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# The human factor in agriculture: An interview study to identify farmers' non-technical skills

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ABSTRACT

*Background:* Farming represents a high risk occupation, responsible for several thousand worker injuries and fatalities worldwide per year. Research within other high risk industries, such as aviation, shipping and healthcare, has identified the importance of non-technical skills in maintaining effective performance and reducing the risk of an adverse event. The aim of the current study was to identify the categories of non-technical skills that are typically used by farmers.
*Method:* A sample of 32 farmers, from within two geographical regions (Scotland and Northern Ireland), were interviewed using the critical incident technique. The interview transcripts were then coded using thematic analysis in order to identify reported non-technical skills.
*Results:* Participants reported the daily use of a range of non-technical skills, these differed according to whether the farmer was working as part of a team or alone. Team non-technical skills were identified as: situation awareness, decision-making, leadership, teamwork and task management. Lone worker non-technical skills were identified as: situation awareness, decision-making and task management.
*Conclusion:* The results indicate that non-technical skills are an important aspect of farmers' work performance and safety; mirroring the findings reported within other high risk industries. Further research is required to validate the skill set suggested here, and to develop a behavioural marker system similar to that used in other industries.



## 1. Introduction

In September 2012 a farmer and both of his sons died after inhaling noxious slurry gases in an underground tank (BBC, 2012). Unfortunately this kind of accident is all too common within agriculture; a high risk industrial sector that accounts for approximately one in five of all fatal injuries to workers in the UK, with 29 recorded fatal injuries to farm workers in 2012/13 (Health and Safety Executive (HSE), 2013). This is the case not only within the UK but internationally; with an estimated 170,000 farm worker fatalities occurring annually worldwide (Douphrate et al., 2013). Accurate estimates of accidents and injuries which do not result in a fatality are difficult to obtain due to problems with under-reporting within the farming sector (Rasmussen et al., 2000). But, the main hazards which can have an impact on farm worker safety are relatively well known, including; machinery (Rautiainen and Reynolds, 2002), farm animals (Mitloehner and Calvo, 2008) and working at height (HSE, 2013). Injuries reported during interactions with these hazards include: fractures; sprains and head injuries (Douphrate et al., 2013). Perhaps most worryingly, a proportion of reported injuries and fatalities involve children, who are at risk in this environment due to participation in farming activities as a member of the family. Reported injuries to children include: lacerations; fractures; head injuries and poisoning (Stueland et al., 1996).

Farming represents a unique, and high risk, working environment, with farmers commonly conducting a wide variety of tasks, both alone and as part of a team (Olsen and Schellenberg, 1986). Lone or remote workers represent a particular risk due to the lack of supervision, or presence of others to help if needed (Huang et al., 2013). In addition to responsibility for their own personal safety, and the safety of any farm workers, farmers must also adhere to regulations developed by an external body (such as the HSE) (HSE, 2013a). There are seasonal variations in the nature of tasks conducted on the farm, and the associated risk, with harvest time linked to a rise in accident rate (Soloman, 2002). There are also some specific risks associated with livestock handling, due to cattle temperament and behaviours (Lindahl et al., 2012). Finally, farmers have been reported to have a high level of risk tolerance when

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engaging in behaviours they consider necessary to complete a task (McLaughlin and Mayhorn, 2011; Glasscock et al., 2006).

In an attempt to investigate possible connections between accidents, injuries and working conditions, several studies have considered the potential impact of psychosocial variables on safety on farms (Erisman and Huffman, 1972; Harrell, 1986). Glasscock et al. (2006) report that high levels of perceived stressors (time pressure, economic concerns) and stress symptoms, combined with low levels of reported safety behaviours, predict an increased risk of injury in Danish farmers. A more recent study Hagel et al. (2013) also found a link between economic worry, or concern, and risk of accident. Specifically, the financial conditions on Saskatchewan farms were linked to the absence of structurally sound buildings and safety shields on farm machinery. The authors suggest that financial issues may prevent investment in safety equipment, and may also result in farm operators working longer hours, thus raising the risk of accident through fatigue (Hagel et al., 2013). Finally, in addition to environmental factors, age has also been identified as a possible risk factor (McLaughlin and Mayhorn, 2011) with older farmers reporting slower reaction times, a high level of risk tolerance and a propensity to work while fatigued.

Despite the negative impact of psychosocial factors there has been very little research conducted to directly examine the strategies or skills a farmer might use to ensure effective and safe performance at work. An HSE report (2005) indicates that farmers can cope with stress by engaging in planning and preparation prior to beginning a particular task. Research examining the maintenance of biodiversity suggests that farmers engage in several decision-making strategies depending on whether the decision will have an impact on their business or personal goals (Farmar-Bowers and Lane, 2009). Research conducted in Denmark developed a model of decision-making for farm managers of large scale agricultural operations that encompassed multiple factors such as prior experience that might influence the decision process (Fountas et al., 2006). However, further research is required in order to identify the full set of skills used, create a shared terminology, and encourage discussion based around non-technical skills (NTS) and safety in agriculture.

There is a large body of research which directly assesses the use of NTS within other high risk industries such as aviation, healthcare and the oil industry. NTS have been defined as the social (leadership, teamwork and communication) and cognitive skills (decision-making, situational awareness, task management) necessary for safe and effective task performance (Flin et al., 2008). Within industry and healthcare a strong link between NTS and adverse events has already been established, for example, adverse events in surgery have been linked to failures in communication (Neale et al., 2001) and teamwork (Catchpole et al., 2008). Similarly failures in situation awareness have been linked to offshore drilling incidents (Sneddon et al., 2006). Finally, the strengthening of NTS through training has been highlighted as a method for improving safety and minimising adverse events within healthcare and industry (Flin and Patey, 2009; Marquardt et al., 2011). The high risk environment of farming suggests that NTS could potentially be equally as important within agriculture. Despite this no research, to our knowledge, has been conducted to assess which NTS might be relevant or useful for farmers.

The aim of the current study was to identify the non-technical skills required for safe and effective performance of farmers, both when working alone and as part of a team. This was done through the analysis of semi-structured interviews with farmers, based on the critical incident technique. That interview technique allowed the researchers to collect a great amount of detail about the thoughts and actions of farmers during positive and negative incidents. The data were analysed using thematic analysis in order to identify the non-technical skills used and compare the reported skills with those reported in other high risk industries such as healthcare (Yule et al., 2006).

## 2. Method

### 2.1. Design

The critical incident technique (Flanagan, 1954; Butterfield et al., 2005) formed the basis for each interview. This method has been previously identified as a method of eliciting detailed information from domain experts (Stemberg and Horvath, 1999). During the interview participants were asked to verbally recall a past incident, while the interviewer asks further questions to discover the tacit knowledge and skills used (Sternberg and Horvath, 1999; Mitchell et al., 2011). When developing the interview questions generic NTS identified for safety critical jobs (Flin et al., 2008) were considered. This was in order to examine those skill categories, while still retaining enough flexibility for other skills to be identified.

### 2.2. Ethical approval

This study was approved by the University of Aberdeen, School of Psychology ethics committee, Scotland (approved June 2014).

### 2.3. Participants

A total of 32 participants (29 male, 3 female; age range 18–61 years) were recruited within a three month period. The first participants recruited were known to the interviewer (JP) and were recruited through personal contact using an invitation letter. Further participants were then recruited using the snowball sampling technique (Goodman, 2011), whereby each participant alerted friends and colleagues to the study and passed on the relevant details for participation. Participants were recruited from within two areas: North-East Scotland ($n = 8$) and the South-Eastern area of Northern Ireland ($n = 24$). The participants were recruited from several different types of farm: Dairy farm ($n = 16$); Beef cattle ($n = 7$); Mixed, with both beef cattle and arable crops ($n = 5$); Sheep ($n = 2$); Pigs ($n = 1$); arable ($n = 1$). The size of farm also varied, ranging from 30 acres to 2500 acres. All of the participants had grown up in a farming environment, and listed farming as their primary occupation. However, although the majority of the sample were full time professional farmers ($n = 30$), two participants worked on their farms part-time, in conjunction with another agricultural role.

### 2.4. Data collection

Digitally audio-taped interviews lasting between 30 and 45 min were conducted between June and August 2014 by the second author (JP). The interviews were all conducted at the participants' place of work, within a quiet room on the premises. All interview recordings were transcribed verbatim by one researcher (JP).

As part of the critical incident technique (Flanagan, 1954), participants were asked to recount one adverse incident, which had resulted in an accident or injury, and one positive farming example, which had resulted in a good outcome. The interviewees were asked to describe the incidents in detail, and were given time to discuss their thoughts and feelings about both incidents, along with their own actions and the actions of any others present.

In the second section of the interview, participants were asked further questions about working alone, and as a member of a team, using questions adapted from previous research on non-technical