On Common Ground at Sea: The Proactive Negotiation for Channel Navigation

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ABSTRACT

The Vessel Traffic Service (VTS) provides support to marine traffic in congested waters to ensure safe and smooth vessel movement in the waters under its purview. The VTS operators monitor the traffic with the decision support system at hand and talk to the ships on the Very High Frequency (VHF) radio. Safe channel navigation is proactively achieved by interaction and communication on the radio. Thus traffic management within the VTS domain is a complex joint activity, in which diverse stakeholders (bridge teams, VTS operators, pilots etc.) adopt one or more available communicative roles within technologically-mediated interactions to achieve safe and fluent traffic movement. This paper argues that the communicative achievement of channel navigation is a complex joint activity requiring the building up and active sustenance of common ground to promote teamwork and contribute to safe and efficient vessel movements. Monitoring common ground is integral to monitoring oceangoing traffic. This paper draws upon data from the audio recordings of the working channel of the VTS in a major South Asian world port. The authors argue that the proactive, real-time dynamic management of common ground contributes to enhanced situational awareness and sustains safe channel navigation.

Keywords: VTS, Ship-Shore communication, Joint activity, Common ground, VHF radio

INTRODUCTION

Shipping is one of the oldest domains in transportation. From regional trade more than 5000 years ago, shipping has developed into one of the largest means of global transportation (Stopford, 2009) with a demand for efficient and safe operations. As in other domains, demands are normally responded to through changes both in technology and organisation. Examples for such change within the maritime domain include, but are not limited to, the increase of the volume and size of vessels through the past decade (UNCTAD, 2013), the introduction of several decision support tools, such as the AIS, electronic chart displays, into one standardised system (Lützhöft, Grech, & Porathe, 2011), or the introduction of safety management systems (Manuel, 2011; Trafford, 2009). However, these improvements, although often introduced to increase the safety within the maritime transport system, have generally been used to increase the overall productivity, counteracting their initial safety effect and as a consequence inducing incidents and accidents (Perrow, 1999). One of the most recent examples of safety measures within the maritime domain has been the definition and introduction of so-called Vessel Traffic Service (VTS), a service implemented to promote safe, efficient and environmental-friendly marine traffic (IMO, 1997).

VTS is a shore-side service within a country's territorial waters. VTS Operators (VTSOs) monitor the traffic, assist in navigational matters, and provide information to all vessels in a designated area, normally port areas or areas that are difficult to navigate. VTS can be delivered on three different service levels: Information Service (INS), Traffic Organisation (TOS), and Navigational Assistance Service (NAS). The service level of a VTS depends upon national regulations. Although NAS is an intervention with the decision making on board, it only has an information providing function, meaning that the actual decision power remains on the bridge and therefore with the Master of the vessel. The core goal of a VTS is to assist the traffic to a safe and expedient passage by providing information. Only when safety is at risk or on request, ships are offered instructions. As the international framework identifies VTS as an assistance service, the VTS operators do not take any part in traffic management tasks such as voyage optimisation, route planning, or the planning of traffic density in the area. That sets constraints on the possibilities of the VTS to actively work for safe and efficient traffic movements. While VTS has often been studied with either focus on technology (i.e. Chang, 2004; Kao, Lee, Chang, & Ko, 2007; Vespe, Sciotti, Burro, Battistello, & Sorge, 2008), information needs (i.e. Brödje, Lützhöft, & Dahlman, 2010; Praetorius & Lützhöft, 2012) or interface design (Van Dam, Mulder, & Van Paassen, 2006), there is only a limited amount of research focusing on the VTS as sociotechnical system, and the challenges that VTS operators face within the settings of their daily work. As Nuutinen, Savioja and Sonninen (2006) note, the VTS system is currently undergoing change; and development both within the VTS system, (e.g. such as chain planning) and the maritime domain as such, will pose new requirements on the VTS as a proactive measure within maritime traffic management.

As outlined above, research within the VTS domain has, to the best of our knowledge, been rather sparse with only little focus on how the VTS actually works to facilitate and coordinate vessel movements within the area of responsibility. This article will therefore use the concepts of joint activity, common ground and coordination to explore how verbal interaction on the Very High Frequency (VHF) amongst the VTS and other actors like merchant vessels and pilots is used to facilitate stakeholder negotiations for safe channel navigation. The analysis will give a unique insight into how the VTS operators work to coordinate vessel traffic through the maintenance and repair of common ground amongst stakeholders, and how that in turn promotes a safe and efficient traffic flow. Engineering involves understanding the need for comprehensive integration of human capabilities (cognitive, physical, sensory, and team dynamics) into a system design, beginning with conceptualization and continuing through system disposal. The primary concern for human factors engineering is the need to effectively integrate human capabilities with system interfaces to achieve optimal total system performance. The goal of human systems Integration (HSI) is to optimize total system performance, accommodating the characteristics of the user population that will operate, maintain, and support the system, and minimize life-cycle costs (Folds et al., 2008).

The attention to human systems integration in system development programs drove hundreds of human-centered design improvements. Efforts were concentrated to maximize total system performance through improvements in human workload, ease of maintenance, and personnel safety which resulted in a cost avoidance of billions of dollars and prevention of hundreds of fatalities and disabling injuries for the system (Booher and Minninger, 2003).

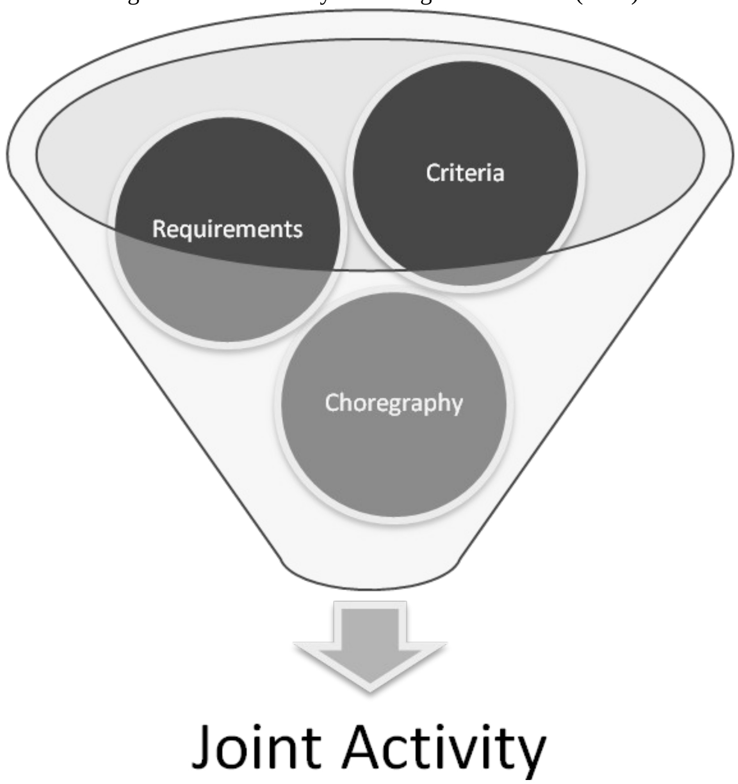
THEORETICAL FRAME OF REFERENCE

Communication is one of the foremost means to coordinate activity in large socio-technical systems (Flin, O'Connor, & Crichton, 2008; Johansson & Persson, 2009). Sociotechnical system in this article refers to the unique mix of functional units distributed over human operators, technology and organisational structure, which can be found in today's complex environments such as aviation (Hollnagel, 2007; Salas, Wilson, Burke, & Wightman, 2006), healthcare (Carayon, 2006) and the maritime domains (Grech, Horberry, & Koester, 2008; Hetherington, Flin, & Mearns, 2006). What these environments have in common is that tasks are normally distributed among individuals that need to coordinate their work in teams with the help of technology embedded in an organisational structure. Therefore, communication, especially in the age of information technology, has a central role for the coordination of work (Johansson & Persson, 2009). To understand the way people communicate with each other can therefore provide insights in how current developments, e.g. such as the e-Navigation strategy within the maritime domain, might affect the possibilities to coordinate actions both within and among teams.

One way of exploring communication is with the help of the concept of joint activity (Clark, 1996). A joint activity is defined as an *activity carried out by an ensemble of people acting in coordination with each other* (Clark, 1996, p.3). The joint activity arises when the participants within a conversation try to perform individual actions in coordination that help to achieve a common goal. The emphasis is on how the individuals actively work to communicate with each other, and how they coordinate their own actions, e.g. turn taking, so that a conversation flows smoothly without any breaks. This approach shows that communication is a lot about coordinating with others, which is also why it has been adopted and used within other domains, such as in aviation, to understand how teams actively coordinate their efforts to achieve a common goal (Klein, Feltovich, Bradshaw, & Woods, 2005).

As depicted in figure 1 below, there are three basic components that facilitate the realisation of a joint activity; requirements, criteria and choreography (Klein, et al., 2005). Each of these three components is essential to successfully coordinate a joint activity within an ensemble of participants.

Figure 1: Joint Activity according to Klein et al. (2005)



Criteria: Intention and interdependence

According to (Klein, et al., 2005), a joint activity has two primary criteria to be carried out successfully; one is the intention and commitment to take part within the joint activity, while the other is the interdependence of actions of the participants within the activity. Joint activities are normally carried out as the action of one actor affects the outcome and the availability of possible actions for the other actors to choose from. Participants in the joint activity are interdependent and therefore coordinating each other's actions is profitable for both of the actors in the effort to achieve individual goals. Intention and commitment for a joint activity therefore means that all participants agree, normally tacitly, to align their individual goals to support the coordination within the joint activity.

Within the settings of the VTS, intention and interdependence manifest itself in vessel encounters in confined water, such as channels. When two or more vessels meet, they need to coordinate their actions on how to pass, overtake or avoid collision, when they would meet each other in the channel. Individual goals (for e.g. arriving ahead at the pilot station) need to be aligned with the overall goal (for e.g. navigating safely in the channel) of the activity.

Requirements: Interpredictability and common ground

Interpredictability characterizes the ability to foresee how other parties within the joint activity will (re)act. As joint activities require the commitment to align individual goals with common ones, it is important that each actor can predict the other parties' behavior to be able to adapt to the ongoing process. It is about making own actions salient so the ensemble involved in the activity can successfully coordinate their actions, even being able to direct and adapt own actions towards the joint effort (Klein, et al., 2005).

Common ground is the basis for interpredictability and interdependence of actions within joint activity. It is defined as the sum of mutual knowledge, beliefs and assumptions (Clark, 1996, p.93) that participants have when entering an activity and which is constantly updated and adjusted as the activity is evolving. Common ground also incorporates social norms and conventions, which, especially in the maritime settings, support each party during the process of interpreting, adapting to and predicting the other parties' behavior. It facilitates the coordination of action and eases the communicative needs, so that participants can e.g. use abbreviations and industry specific technical jargon and still ensure that their intentions to act in a specific way are understood.

Choreography: Joint actions, signaling, coordination and costs

Any joint activity consists of at least two or more joint actions (Clark, 1996), in which the participants of the activity engage with and carry out, e.g. posing a question or answering one. These actions, within the larger frame of the joint activity need to be coordinated, so that the communicative flow is uninterrupted. This coordination is called choreography, as it requires every participant to clearly signal the intention of the action that the participant is executing. Only when actions are properly coordinated, the joint activity can be successfully achieved. However, coordinating often means not only to clearly signal one's intention, but also to postpone personal goals to be able to achieve the joint ones. This means that the choreography and the joint actions come with a cost, the prioritising of common goals over individual ones.

Requirements

To define the requirements of humans as a fundamental system component, it is essential to understand the inherent capacity of user populations and their typical operational environment (Booher, 2003). A description of a population's capacity incorporates more than the basic anthropometrics or the cognitive capability of the average member of the user population (Chapanis, 1996).

METHODOLOGY

To explore the joint achievement of channel navigation an ethnomethodologically informed ethnography (Atkinson, 1988; Garfinkel, 2002) was undertaken in the VTS office of a major South Asian world port. The study analysed naturally occurring data (Silverman, 2001) supported by interviews and field notes of observations. The VHF interaction on the main working channel was recorded and transcribed verbatim and complemented by semi structured and casual unstructured qualitative research interviews, further supported by field notes of ethnographic observations in the VTS office. The transcripts were imported as a single file into the CAQDAS (Computer Aided Qualitative Data Analysis) package ATLAS.ti and coded to explore the themes and the patterns in the data.

ANALYSIS AND RESULTS

The study reveals that proactive communication and negotiation on the VHF radio is an integral feature of the joint activity of channel navigation. With the help of empirical examples the authors illustrate the display of intention, interdependence, inter predictability and the mutually oriented choreography of joint actions in the joint activity.

In example 1 below, merchant vessel, *Five Bay*, is inbound and nervous. It exhorts the VTS to tell the vessel how to pass. The VTS operator first clarifies and confirms the intention of the dredger in the passing situation and thereafter assurers *Five Bay*, attesting to the VTS' key role in the maintenance of common ground between the participants

Example 1
VTS as coordinator between vessels – Maintaining common ground

1. **Five Bay –** tell me where we're going to pass because it is going for collision; tell me where we have to pass?
2. **VTS –** one two three, VTS
3. **VTS –** *NAM one two three*, VTS
4. **NAM 123** – yes VTS, this is *one two three*, I am altering my course to starboard *Five Bay* will be very clear off me
5. **VTS** – okay, you please alter to starboard and pass red to red.
6. **NAM 123** – Yeah okay, okay
7. **Five Bay** – VTS tell me where I have to pass this vessel, is this vessel must remain on my port side or what to do?
8. **VTS** – *Five Bay*, you please pass red to red, this dredger is altering to starboard now
9. **Five Bay** – okay understood, understood
10. **NAM 123 –** *Five Bay*, this is *NAM one two three*, you follow your channel. I am altering my course to starboard. I am following my channel you will be very clear off me, don't worry

Example 2
VTS as traffic organiser – initiating common ground between vessels

1. **VTS** – *Lanner*, VTS
2. **L** – yes *Lanner* replying, over
3. **VTS** – okay, you please pass red to red, port to port with the inbound vessel *Trinity*
4. **GL** – Roger copy, inbound vessel, port to port
5. **VTS** – *Trinity*, *Trinity*, VTS
6. **Trinity** – VTS this is *Trinity*, go-ahead Sir, over
7. **VTS** – Pass port to port red to red with the outbound tanker *Lanner*
8. **Trinity** – Okay Sir, copy port to port sir, over

The VTS operators monitor traffic in the channel and talk to vessels when deemed necessary. In the example below the VTS operator overhears two vessels negotiate a passing situation and the VTSO intervenes in the interest of safety and asks the vessel to change its intention in the passing situation as according to the VTSO there wasn't enough time and space to perform the originally agreed maneuver.

Example 3
VTS Intervention in passing situation – repairing common ground

1. **Sevak** – *NAM one two three*, *Sevak*
2. **NAM 123** – *Sevak*, *NAM one two three*
3. **Sevak** – Yeah *one two three*, we'll be passing red to red.
4. **NAM 123** – Okay passing red to red.
5. **VTS** – Yeah but *Sevak*, VTS come in.
6. **Sevak** – VTS, *Sevak*
7. **VTS** – do you have that much time and space to go red to red?

8. **Sevak –** Roger Roger.
9. **VTS** – Anyway otherwise, keep clear of, why don't you keep green to green till you clear *NAM one two three* go to port, tell him, over.
10. **Sevak –** *Yeah okay one two three*, *Sevak*
11. **NAM 123 –** Yeah *Sevak* copied, starboard to starboard, green to green.
12. **Sevak –** Roger green to green

A key interactional practice noticed on the VHF radio is that an entity first contacts the VTS to get information about another target and thereafter contacts the same target in question to negotiate a maneuver. This proactive practice attests to the VTSs key role in the joint activity as the possessor of the latest information pertaining to the traffic situation in the channel by virtue of the decision support system at hand. Therefore, in order to enhance their situational awareness, participants tend to talk to the VTS before talking to each other. This is especially true for harbour pilots, who, like to know which colleague is piloting which ship.

Example 4

Interactional practice – get information from VTS and then contact entity

1. **P 80** – VTS, VTS, Pilot eighty
2. **Unknown vessel** – *NAM two one six*
3. **VTS** – Pilot eighty, VTS go-ahead
4. **P 80** – Haan *Global Atlas* mein pilot kaunsa hai? (translation - yes, who is the pilot on *Global Atlas*?)
5. **VTS –** *Global Atlas*, pilot thirty seven
6. **P 80 –** thirty seven sahib, Pilot eighty
7. **P 37 –** eighty go ahead please.
8. **P 80** – Good morning Sir I'm on *Shiksha* just on your starboard quarter, sir just maintain your, my course and speed and overtake you from starboard side
9. **P 37 –** please go-ahead, you can. Starboard side will be clear, because I am passing this *Lucy*, I will be coming more to port, she is lining, I will be lining her up for docking into one dock so starboard side overtaking no problem.
10. **SP 80** – Okay Sir, thank you Sir.

In examples five and six below, the VTS operator initiates common ground between inbound merchant vessel *Hong Kong* and outbound vessel *LS Supplier*. The VTS operator proactively initiates the common ground to reduce uncertainty and increase trust and safety in the joint activity.

Example 5

VTS as traffic organiser – initiating common ground between vessels

1. **VTS** – *LS Supplier*, VTS
2. **LS Supplier** – VTS, *LS Supplier*
3. **VTS** – How you we'll be passing with the inbound vessel *Hong Kong*?
4. **LS Supplier** – Port to port
5. **VTS** – You confirm from the vessel, inbound vessel
6. **LS Supplier** – Okay Sir, will. *Hong Kong*, *Hong Kong*, *LS Supplier*
7. **Hong Kong** – Yes this is *Hong Kong*, confirm we'll be passing port to port over
8. **LS Supplier** – Roger Sir, port to port
9. **Hong Kong** – Okay thank you port to port

Example 6

VTS as traffic organiser – initiating common ground between vessels

1. **Hong Kong –** Outbound vessel *Kajal*, *Kajal XX*, this is inbound vessel, *Hong Kong*, ahead of you, calling, over
2. **VTS** – *Kajal twenty*, *Kajal twenty*, VTS
3. **Kajal 20 –** VTS, *Kajal twenty*

4. **VTS** – The inbound vessel is calling you, please reply
5. **Kajal 20** – Okay Sir
6. **Hong Kong –** Outbound vessel *Kajal*, *Kajal XX*, this is, *Hong Kong* calling, over
7. **Kajal 20** – Okay sir, *Hong Kong*, this is *Kajal twenty*
8. **Hong Kong** – Okay, good, good afternoon Capt port bow, I will pick up pilot and the, so we will pass port to port, to red to red, over
9. **Kajal 20** – Okay sir, confirm with you port to port
10. **Hong Kong** – Yes that's correct, thank you
11. **Kajal 20** – Welcome

As emphasised earlier, participation within a joint activity, comes at the expense of a cost of coordination, i.e. adjourning individual goals for the joint ones. In example 7, for instance, the pilot on-board the dredger NAM 123 postpones his personal goal of reaching the dredging area quickly for the goal of the joint activity of safe channel navigation by slowly following another inbound vessel.

Example 7
Postponing own goal for goal of joint activity

1. **P 30 –** Pilot fifteen, pilot thirty
2. **P 15** – Bolo (translation – speak)
3. **P 30** – Kya speed hai abhi (translation – What's the speed now?)
4. (interruption) (line omitted)
5. **P 30** – Okay because I have to go to number two dock channel for dredging also
6. **P 15** – Your dredger comes later on, first this has to be done, then dredger to follow
7. **P 30** – Yeah I am slowing down. I will follow you only
8. **P 15 –** That is correct

In example eight two ships *Global Atlas* and *Bernice* have been communicating. *Global Atlas* has a pilot at 11 am and *Bernice* has a pilot at 10:30. *Global Atlas* agrees to slow down so that *Bernice* can overtake and go ahead for the pilot. This example highlights the coordination and the choreography involved in the joint activity of channel navigation.

Example 8
Coordinating and choreographing joint actions

1. **GA** – yes what time you will arrive at, to the pilot station? Over.
2. **B –** I'm scheduled for pilot station ten thirty
3. **GA** – ten thirty so okay I have reduced my speed, so you can cross ahead of me, over.
4. **B** – Okay, copy thank you, will reduce your speed and I will go ahead of you, that's correct.

DISCUSSION OF RESULTS

The participants in channel navigation coordinate and choreograph their actions by displaying intention and agreeing upon a mutually acceptable course of action within the framework of the joint activity. The results reveal that personal goals are sacrificed or postponed in the larger interest of the navigation in congested waters. The VTS by virtue of its role, supported by the decision support system works to initiate, repair and maintain common ground between the participants. The interactional practice of getting information from the VTS and thereafter contacting the self same entity serves to initiate common ground between the participants. The results reveal that participants pursue common ground and coordinate their mutual interests to successfully achieve safe channel navigation. The results reveal that proactively pursuing common ground is carried out to increase inter predictability between interdependent participants engaged in the critical task of navigating in restricted waters. The emic rationality (Pike, 1967) of the participants is visible in the mutual intelligibility of the VHF communication and the use of naturally occurring data in this study serves to lend credibility and validity to the conclusions drawn (Hammersley & Atkinson, 2007).

CONCLUSIONS

The proactive negotiation for channel navigation is integral to the successful achievement of the joint activity. This study has shown with the help of empirical examples the joint activity of channel navigation between the three main participating groups – the VTS, pilots and seafarers who engage in proactive talk to negotiate passing situations, overtaking situations and collision avoidance situations in the channel. The role of the VTS is that of a facilitator encouraging and supporting open communication to reduce misunderstanding in the channel. Common ground is built, re-built, repaired and maintained and is an ongoing activity.

Despite the findings of the MARCOM (1997) project that VHF communication should not be undertaken for collision avoidance and the COLREGs which does not advocate its use, this study is in line with the findings of Bailey and Froholdt (2011b, 2011c). This study finds that proactive communication and negotiation is integral to the fabric of the joint activity of channel navigation in the port. The joint activity is successfully achieved through displaying intention, coordinating and choreographing actions and reactions in line with the common goal. Communication reduces uncertainty, increases trust and predictability between the participants who are interdependent in the joint activity.

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