothari et al. 1995).A factory worker in Pakistan is 8 times more likely to killed on job than a factory worker in France. Not only nation but size of economic sector and size of industry also plays a major role in safety against hazards (Benjamin O Alli 2008) .

To abandon old traditions and adopt new innovative approach in the construction industry is a strenuous job but the first step is to comprehend the innovation itself, to gain insight in understanding the hindering factors in adoption (Aletha M Blayse and Karen Manley 2004). As there is much space for innovation in underdeveloped countries like Pakistan. The challenges in adoption of innovation is mainly due to lack of investment in research and development (R&D) and poor communication between industry and academia (Mohammed Fadhil Dulaimi, Florence Y Y. Ling et al. 2002). This study shows that the UAS can be used as a tool to improve the conditions of health and safety in the construction industry. Using UAS would lead to proactive decision making by the management to reduce time delays and cost overruns.

2. LITERATURE REVIEW:

Health and safety are important aspects for all branches of all parts of life. In case of construction industry, it is more so. All aspects of the works in a construction projects are affected by health and safety (Phil Hughes and Ed Ferrett 2012). (Pakistan Bureau of Statistics (PBS) 2017). The Pakistan’s construction industry relies heavily on manual labour and orthodox construction practices which has resulted in poor standard of health and safety (Aftab Hameed Memon, Mohsin Ali Soomro et al. 2017). Hence ensuring proper health and safety measures of the people that contribute to this sector is a major challenge.

2.1 Importance of health and safety:

According to the US bureau of labour statistics (Bureau of Labor Statistics (BLS) 2016) construction and civil works remains the occupation with the highest number of on-job casualties. There is no organization or agency which enforces health and safety in construction industry of Pakistan e.g. OSHA in US. Safety managers are always trying to move towards a safer and zero-accident jobsite (Javier Irizarry, Masoud Gheisari et al. 2012) but still onsite accident and injury is an occupation hazard of the construction industry.

2.2 Labour laws to ensure safety:

In Pakistan, there are no specific legislations or authority that enforces the safety at construction site. This means that each contractor employs safety measure subjectively and generally the cheapest and low-cost measure are taken to provide safety whether they be in terms of personal protective equipment or insurance.

2.3 Cost of accidents:

The cost of accident may just not be a direct cost such as employee compensation damages to building, equipment etc. but also could be indirect or hidden cost such as business loss, time loss, loss of good will, overtime etc. These losses may not be covered by the insurance company.

Studies from Health and Safety Executive (UK) show that indirect or hidden cost can be up to 36 times greater than the direct cost of the accident. (Phil Hughes and Ed Ferrett 2012). Hence proving health and safety in today's dynamic and ever-changing construction projects is not only imperative for the protection of the workers well being but also for the completion of projects in scheduled time and the allocated budget.

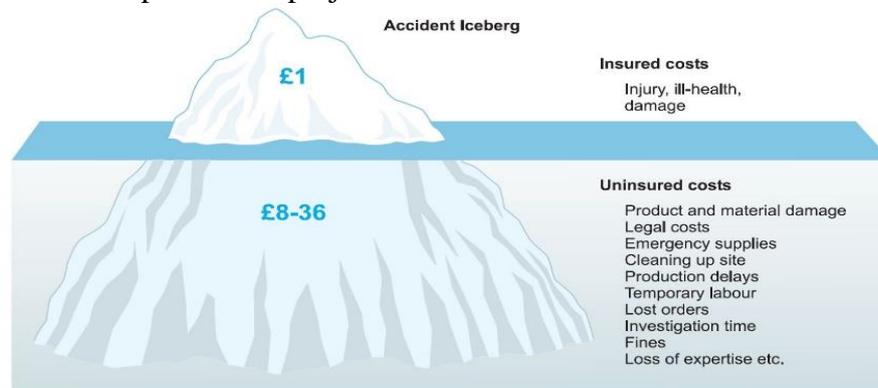


Figure 1 Accident cost iceberg

2.3 Factors compromising health and safety:

(T Michael Toole 2002) identified eight root causes that compromise the health and safety of workers on a construction site:

1. Lack of proper training
2. Safe equipment not provided
3. Unsafe site conditions
4. Poor attitude towards safety
5. Deficient enforcement of safety
6. Unsafe methods or sequencing
7. Not using provided safety equipment
8. Isolated or sudden events

Out of above eight factors, five underlined factors can be monitored by just observation using Unmanned Aerial System (UAS). Hence to improve safety at the construction site, safety managers need a way to efficiently observe and correct practice or action that may compromise the safety of the people working at the jobsite.

(Javier Irizarry, Masoud Gheisari et al. 2012) explains that observation has three main characteristics

1. Being Frequent
2. Directly Observing
3. Direct Interaction with workers

Hence this is done by safety manager, who would inspect the job site on a regular basis and assess the safety of the site by observing and interacting with workers. But in construction industries the project are generally large and complex, this would mean that much more time is taken and the inspection becomes even more complex (Javier Irizarry, Masoud Gheisari et al. 2012). (Atieh Sadat Borhani 2016).

2.4 Use of Unmanned Aerial Systems for health and safety:

Advances in technology can provide great benefits in important areas of construction such as health and safety. (Javier Irizarry, Masoud Gheisari et al. 2012). UAS (Unmanned Aerial System) is the complete package needed for the observation of

construction site. UAS includes the Unmanned Aerial Vehicle (UAV) commonly known as a drone, the ground control system, the controller, camera, GPS and all tool and software required for the working and maintenance of the UAS (ICAO 2018). UAS hold the best prospect to taking a step towards a zero accident and safer construction sites. UAS has low cost, high mobility, safety support, high speed visual assets acquisition and data transfer. UAS is also a key contributor to the automation for its ability to give real time and accurate observation of the construction sites work safety, cost-effectiveness and carbon emission reduction, while there are possible adverse impacts on the basis of current limitations of Unmanned Aerial Systems however, it can be predicted that the usefulness of drones will continue to increase in the future of the construction industry (Yan Li and Chunlu Liu 2018). In developing countries like Pakistan where both construction industry and the academia has failed to form a standard mechanism for monitoring and enforcing safety for the health and wellbeing of all worker at the construction jobsite, new technologies such as UAS should be applied to provide a better mechanism of safety.

The real life application varies from project to project e.g. building project or a road project. In a construction project a skilled safety manager with knowledge of handling drones can stay on site in his office and hover the drone over construction site for inspection. With real time data available to safety manager, he can take proactive decisions and take measures before the occurrence of accident or notify about the presence of hazards to the stakeholders. Every type of project will have its own sets of rules e.g. frequency of visits made by drones, quality of image taken by drone, different point of interests etc.

Thus, it is necessary to identify the barriers that inhibit the adoption of this technology in Pakistan's construction industry.

3. METHODOLOGY:

The study was done using a mixed research method in which both quantitative and qualitative data were acquired through web-based questionnaire and semi structured interviews. From all the data obtained, its analysis led to development of a framework was developed that can help in adoption of UAS technology in construction industry.

3.1 Survey:

A pilot survey was conducted to ensure the validity of questionnaire by stakeholders. Responses from pilot survey were incorporated in questionnaire.

The online questionnaire for survey consisted of 32 questions and 62 responses were received. The introductory question requested the information about the respondent, the responses showed that majority of our respondent were contractors (40%) followed by clients (24%) and consultants (21%).

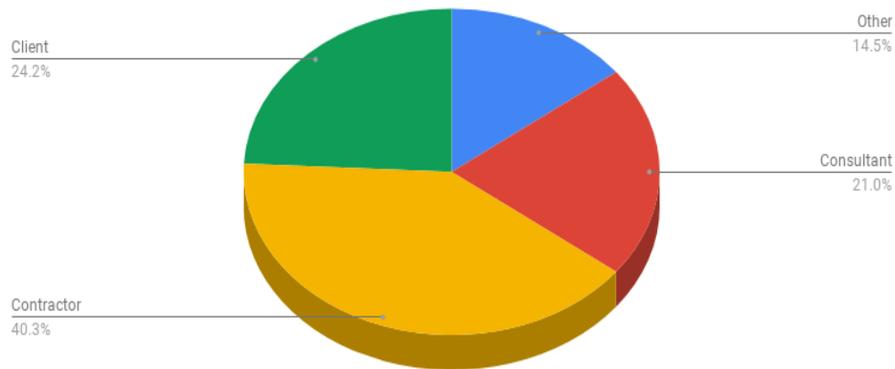


Figure 2 Respondent percentage

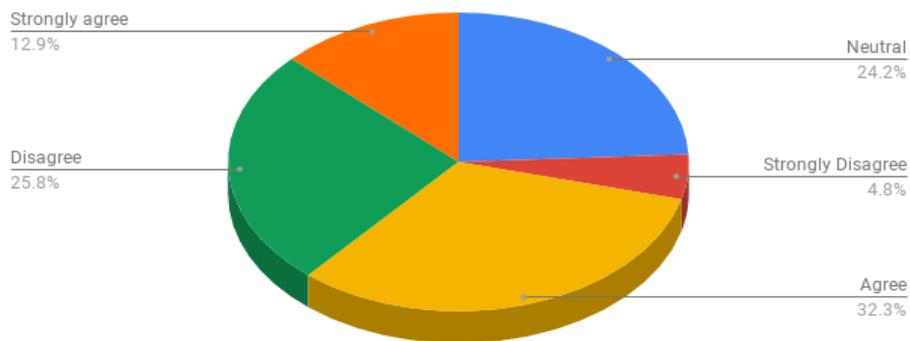


Figure 3 Response to implement of UAS

The second section of the survey was used to collect data about the perception of using UAS for safety and its benefits. 21% of the respondents strongly agreed and 35.5% agreed that UAS can be very beneficial for safety in their work.

The third section of the survey collected data about the advantages that UAS can give to the construction firms. The respondents agreed that using UAS would give a competitive advantage to the firms, the respondents also identified that there was a need for technology training and increase in quantity of skilled labour which could only be brought about by improvement of attitude and commitment from higher management of the construction firms.

The fourth section of the survey collected data about the lack of incentives and motivation from the regulating agencies such as Pakistan Engineering Council. Majority of our respondent affirmed that they do not receive any incentive for applying new methods of safety on the construction sites.

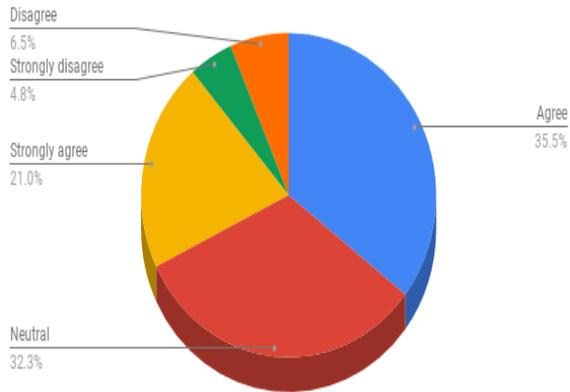


Figure 4: Response to benefits of UAS advantage

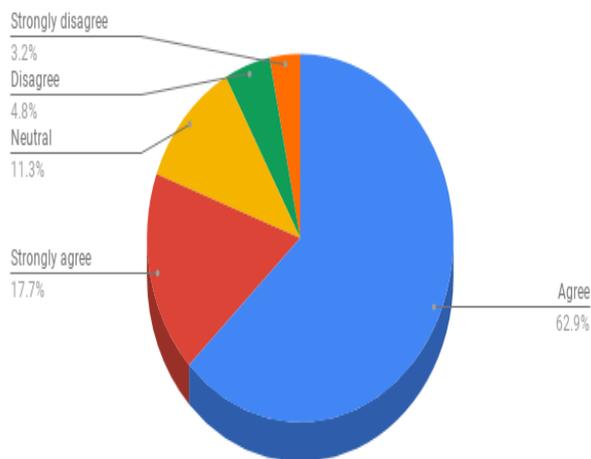


Figure 5: Response to UAS as competitive advantage

The last section of the survey was used to affirm that regulation and acts would be required for the use UAS on construction sites.

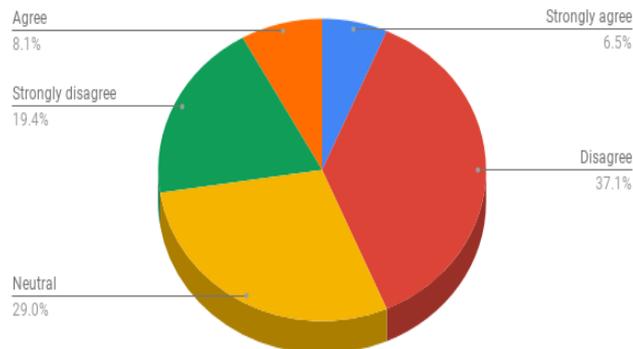


Figure 6: Response regarding incentive to use technology for safety.

awareness, when stakeholders are willing to accept the existence of technology and adopt it for their benefit. Proper training and education are required to create and increase the quantity of skilled labours. Initial investment requires motivation from higher authorities in the form of incentive for adoption of technology like tax levy etc. With enough proper rules and SOPs, UAS can be effectively used in construction industry. First cycle of the technology adoption will reveal the unseen factors which may occur during adoption of the technology and can be used to improve rules and regulations regarding usage of drone which further improve the health and safety of workers in the construction industry.

5. CONCLUSION:

The research conducted considered areas of occupational health and safety, behaviour and attitudes towards technology adoption for safety in construction industry. Construction industries of underdeveloped countries rely on traditional approaches of providing safety by responding reactively rather than proactive approach and SOPs which is necessary to reduce time delays and increase productivity of labours. Our research suggested, use of UAS for health and safety. Some of the major factors were identified which inhibit the adoption of technology (i.e. UAS) for providing health and safety and prevent accidents and hazards from occurring in the construction industry. From this research, the main factors identified which inhibit the adoption of Unmanned Aerial System (UAS) in the construction industry of Pakistan are lack of awareness about the technology and its benefits in applying this technology in the construction industry. The poor attitude towards health and safety of worker in the construction industry also plays a major part.

A conceptual framework was developed for technology adoption of UAS for the purpose of improving health and safety in construction industry of Pakistan. Future research should validate this proposed framework by translating into practice and to modify it according to the new factors that may emerge while applying Unmanned Aerial System (UAS) in construction industry.

6. LIMITATIONS:

Our study had few limitations the first being a small sample size due to lack of responses to questionnaire, secondly lack of any case study that was available, third that there are only a handful of technology adoption experts that have the expertise to help improve the framework, fourth there is no reliable data source about the accidents on construction sites.

This study was limited to only a theoretical study due to the unavailability of an Unmanned Aerial System (UAS).

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