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Team Situation Awareness in VTS

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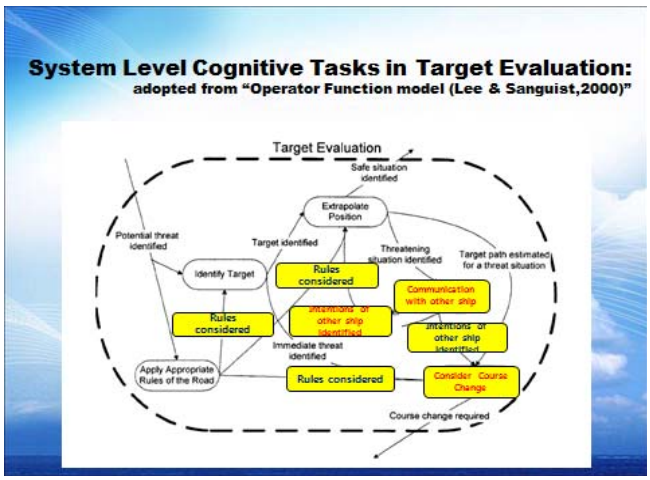
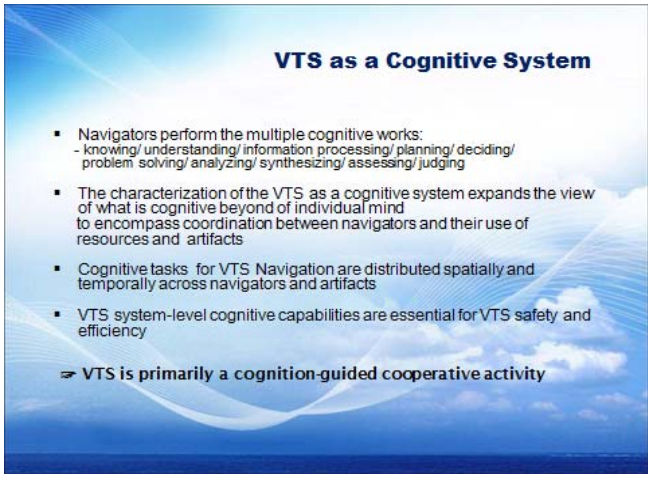
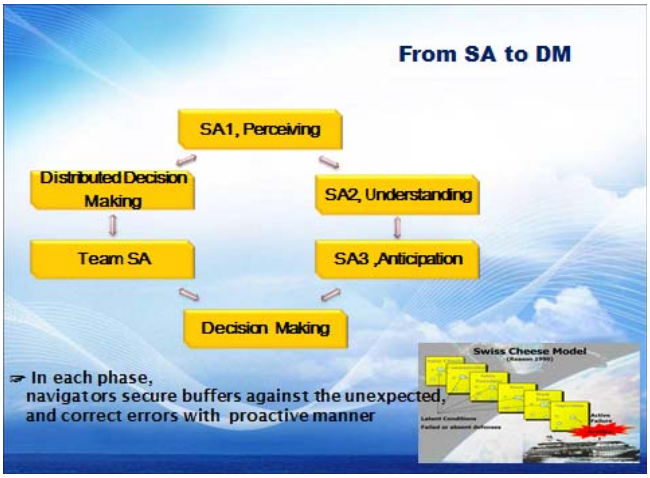
요 약 : VTS에서 항해하는 선박들은 자율적인 행위자들로서 서로 영향을 끼치며 상호작용하는 한편 서로의 안전에 대해서 상호의존하게 된다. 복잡한 항해상황에서의 불확실성으로 인한 위험을 극복하기 위한 방안으로 최근에 상황자각 이론이 각광을 받고 있다. 하지만 다수의 선박들에 의한 개별적인 상황판단이 제대로 이루어진다 하더라도 동일한 상황에 대한 해석이 서로 다른 경우 사고로 이어질 우려가 높다. 본질적으로 VTS 항해는 인지과업을 서로 도와가면서 항해하는 시스템이라고 할 수 있다. 본고에서는 팀 상황자각이 공통기반과 동일한 멘탈모델에 의해 성공적으로 이루어지는 과정을 논의하고, 상황자각 실패 사례를 통해 좀 더 구체적으로 살펴보았다. 또한 팀 상황자각과 관련하여 커뮤니케이션의 중요성을 강조하고 VTS 항해 상황에서 항해자들의 팀상황자각을 실질적으로 도울 수 있는 방법으로 '공동운용화면' 시스템을 제안하였다.

핵심용어 : VTS, co-Navigation, Cognitive Tasks, Situation Awareness, Team Situation Awareness, Distributed Decision Making, Common Operative Picture, co-episodic Simulation, Proactive Decision Making, VTS Resource Management







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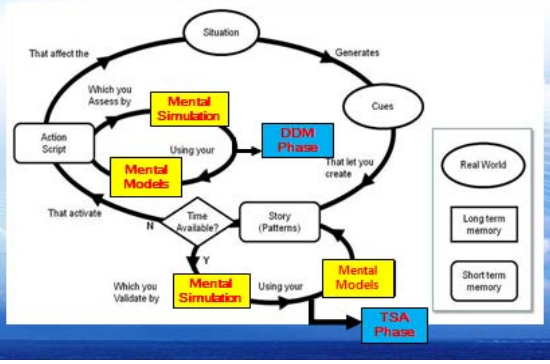
Recognition-primed DM Model (Klein,1997):

- Naturalistic DM is an attempt to understand how people make decisions in real-world contexts
- **Key Features of RPD Model :**
  - first option is usually workable (not random generation)
  - serial generation/ evaluation of options (not concurrent evaluation)
  - satisficing (not optimizing)
  - evaluating through mental simulation (not decision analysis)
  - focus on elaborating and improving options (not choosing between options)
  - focus on situation assessment (not decision events)
  - decision maker primed to act (not waiting for complete analysis)

Case of TSA Failure

TSA and DDM in Recognition-primed DM Model (Klein,1997)



Case of TSA Failure

13:27:20 조석 2: 701 신정호, 조석2호입니다. 우현 대 우현 투박합니다.

13:27:21 701 신정: 네, 우현 대 우현이요. 그런데 우리 앞에 배가 우리 오는데로 나오고 있거든요.

13:27:31 조석 2: 네, 아여튼 109번 (buoy) 바깥으로 도십시요.

13:27:39 701 신정: 109번 바깥으로요? 그,, 아직까지 안돌아오면 안되겠습니까?

13:27:42 조석 2: 아,, 우리가 딱 어떤간하게 걸리겠는데요?

13:27:46 관제사: 제 이야기 들으세요. 제가 정리합니다. 조석2호, 오든족으로 더 돌려서 완전히 우 배가 좌현 대 좌현하세요.

13:27:54 조석 2: 좌현 대 좌현, 네 알겠습니다. 좌현 대 좌현 하겠습니다.

13:28:00 관제사: 조도농협, 합주신합.

13:28:03 조도농협: 네, 조도농협.

13:28:04 관제사: 속도 낮추셔가지고 701신정호 따라 나가세요.

13:28:08 조도농협: 알 알겠습니다.

13:28:10 관제사: 속도 낮추세요. 지금 속도 안낮추면 제적지금 그 죽에서 위험하게 됩니다. 조도농협 지금 빨리 속도 낮추세요.

13:28:21 관제사: 조도농협, 그리고 조석2호하고 좌현 대 좌현이에요.

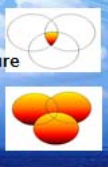
13:28:27 조도농협: 알 알겠습니다.

Cognitive Cooperation: Team SA

- **Cooperative works in cognitive navigational tasks:**
  - collaborative monitoring/ information sharing and crosschecking/ joint attention/ transactive memory/ understanding of other's intention/ forming shared goals/ cooperative communication/ distributive DM
- Various members have their own understanding of situation based on their own information available
- TSA is more than the sum of individual SA; Interaction-related SA
  - Agreed interpretation of situation and co-simulation for future action
- TSA is core factors for cooperative works in VTS Navigation
- TSA consists of shared SA and distributed SA

☛ most of accidents in VTS are attributed to TSA failure

☛ extending BRM into VTS Resource Management (VRM) is highly demanded



Case of TSA Failure

TSA and co-episodic Simulation

☛ **VTS emerges from cognitively cooperative interactions of autonomous navigators, not by regulative authorities**

- Our capacity to empathize with others is mediated by embodied simulation mechanism;
  - humans are capable of understanding inanimate objects by placing ourselves into them(e.g. moving light-dot displays of people's behaviors)
- Simulating possible future events based on common ground and common mental model is essential to co-Navigation system
  - shifting the perspective form the immediate situation to goal-directed future situation
  - simulating other navigators' perspectives are required
  - common ground is the sum of mutual knowledge, mutual beliefs, and mutual suppositions
  - intentional attunement is required for 'we-ness'

☛ **The value of VTS is created by the cooperative participation of navigators.**

Core Tools for co-Navigation: the Concept of COP

- Collaboration among navigators is possible when navigators have common ground for the situation
- For this, jointly viewing the same concerned events in real time is essential
- Common Operative Picture (COP) can provide a "what-you-see-is-what-I-see" capability (Smallman et al., 2005)
- A client-server architecture can provide the same VTS display to navigators across the VTS area
- Using tele-pointers with COP makes easy to negotiate maneuvering DM
- Social visualization function of COP makes navigate feel connected; thus navigators being held accountable for their action

☛ **The basic role of COP is to make interaction visible**

VHF communication in co-Navigation Era

☛ **Degradation of TSA is generally attributed to lack of communication**

- Makes navigators' actions visible
- Make maneuvering intention of navigators publically manifest; therefore their intentions readable to all navigators
- Induce trust among navigators and help achieve cooperation among navigators through voice communication
- Combined with COP, it facilitates negotiation about navigational distributed decision making;
  - overheard information can be easily personalized and contextualized, leading to TSA

☛ **VHF is the most important navigational instrument to construct TSA**

The Conceptual Diagram of COP

Charts in co-Navigation Era

- Function as tools for thought in the domain of spatial cognition
- Augment navigators' cognitive competence through presenting dynamic spatial relationships of ship movements
- Function as tools for cooperative works through enhancing communication capabilities
- Give rise to allocentric perspective by providing big pictures of situation:
  - bird's eye view and third person point of view
- Function as a predictive display for aiding SA3 and TSA
- Function as a platform for action-simulation

Functions of COP

- Cognition-enhancing: for SA-TSA
- Co-simulation- enabling: for TSA &DDM
- Communication-encouraging: for trust building
- Coordination-facilitation: for DDM
- Action-prompting: for proactive attitude
- Norm-enforcing: for safety culture
- Cooperation-fostering: for safety and psychological satisfaction

☛ **Sharing of the same VTS display enables navigators to cooperate cognitively and socially.**