Distributed Team Mental Model Similarity in Maritime Simulation

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1. Introduction

Various actors in the maritime traffic system often interact with each other during navigation and manoeuvring of ships in areas such as ports and channels. Shipmasters, tugmasters, maritime pilots, as well as shore based Vessel Traffic Service (VTS) operators participate in what can be characterised as a socio-technical system, also consisting of various technologies and procedures. In order to explore and if possible measure the interactions within this team, we will use concepts from the Team Mental Model (TMM) and Joint Activity (JA) theoretical frameworks. Elements relevant to these theoretical frameworks have been identified in existing research on the maritime domain, for example by van Westrenen (1999), Lutzhoft and Bruno (2009), Brodje et al. (2012), Praetorius (2012), and Lappalainen et al. (2014).

A TMM may be described as team members’ shared, organised mental representation of elements within the teams’ environment (Klimoski and Mohammed 1994). They are often considered to consist of both task and team related content, such as goals, roles and responsibilities, as well as characteristics of other team members. They are also commonly considered to be operationalised in terms of similarity and accuracy, where similarity refers to the extent to which team members’ individual Mental Models (MMs) converge, and accuracy reflects the extent to which the model is correct. Studies from a variety of different settings support the assumption that a high similarity and accuracy TMM predicts team performance (see DeChurch and Mesmer-Magnus 2010a, Mohammed et al. 2010). However, as pointed out by Klimoski and Mohammed (1994) as well as Cooke (2003), amongst others, a high degree of similarity may be less relevant for teams where members have a distributed functional specialisation, yet interdependent roles.

According to Clark (1996), people participate in joint activities when they are dependent on the actions of others to achieve goals they have in common. To achieve their common goals they need to coordinate their actions with each other, and for this participants need mutual beliefs and expectations. Clark refers to these mutual beliefs and expectations as common ground. The notion of common ground is therefore a prerequisite for coordination, hence also for joint activity according to Clark.

The current research describes a pilot study aimed at assessing the TMM similarity of a distributed team within the maritime traffic system using concepts from the TMM and JA theoretical frameworks.

2. Method

One of the most significant challenges in the field of TMM research has been in relation to measurement (Mohammed et al. 2000, DeChurch and Mesmer-Magnus 2010b). Therefore the systematic testing of measurement techniques and tools in a controlled environment is valued. One tugmaster, three maritime pilots, and three VTS operators from an Australian port who attended a one day maritime simulation exercise agreed to participate in this pilot study. The exercise scenario was a ship arrival in the port where the participants normally worked. As this pilot study was not the primary reason for the participants to attend the exercise, data gathering had to be carried out as unobtrusively as possible. This meant that there were time constrains and limited access to respondents. As no external shipmasters attended the exercise, additional data collection was carried out with two randomly selected shipmasters with experience from Australian ports at a later date.

In most existing TMM research, similarity has been assessed by comparing team members’ individual MMs with each other. For the purpose of measuring TMM similarity in this study, a scoring scheme for self-reporting was developed. This scheme consisted of statements related to both task and team related content, based on the TMM (Klimoski and Mohammed 1994) and JA (Clark 1996) theoretical frameworks. Participants were asked to rate themselves and the other team members in regards to proficiency, adherence to procedures, communication, trustworthiness/reliability, skills, and how necessary they were for the operation, on a five level Likert scale. This scoring scheme was distributed to the participants before commencement of the simulator exercise.
3. **Results**

Preliminary results show that on average, the maritime pilots and VTS operators ranked the shipmaster lower than everyone else in relation to all statements, i.e. less proficient, adhered less to procedures, communicated less appropriately, were less trustworthy/reliable, less skilled, and less necessary for the operation. On the other hand, the shipmasters ranked the tugmaster and VTS operator lower, while the tugmaster indicated he did not generally interact with the shipmaster and could therefore not rate this category. On average, all participants ranked their own category higher than the others.

4. **Discussion and Conclusions**

Results indicate a difference in perceptions between categories of participants. Perceptions can be difficult to verbalise, they are not necessarily accurate, and they may appear biased. However, they still form part of individuals' MMs which are used to reason, make decisions, and can be the basis of behaviour.

A high degree of similarity in regards to all elements of a TMM is not always desired, as team members may have distributed functional specialisation, yet interdependent roles. This may be the case in the maritime team under study.

This research has raised a number of questions. For example, how accurate are the participants' perceptions? How can a baseline for accuracy measurement be established? And are the team members under study interdependent? These questions need to be explored further.

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**References**


