



## Integrating early refresher practice in height safety and rescue training

Kenneth Lawani\*, Billy Hare, Iain Cameron

Department of Construction and Surveying, Glasgow Caledonian University, Cowcaddens Road, G4 0BA, UK

### ARTICLE INFO

#### Keywords:

Wind technician  
Wind turbine  
Job knowledge test  
Situational judgment test  
Wind turbines standards

### ABSTRACT

The non-routine practice of wind turbine height safety and rescue skills after training has significant impact on the competency and health and safety of construction and maintenance technicians. The proposition is that wind technicians who undertake initial training without practically carrying out hands-on rescue roles are most likely to forget the procedural steps during emergencies except there is an early refresher practice integrated within the system. Longitudinal study of 30 (subsample) wind technicians using Job Knowledge Test (JKT), hands-on practice test with Situational Judgment Test (SJT) and pictograph of the rescue device was employed. While the level of performance of wind technicians improved during acquisition, there was observed decline in performances over one and three month non-practice intervals. This confirms the significance of integrating early refresher practice of rescue and evacuation skills and the factors influencing the competence of the technicians over these timescale. To improve the competency of technicians and reduce the risk of injury or failed rescue, actual timescales have been identified showing that early refresher practice should be undertaken at three months after acquisition for returning technicians and within one month for new technicians.

### 1. Introduction

The significance of real-time rescue for wind technicians working on onshore and offshore wind farms cannot be overstated. Over the last 12 months, there has been series of fatal wind turbine related accidents resulting from falls from height (two within a month in Scotland) and this calls for an evaluation of refresher trainings associated with working at height on a wind turbine.

The integration of early refresher practice has been identified as potential solution to problems of skills and knowledge retention. This is very relevant in situations where individuals undergo training and end up not using or practicing such skills after a period of time (Arthur et al., 2007; Arthur Jr, et al., 2010; Kluge & Frank, 2014; Arthur Jr, et al., 2013). There are job requirements that necessitate certain groups of workers to undergo certain types of trainings as part of the employment strategy in scenarios where the workers do not have the opportunity to perform such skills over a period of time. Without comprehensive evaluation of practice and performance, determining skill decay and initiating early refresher practice for wind technicians is not practical.

The technicians generally undergo the basic level height safety and rescue training endorsed by RenewableUK (RUK) and the Global Wind Organisation (GWO), the main renewable energy trade association responsible for developing training standards to enhance the basic skills and knowledge of anyone working in the renewable energy sector. The

work at height and rescue – Wind Turbines Standards (WTS) outlines the basic safety training and competence recommended for all personnel involved in working at height on wind turbines. This was achieved in consultation with members and key stakeholders endorsing benchmark standards, which incorporate the Global Wind Organisation (GWO) requirements. Though past research has highlighted the significance of refresher training, there is, however, considerable disagreement concerning the appropriate content and frequency of such training, (Teachout et al., 1993; Paulin et al., 2002).

The existing basic work at height and rescue training regarding use of rescue and evacuation devices on a wind turbine is adequate enough to attain some level of proficiency at the end of the training. However, the likelihood of wind technicians retaining such skill and knowledge up to a period of 24 months before embarking on formal refresher training has not been supported with evidence by the responsible organisation. Also, the competency of technicians to procedurally execute such skills in an emergency situation is paramount if there are no existing support services in place to aid the retention of the basic skills after periods of non-routine practice. Therefore, managing the safety and health of these technicians require some evidence to determine the pattern of decay of their skills and knowledge. This study examines part of the wider issue of ‘work at height’ which is one of the most fatal and high risk work activities associated with construction and maintenance workers.

The application of this study is not limited to only wind turbine

\* Corresponding author.

E-mail addresses: [Kenneth.Lawani@gcu.ac.uk](mailto:Kenneth.Lawani@gcu.ac.uk) (K. Lawani), [B.Hare@gcu.ac.uk](mailto:B.Hare@gcu.ac.uk) (B. Hare), [I.Cameron@gcu.ac.uk](mailto:I.Cameron@gcu.ac.uk) (I. Cameron).

<https://doi.org/10.1016/j.ssci.2018.03.029>

Received 5 July 2017; Received in revised form 10 January 2018; Accepted 28 March 2018  
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rescue safety but also to other high hazard industries. Industries like construction involved in the use of mobile elevated work platforms (MEWPs) recorded two fatalities because an initial crush was compounded by a colleagues' inability to use the emergency lowering controls. Also, a review of the cause of explosion on the Rough 47/3-B gas storage installation operated by Centrica Storage in the North Sea in 2006 revealed that the lifeboat coxswain were unable to procedurally execute the specific steps needed to launch the lifeboat on the Rough installation. Therefore, this study can potentially inform rescue equipment designers and manufacturers in identifying and reducing strategic signs of forgetting effects by introducing cues or prompts; man-machine interaction modalities (a particular way of doing or experiencing something); error correction strategies; and instructions in the design of equipment focusing on elements of the rescue or evacuation tasks that are most critical. These are especially important for 'low frequency high impact' (emergency) scenarios e.g. in associated industries like telecommunications, industrial climbing & rigging, scaffolding, and tower crane which use rescue devices and are prone to similar retention of rescue skills. The integration of early refresher practice can enable the management to tailor resources and personalise some aspects of training to meet the required needs of workers (employees, self-employed and agency workers) rather than the generic training that is not always beneficial to all.

## 2. Scope of study

Wind technicians generally undergo a two-day work at height and rescue training which deals with safety critical skills and knowledge. Also, there is little or no training provided during intervals of non-practice and such acquired skills and knowledge for rescue and evacuation can be forgotten with the passage of time. Such forgetting can result in performance decline. Studies have also shown that practice of a task translates into procedural knowledge which leads to the acceleration of skilled performance, (Anderson, 1983; Kluge et al., 2010; Kim et al., 2013) and that complex skills with limited workplace practice can degrade over a period of hours, days, weeks or months of non-practice.

The training the technicians undergo cover aspects such as dangers of working at height; how to assess the hazards and implement effective controls; how to use restraint, positioning and fall arrest systems; selecting proper anchor points; practical climbing on ladders using fixed vertical safety systems; recognising and dealing with suspension trauma; planning for emergency procedures; features and limitations of the rescue equipment being used; and how to rescue a suspended colleague from an in-reach and out-of-reach situation.

This paper focuses on the discrete procedural skills necessary for safe rescue of wind technicians during emergencies. The study investigates the impact of not integrating early refresher practice of rescue and evacuation skills within a period of one and three months. Also, the adopted training model for technicians implicitly assumes that technicians are capable of retaining the height safety and rescue skills over a period of two years but there is no published support for this assumption which this study considers unsustainable.

For every wind technician that has undergone the basic work at height safety; rescue and evacuation training; they are deemed fit to act as the first responders in emergency situations whilst working on any onshore or offshore wind farm. Therefore, determining the magnitude of their skill retention in using the rescue devices and initiating a safe evacuation plan is paramount. Also, the potential opportunities for technicians to embark on a refresher training in order to improve safety, proficiency and skill reliability after training is still lacking. Therefore, this process of investigating rescue and evacuation skills and knowledge will objectively provide relevant planning information on how much technicians learn and forget, thereby allowing for effective planning of training regimes.

The simple proposition is that when a wind technician undergoes

training, their proficiency increases; in the absence of training and practice, proficiency declines. This study recommends refresher practice when technicians execute rescue skills below a set '*limit state performance*', and to also identify when their proficiency is within its '*peak allowable performance*'. Using this method, routine reviews of proficiency testing by employers will alert them to subtle shifts that might impact on output and embark on training employees that are underperforming in terms of safety, consistency in rescue procedures, accuracy and timeliness which are priorities during emergency rescues.

### 2.1. Practice/performance

Practice is the physical act or mental rehearsal of a task undertaken with the implicit or explicit goal of attaining some level of proficiency in performing that task, (Cannon-Bowers et al., 1998). Evidence suggests that for a successful transfer of training, technicians need both the resources and available opportunities to practice and perform the newly acquired skills (Clarke, 2002; Salas et al., 2006; Burke & Hutchins, 2007; Weissbein et al., 2010). Practice supports the procedural learning of skills by knowledge compilation which eventually translates declarative knowledge into procedural knowledge (Anderson, 1983; Kim et al., 2013) leading to the acceleration of skilled performance. Kluge et al. (2010) showed that practice improves skill retention; although this statement seems to be common sense, it has not been systematically investigated in comparison to other dynamic tasks such as height safety, rescue and evacuation for wind technicians.

There are several theories which advance the power law of practice (Newell & Rosenbloom, 1981; Delaney et al., 1998; Lee & Anderson, 2001). Anderson (1993) claims that the speed up is due to two mechanisms: knowledge is converted from a slow format (declarative knowledge) into a fast format (procedural knowledge) and the speed of individual pieces of procedural knowledge also increases with practice. Logan (1988) stated that with considerable practice, perceptual-motor skills can sometimes become automatic and that automatic processing is fast, effortless, and autonomous. In contrast, Carlson et al. (1990) stated that skill as a whole never become as automatic as driving one's car despite considerable practice. In summary, the amount of previous practice is directly related to an individual's current potential performance.

The degree to which the task environment can change while technicians plan and execute a rescue and evacuation activity and the range of possible actions are fairly unpredictable while working at height. However, the relationship between deliberate practice and performance would generally be more positive for high-predictability activities than for low-predictability activities based on the notion that effects of training and deliberate practice on performance are stronger when the task environment is more predictable, see (Macnamara, et al., 2014).

### 2.2. Training

There is agreement that the single most important contributing factor of both skill and knowledge retention is the depth or amount of initial training or acquisition, (Weissbein et al., 2010; Cameron et al., 2011; Hatala et al., 2014). Hare & Cameron (2011) reflected on the fact that the extent of safety training or qualification is expected to be a significant factor in relation to competence but however, no previous research has confirmed this link with training levels. Also, literature does not holistically offer an understanding of how best to abridge the loss of relevant skills in the absence of regular schedules of refresher training. However, it is understood that training can be enhanced by the instructor or system through the provision of supplementary cueing, feedback which leads to feedforward and the specification of the instructional facilities.

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