

VERBAL PROTOCOL ANALYSIS OF ON-THE-JOB TASKS FOR AIR TRAFFIC CONTROLLERS: A COGNITIVE APPROACH FOR THE SYSTEMATIC DESIGN OF A TRAINING PROGRAM IN THE AVIATION INDUSTRY

Philip N. Anding and Peter Songan

Faculty of Cognitive Science and Human Development

Universiti Malaysia Sarawak

**Tel.: 082-671000 Fax: 082-672281 email: aphilip@mailhost.unimas.my,
songan@mailhost.unimas.my**

Abstract

A cognitive task analysis was conducted using verbal protocol analysis to try to understand how the approach air traffic controller carries out the task of providing safe, orderly and expeditious flow of air traffic. The verbal protocols represent the verbal communication and explanation given by the approach air traffic controllers as they carry out their tasks. The verbal protocols were analysed based on two protocol representations, knowledge states and the conceptual operators. This study, which was carried out at a relatively busy airport, identified nine conceptual operators and four knowledge states associated with the job of the approach air traffic controller. These knowledge states and conceptual operators were then used to develop the verbal protocol coding scheme and a simplified mental model for the approach air traffic control. This study demonstrated that verbal protocol analysis was an extremely useful method for identifying thinking processes and for studying superior performance. This cognitive approach systematically identifies the knowledge and skills that should be incorporated into the curriculum of a training program for air traffic controllers.

1. INTRODUCTION

Cognitive task analysis (CTA) involves the modelling of primary knowledge, skills, and mental models required to perform a specific task or job. Verbal protocol analysis is one of the general methods of CTA. The procedures used to study human information processes by protocol analysis typically involve asking the subject to think aloud while performing the task. Protocol analysis has become an increasingly important technique for studying human intelligence (Gordon, 1994). Its importance stems from the fact that it is one of the few methods in cognitive science that gathers data with sufficient temporal density to test models that account for behaviour nearly second by second (Simon & Kaplan, 1989).

Most applications of protocol analysis view problem solving as a search through a problem space accumulating knowledge about the problem situation, and applying operators to the knowledge to reach each new point in the space until a solution is reached (Redding et al., 1992; Redding, 1995). Verbal protocols generally provide explicit information about the knowledge and information heeded in solving a problem rather than about the processes used. Thus, it is usually necessary to infer the processes from the verbal reports of information heeded instead of attempting to code processes directly (Simon & Kaplan, 1989).

A study using verbal protocol analysis was conducted for air traffic control (ATC). The verbal protocols constituted the verbal communications and its related explanation given by the approach air controllers as they carried out their tasks. The verbal protocols were concurrent ones and as such tend to be the least intrusive and to provide the most accurate records of the nature and sequence of subjects' mental processes (Ericsson & Simon, 1993). In view of the