

CHALMERS

**Tacit Knowledge: Nature and Transfer
in Safety-Critical Systems**

Application on Maritime Pilot Training

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ABSTRACT

The accumulation of knowledge, intuitive understanding, expertise, and skills in managing both routine and non-routine situations occurs over extended periods. These insights, often unspoken, deeply personal, and based on experience, are difficult to formalize and communicate and commonly referred to as tacit knowledge. The departure of experienced individuals from an organization can result in significant declines in productivity, efficiency, and safety due to the loss of specialized knowledge and skills, including tacit knowledge. In safety-critical systems, the erosion of such knowledge can have severe consequences, particularly in the event of malfunctions or system failures. Thus, the transfer of tacit knowledge is crucial in educational settings, where novices develop their knowledge and skills to ensure compliance with industry standards for efficiency and safety.

This thesis aims to evaluate the nature and transfer of tacit knowledge in safety-critical systems, focusing specifically on maritime pilot training within the context of simulator-based training. Furthermore, it evaluates the use of eye-tracking as a didactical tool and for managing tacit knowledge in this training environment. In addition, the thesis explores the nature of tacit knowledge, develops a taxonomy related to associated concepts, defines tacit knowledge within a structured framework and compares to maritime pilot training, and proposes guidelines to enhance its transfer in such training.

An exploratory mixed-methods design was employed, incorporating a systematic literature review conducted in accordance with PRISMA guidelines, evaluating 22 studies on tacit knowledge transfer in safety-critical systems. Additionally, a study grounded in activity theory evaluated tacit knowledge transfer in maritime pilot training, involving 21 participants. A usability study further examined the use of eye-tracking as a didactic tool in simulator-based maritime pilot training, including tacit knowledge evaluations with 57 participants. Data were collected through interviews, observations, questionnaires, document analysis, and eye-tracking. The data analysis employed descriptive statistical methods, inductive thematic analysis, activity theory, and knowledge creation theory, utilizing the SECI model.

The findings revealed that tacit knowledge resides in various domains and proves challenging to define and operationalize. Consequently, tacit knowledge was re-conceptualized as a framework encompassing several interrelated components. When this framework was compared to pilot training, tacit knowledge was only partially observed in social learning environments, such as apprenticeships during actual pilotage, but was less evident in other areas of training, particularly in simulator sessions. In these contexts, concepts such as intuition, procedural knowledge, pattern recognition, and muscle memory were often used interchangeably but were later identified as related yet distinct. Recommendations for more effective tacit knowledge transfer include alumni functions, job rotation, mentorship, staff rotation, and the development of repositories to capture best practices and operational experiences. Additionally, guidelines for conducting efficient research into tacit knowledge transfer could serve as a foundation for an improved training syllabus.

In conclusion, this thesis presents a comprehensive and systematic mapping, deconstruction, and definition of tacit knowledge, accompanied by a foundational taxonomy on the subject. This work culminates in the development of a framework applicable to research on organizational learning. Furthermore, the thesis provides guidelines designed to enhance maritime pilot training, as articulated throughout the document.

Keywords: Tacit knowledge, systematic literature review, safety-critical systems, socio-technical systems, activity theory, SECI model, mixed-methods, maritime pilot training, simulators, eye-tracking,