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What do aircraft accident investigators do and what makes them good at it? Developing a competency framework for investigators using grounded theory

Jim Nixon*, Graham R Braithwaite

Cranfield University, Cranfield Safety and Accident Investigation Centre, MK43 0AL, United Kingdom

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ABSTRACT

We present a new analysis of the tasks carried out by air accident investigators and propose a new competency framework which captures the competencies demanded of an effective investigator. Using a subject-matter expert panel, a hierarchical task analysis (HTA) was developed to frame and organise the diverse activities that are required of the air accident investigator. Supported by the HTA, a competency framework was developed using structured interviews based on repertory-grid interview technique. Grounded theory was used to abstract competencies derived from the interviews. The resultant competency framework could be applied to selection and training future investigators in other safety critical domains. More immediately, the framework can deliver insight into what differentiates the good investigator from the excellent investigator.

1. Introduction

In 2004 Ken Smart, former chief inspector of the UK Air Accidents Investigation Branch (AAIB) wrote:

> *"In my experience it is a relatively straightforward process to establish a candidate's professional qualifications and experience. Far more difficult is to get a good assessment of a candidates personal qualities."*
>
> Smart, 2004

We have little doubt that this is a common refrain in all but the most straightforward of roles and their associated selection processes. In this article, we address part of this challenge through the development of a new task analysis and resulting competency framework for air accident investigators. Air accident investigation is a highly specialised and demanding role. In the United Kingdom, the AAIB is the government body responsible for the investigation of air accidents and has been extant since 1915. The AAIB's purpose is "…to improve aviation safety globally by determining the causes of air accidents and serious incidents, and making safety recommendations intended to prevent recurrence. It is not to apportion blame or liability." (AAIB, 2017a). Since 1951, the International Civil Aviation Organisation (ICAO) has published international standards and recommended practices (SARPS) to its member states that air accidents and serious incidents should be investigated in the same way (ICAO, 2016). In Europe, this was mandated by the European Parliament through EU996/2010 (European Union, 2010).

Air accident investigation is a complex task that draws upon a broad range of skills. Although many of the component parts of the task are not inherently difficult, it is the nature of accidents that creates the potential for great complexity (Strauch, 2016). Air accidents are unscheduled, destructive and may lead to loss of life. They are often highly visible, shocking and can become politically sensitive. Investigators must react swiftly in order to preserve evidence which may be perishable or vulnerable. Investigators will likely work in a multinational, multidisciplinary team, formed at short notice and often working away from their main base. An investigation may continue for many years following a large or complex accident, yet the pressure to reassure the travelling public, as well as the operators of aircraft is immediate. Investigators need to be led by evidence, some of which may have been damaged or destroyed by the accident or which witnesses may be unwilling to share because of the fear of negative consequence.

Air accident investigators are characterised by a high level of technical skill and knowledge in the aviation domain. We suggest that this is given; technical skill alone cannot differentiate excellence in this complex role. In this article we develop a competency framework that can be used to progress and develop high work performance of the investigator. The idea of competencies has been progressed in the human resources and personnel literature and is related but distinct from merely a descriptor of *what* an employee does in a given role (Shippmann et al., 2000). In eliciting descriptions of competencies

* Corresponding author.
E-mail addresses: jim.nixon@cranfield.ac.uk (J. Nixon), g.r.braithwaite@cranfield.ac.uk (G.R. Braithwaite).

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Shippmann et al. found a plurality of understanding including the related concepts of skills, abilities, performance, knowledge and behaviours. Of particular interest in the current article is the idea that competencies can differentiate the higher performer: the superior from the mediocre (Campion and Odman, 2011; Olesen et al., 2007; Parry, 1996). Of more practical value to the employee is the application of competency frameworks to coach average performers to superior performance (Shippmann et al., 2000). Shippmann et al. propose that whereas job-analysis is focussed on the *what* competency analysis is focused on the *how*. That is the difference between *what* tasks are done by the employee and *how* those tasks are done by the employee. Competencies are performance shaping factors of a job or role, modifying performance on a task. Sanchez and Levine (2009) develop the definition of a competency further. They propose that competency modelling is a higher level description of a role which is aligned with an organisational strategy and purpose. They argue that the strong acceptance of competency modelling by senior management is a result of the strategic and direct language used when writing competencies. This is in stark contrast to the sometimes opaque psychological vocabulary associated with descriptions of jobs or the personal attributes required to do them.

With reference to the literature, a core, generic set of competencies that could be applied to a broad groups of jobs, for example leadership or technical roles is proposed. Notably the so-called 'great eight' (Bartram, 2005) which include competencies relating to decision making, leading and communicating. Generic professional competence standards are also proposed by Lester to include ethics and professionalism and profession specific problem solving and evaluation (Lester, 2014). These generic frameworks provide an effective frame of reference to understand content and construct validity. In other words what is the kind of material that is found in a competency framework and is this material synonymous with the understanding of a competency? In addition the meta-analysis proposed by Bartrum includes reference to selection tests which could differentiate these competencies. Despite the availability of these generic frameworks, progression and development of a bespoke framework for air accident investigation remains a valuable line of inquiry. The task is specialised and we view it as important for the practical application of the framework for it to be specified in the language of the sector and its stakeholders. This is identified as a key user acceptance factor for the deployment of such frameworks within organisations (Cummings and Worley, 2008).

Air accident investigation is a complex role. We show that the good investigator must have a diversity of competencies in addition to excellent technical knowledge of aviation systems and processes to achieve success in the role. One hazard in assembling a classic job analysis is that the role itself may be reduced to a number of independent activities. While this is an important element of the process, the focus could then be shifted towards generating lists of required technical knowledge omitting the performance shaping factors that could make the good investigator a great investigator.

The research presented in this article is informed by two aims. Firstly to understand what tasks accident investigators do. Secondly, to understand what competencies make investigators good at these tasks. These aims have been met firstly through the development of a hierarchical task analysis (HTA) in conjunction with a subject-matter expert (SME) panel. Secondly, competency data was elicited using individual, structured-interviews with the SMEs informed by the HTA. We have developed an interview structure using repertory-grid interview techniques. Finally the results of the structured interview are analysed using a grounded theory approach, the output of which informs the generation of competencies. The resulting competency framework contains a rich hierarchy of competencies and sub-competencies which are then finally placed into context using narratives.

2. Method

2.1. Participants

The research conducted was approved by the University ethics committee prior to starting the interviews. All participants gave written informed consent before participating in the study. An SME panel was assembled to represent UK accident investigator roles in the research.

Participants were sampled purposively. Participants were drawn from accident investigators having had experience in the civil or military accident investigation domain. Six investigators participated in the SME panel as a group to validate the HTA, and individually to elicit the competencies. Participants had a cumulative experience of 82 years, representing a high level of expertise and wide ranging experience in the accident investigation process including military, civil fixed-wing, rotary-wing, and engineering and flight operations. The mean level of participant experience is 13.6 years (SD = 5.6). Sample size in qualitative research has generated much discussion and debate (for example see Crouch and McKenzie, 2006; Morse, 2000). In quantitative research arguments to support selection of sample size can be framed in terms of the confidence of an inference from sample to population or the power of a study to find a given effect size avoiding a Type II error. It is not germane to frame selection of sample size in qualitative research in these terms. For the research presented in this article a smaller, expert sample was used to generate in-depth insights into the accident investigator role. The six investigators purposively sampled bring a depth of experience over 82 years. The modest sample size is warranted by the highly specialised nature of the industry which in the UK, has a population of fewer than twenty-five full-time investigators (AAIB, 2017b). As such the panel represents appropriate reliability which will be demonstrated empirically through category saturation in the interview data when new codes are not forthcoming (Guest et al., 2006).

2.2. Design and procedure

Two designs are employed to generate data to support construction of the HTA and secondly to elicit attributes which differentiate high performance investigators. These attributes will form the competency framework.

2.2.1. Generation of the HTA

The generation of the initial HTA was led by the first author (JN) in conjunction with an independent SME, not represented on the wider SME panel employed in the research. The independent SME has 10 years of experience as a Royal Navy air accident investigator. Following creation of the initial HTA, a facilitated workshop was held with the SME panel Participants were briefed on the purpose of the session and gave informed consent to participate in the research. Investigators were given 15 min to familiarise themselves with the HTA. A facilitated discussion was then conducted to establish any tasks that had been omitted from the HTA and the order of tasks presented. The specific wording of tasks was also addressed during the interview. All changes and alterations were recorded on front of participants and discussion progressed until all workshop participants agreed on the changes made to task wordings and order. One investigator who was not able to join the workshop gave comments and changes prior to the workshop and these comments and changes were incorporated into the main workshop discussion. During this workshop, a final version of the HTA was agreed by the panel.

2.2.2. Generation of competencies

Structured interviews were conducted by the first author (JN) with participants to elicit the qualities of stronger and weaker accident investigators. Participants were interviewed individually and briefed on the purpose of the session and gave written informed consent to participate in the research. Participants were informed that the interview