# Balancing on the Boundary: Vessel Traffic Services in the Maritime Traffic System

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Shore-based systems monitoring and interacting with maritime traffic have been established around the coast lines of the world since the mid-20th century. To provide harmonisation of these systems the International Maritime Organization and the International Association of Marine Aids to Navigation and Lighthouse Authorities have issued recommendations and guidelines for the establishment and operation of what is now called Vessel Traffic Services. Despite these efforts, studies have highlighted issues with the ability to form expectations about Vessel Traffic Services. In order to research what lies beneath the surface of these issues and how they can be overcome, three group interviews with a total of 24 Australian Vessel Traffic Services operators were conducted, using the concept of common ground as a framework guiding the study. Results suggest that existing bases for common ground, such as international recommendations and guidelines and local rules and procedures, are not always relied upon. Instead expectations are based on participants' nationality, language, professional background, and direct personal experiences. Results also indicate that Vessel Traffic Services often focus on activities related to port operations rather than vessel traffic, and that interpretations of the current traffic situation are not always based on the same information across participants in the Maritime Traffic System. To overcome these issues it is suggested that the establishment of reliable shared bases among participants in the Maritime Traffic System should be facilitated.

**Keywords**: Vessel Traffic Services (VTS), Maritime Traffic System, Joint Activity, Common Ground, Coordination

## 1. Introduction

Following technological advancements such as Very High Frequency (VHF) radio and Radio Detection and Ranging (RADAR), the first shore-based systems monitoring and interacting with maritime traffic were established in the mid-20th century. This development was however debated within the maritime community as until then maritime traffic had largely been managed without involvement from ashore. Nevertheless, these systems were soon being established around the coast lines of the world, and it became apparent that some form of international harmonisation was required (IALA, 2012). Accordingly, in 1968, the International Maritime Organization (IMO) (at that time called the International Maritime Consultative Organization, IMCO) adopted its first recommendation on Port Advisory Services (IMCO, 1968). In 1985 this recommendation was followed by a set of guidelines on what was now called Vessel Traffic Services (VTS) (IMO, 1985). The current guidelines on VTS, issued in 1997 (IMO, 1997), recognise the importance of close cooperation between VTS and the participating vessels, and that safety and efficiency could be improved if VTS are established and operated accordingly. The guidelines however only describe the principles and general operational provisions for VTS. A more comprehensive and detailed framework is therefore provided by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) – a consultative organisation to IMO. IALA have developed a range of recommendations and guidelines on VTS, concerning for example performance standards for VTS

equipment, operational procedures, and training and certification of VTS personnel. The implementation of VTS in accordance with IALA standards is however the responsibility of a national Competent Authority. In Australia this is the Australian Maritime Safety Authority (AMSA) (2013).

Despite the efforts to harmonise VTS, studies have highlighted issues associated with the ability for participants in the Maritime traffic System (MTS), such as seafarers, maritime pilots, and tug masters, to form expectations about and predict the actions of VTS. Praetorius and Lützhöft, for example, state that "the most pressing issue identified is the structural incoherence of the VTS as a service regulated internationally, but implemented nationally. Without a common education and language proficiency, and without a general service level, it is hard to promote safety as those who use VTS, do not know what type of service can be expected" (2012, p. 4871). Similarly, Bruno and Lutzhoft (2009) discuss how uncertainty about the role, competence, and language use of VTS operators can lead to a lack of trust among the users of the service and make coordination difficult. In order to increase predictability, and hence the ability to coordinate, Bruno and Lutzhoft suggest further research on how common ground between ship and shore can be created and supported. The aim of this study is therefore to research what lies beneath the surface of the issues that have been highlighted, and how they can be overcome. The concept of common ground is used to guide the study, which ultimately forms part of a larger research project on the MTS.

## 2. Conceptual Framework

Clark (1996) describes how people who have a common goal, and whose actions depends on the actions of each other, have to coordinate in order to reach that goal. What emerges when people act in coordination, Clark calls a joint action or a joint activity. A prerequisite for coordination, and thus for joint actions and joint activities, is common ground between the participants.

### 2.1 Common Ground

Common ground between people is "the sum of their mutual, common, or joint knowledge, beliefs, and suppositions" (p. 93). It is accumulated along a joint activity and divides into three parts:

1. *Initial common ground* - what the participants presupposed when they entered the joint activity.

2. *Current state of the activity* - what the participants presuppose to be the state at the moment.

3. *Public events so far* - the events the participants presuppose have occurred so far.

The initial common ground concerns for example rules and procedures of the activity, and the role, strengths, weaknesses, and practices of participants. It represents the initial state of the activity, but as the activity progresses, this state changes and participants need to interpret elements of the scene as they are at the moment. For this, an external representation of the activity is, according to Clark, particularly useful - if not essential. An external representation could for example be a physical model with manipulable markers denoting elements of the activity, which are simultaneously accessible to all participants and therefore can be assumed to be part of their common ground. Clark argues that a highly reliable representation of the current state of the activity can prevent disputes, it is an effective memory aid, a medium for recalling past actions and anticipating future ones. In addition to the initial common ground and the current state of the activity, participants also need to keep track of the openly recognised events since the beginning of the activity. These events are usually represented in some form of record which participants can take as part of their common ground.

## 2.2    Representation of Common Ground

The basic representation of common ground, Clark suggests, is a shared basis. As people cannot *know* what is common ground they have to act on what they *believe* is common ground, and a shared basis is something which justifies that belief. According to Clark, a shared basis must 1) hold information which every member of a community has, 2) indicate to all members of that community that every member has that information, and 3) indicate to members of the community what is common ground.

For example, it is the convention at sea that two vessels in a head-on situation both alter their course to starboard and pass each other 'port to port' (both vessels with their left side to the other vessel). This regularity in behaviour is formalised in the International Regulations for Preventing Collisions at Sea (COLREGs) (IMO, 1974). In order to become a navigating officer it is generally a requirement to have thorough knowledge about the COLREGs. Being an officer hence indicates to other officers that they have this knowledge, and that this knowledge is common ground. The navigating officers on both vessels may assume it is common ground between them that they will pass each other 'port to port', unless they explicitly agree on something else, and they choose their individual actions accordingly.

## 2.3    Similarities with other Relevant Concepts

Clark's concept of common ground has similarities with other concepts relevant to teamwork and coordination. Situation Awareness for example concerns the perception, comprehension, and projection of elements in a relevant environment, or "knowing what is going on" (Endsley, 1995, p. 36). On a team level, it is according to Endsley the overlap between team members' individual Situation Awareness requirements that constitutes much of team coordination. This is not dissimilar to Clark's view of coordination and common ground. The Team Mental Model (TMM) is another concept bearing resemblances with common ground. TMM concerns the overlap of mental representations of elements in a relevant environment across team members, or to be "on the same page" with each other (Mohammed, Ferzandi, & Hamilton, 2010, p. 877). The shared basis representation of common ground – an external key to the knowledge, beliefs, and suppositions which are internal to people – is however an interesting point of difference. This representation has certain similarities with the concept of trust. For example, Baier (1986) describes trust as the grounds for expectations of certain behaviour, and Jarvenpaa, Knoll and Leidner (1998, p. 31) describe trust as "an expectation that others will behave as expected". With these interpretations, mutual trust can form a shared basis for believing that others will perform expected actions and hence enable coordination.

## 3.  Methods and Procedures

To learn about VTS in the MTS, with a focus on common ground, three group interviews with a total of 24 Australian VTS operators were conducted. Interviews give an insight into peoples' experiences, views, opinions, and how they understand for example their work situation. When conducted in group form rather than in individual form, the interaction among subjects can allow for a variety of spontaneous, personal, and potentially conflicting perspectives on a topic to be captured (Kvale, 1996). Group interviews can also help in identifying shared and common knowledge, and facilitate the discussion of sensitive topics (Kitzinger, 1995). For these reasons group interviews were selected as the method of data collection in this study.

## 3.1    Data Collection

Six subjects from the same VTS centre participated in the first group interview. All had worked several years in VTS and all except one was trained and certified in accordance with IALA

recommendations and guidelines. One subject had previous experience from seafaring on cargo ships, while another had experience from seafaring on navy vessels. The remaining four subjects had no seafaring training or experience. At the time of the interview this VTS was not yet authorised by AMSA (2015). This first group interview was conducted as part of a research project exploring possible developments of shore based services to ships, and the subjects were asked by the moderator to describe what they think is required for successful ship assistance. No other questions were asked and subjects had to interpret the question in their own way. Concepts which were emphasized by the subjects and frequently brought up during the discussion were written on a white board by the moderator. When everyone had been given the opportunity to share their view, subjects were asked to rank the concepts that had been written on the white board in order of importance. The moderator wrote down each subject's ranking on the white board. The white board was photographed after the concepts had been written down and prioritisations made. Field notes were also taken during the session by two assistant researchers.

In the second group interview, six subjects from six different VTS centres participated. All had worked in VTS for several years and all except one were trained and certified in accordance with IALA. Two of the subjects had a seafaring background from cargo ships and one from navy vessels. In the third group interview, 12 subjects from 10 different VTS centres participated. Their experience in their current role ranged from a couple of months to several years, none were however trained and certified in accordance with IALA. All centres represented in these group interviews publically promulgated they were operating a VTS, though at the time of the interview only one was authorised by AMSA (2015). In these two group interviews, each subject was first asked to describe their everyday work in their respective VTS centre. This discussion highlighted similarities and differences in the operation of centres, and there was much interaction among subjects who asked each other about their different practices and procedures. In both cases this discussion lasted for almost an hour, which was more than initially anticipated. Given that there was flexibility in the time available for these two sessions, the fact the subjects were all engaged in the discussion and positive towards continuing, and as new and useful data kept emerging, the discussion was allowed to continue. After a short break, the group interviews resumed. The sessions were now more strictly moderated and the discussions were steered towards concepts from the conceptual framework. Subjects were for example asked to describe their own role, with whom they interact, and what information they use during work. Subjects were also asked about what they based their comments and views upon. As several of these concepts had already been brought up spontaneously during the first hour of the two group interviews, some of the previously mentioned experiences were used as starting points for further probing. Concepts that were emphasized and used frequently by the subjects in this discussion were written on a white board which was photographed after the session. In both instances, this second part of the group interviews lasted for approximately one additional hour. During the whole session, field notes were taken by the moderator.

### 3.2    Data Analysis

Analysis commenced during the group interviews as the discussions were condensed into concepts which were written on a white board. In this process the moderators' interpretation of what was said by the subjects was also tested as they had the opportunity to comment on what was written. After the data collections, the photographs with concepts on the white boards, and the field notes, were categorised according to the conceptual framework. These categories were; *initial common ground, current state of the activity, public events so far*, and *basis for common ground*. Remaining uncategorised data was also checked for new concepts not captured by the conceptual framework.

## 4.  Results and Discussion

VTS operators are involved in several different activities with several different participants at the same time and therefore need to find initial common ground, interpret the current state, and keep track of what events have occurred, in a range of activities.

### 4.1    Initial Common Ground

The majority of subjects agreed that being trained, certified, and appointed a ship master/officer in accordance with international standards, is not always sufficient evidence that the expected or necessary skills are held. Instead nationality, language, and direct personal experiences appear to form better quality evidence for such assumptions. For example, one subject described how vessels manned by seafarers from certain nations or by those who do not speak English well are more likely to behave unexpectedly or fail to comply with local rules and procedures. Similar views were shared by a third of the subjects. Another subject described how VTS operators may avoid interacting with vessels before the local pilot has embarked, as the lack of language skills and knowledge of local rules and procedures among some seafarers can make coordination difficult. In contrast, domestic seafarers are considered more predictable and reliable, as they often have experience from the area, knowledge about local rules and procedures, and speak the local language. Discussion among subjects regarding varying perceptions between seafarers from different countries of concepts such as safety and efficiency further emphasizes nationality as an important basis for inferences.

Of the 24 subjects who participated in this study, six had a seafaring background, and there were mixed views as to whether such background was necessary for their work. More than half of the subjects said they had experienced some sort of negative treatment or attitude which they associated with their lack of seafaring background. The VTS operators are sometimes, according to one subject, regarded as outsiders who don't understand the seafaring practices, values, skills, and language. Different explanations for this negative treatment or attitude was suggested, for example that it is not the lack of seafaring experience that is the problem, but the insufficient training of VTS operators and the lack of consistency in the provision of VTS. The same subject empathised with the pilots and seafarers in that 'it would be difficult to trust someone who had only attended a two weeks long VTS operator course if they had no previous seafaring training or experience'. A similar view was held by another subject who suggested that a seafaring background may not be necessary, but that the pilots and seafarers need some way of knowing that the VTS operators have the required competence.

The subjects' descriptions also pointed to substantial differences in the establishment and operation of VTS. For example, of the VTS centres represented in this study, only one was established and operated in accordance with IALA standards and authorised by AMSA, while the others were not. Furthermore, two of the VTS centres in this study were established and operated by public authorities, with the others by commercial entities.  Another important difference between the VTS centres was that some were organised under a harbour master who can exert legal powers through the VTS, such as instructing vessels to take certain actions, while others had no such arrangement. Different VTS centres also provided different levels of service; some direct vessel traffic, some provide advice to vessels, and some merely disseminate information. More than half of the subjects, however, felt that the level of service provided by their VTS did not correspond to that which was officially promulgated. Three subjects were not aware of any official promulgation of their level of service or their procedures, but said that instead this information was emailed to vessels by the ship's agent. There was furthermore different practices between VTS operators who work at the same VTS centre. For example, two subjects from the same VTS centre described how different operators apply different criteria and procedures in relation to the granting of departure clearances for vessels. Suggestively, this was due to unclear and ambiguous management of the VTS, which was a problem

the majority of subjects' could relate to. Three different subjects, however, explained how the VTS operators and their managers had come closer to a mutual understanding of VTS during the process of seeking authorisation with AMSA. In this process both the operators and managers had jointly established a set of operational procedures in accordance with IALA standards, and hence they had read and discussed these recommendations and guidelines. Seemingly, the operators and managers now had reason to believe they had mutual knowledge, beliefs, and suppositions about VTS.

## 4.2    Current State of the Activity

The Automatic Identification System (AIS) was, according to the vast majority of subjects, considered an essential tool to interpret the state of the vessel traffic. AIS information, such as the name, position, and movements of most large vessels can be represented on an electronic chart display which VTS operators use to get an overview of the VTS area. All subjects in this study, however, highlighted that there are shortcomings with AIS. For example, small vessels such as fishing boats are not always equipped with AIS and hence not represented on the electronic chart display. Similarly, subjects from two VTS centres emphasized that navy vessels often chose not to transmit AIS data, or only transmit sporadically. It was further highlighted that AIS data which is entered manually, such as a vessel's destination and estimated time of arrival, is often unreliable compared to that entered automatically, such as position, and course and speed over ground. More than a third of the subjects had also experienced how pilots call up the VTS on VHF radio and ask about information which is already available to them through the AIS. Two subjects suggested this could be as the AIS equipment is sometimes located in an awkward position on a vessel and is therefore not easily accessible to the pilots. Another issue which was brought up was the limitation in AIS coverage with the equipment used by VTS. More than a third of the subjects described how internet websites or mobile phone applications providing greater AIS coverage are sometimes used in their VTS centre.

In addition to the electronic chart display with AIS, the VHF radio was considered an essential tool and the primary means for interacting with vessels. As VHF transmissions are openly broadcast, it is also used for overhearing communication which does not directly involve VTS but help in interpreting the current state of vessel traffic, in particular since it is a means to access information regarding vessels not equipped with AIS or not transmitting AIS data. The majority of subjects, however, had experienced problems with contacting vessels by VHF radio and it was believed that some seafarers and pilots occasionally use the wrong channel or even switch the VHF radio off as all the communication and noise can be considered distracting. Furthermore, although all transmissions are broadcast, it cannot be taken for granted that everyone has actually received and understood the message. Poor sound quality, interruptions, language barriers, and differing interpretations of information all contribute to reducing the quality of VHF communication as a basis for assumptions. A way for VTS operators to deal with these shortcomings is to use a landline, satellite, or mobile telephone instead, and more than half of the subjects stated this was a common practice in their VTS centre. While the telephone has several advantages in comparison to the VHF radio, the disadvantage is that information is not broadcast, and therefore not simultaneously accessible to all participants.

Another issue with the equipment the VTS operators use is that it in some aspects differs from that which is used by pilots and seafarers. One subject described how they had fairways and buoys marked on their electronic chart display which were not shown on the charts used by pilots' or seafarers. Another subject who had seafaring experience stated that if an AMSA inspector had seen a vessel using the same charts and publications as they did in the VTS, that vessel would likely have been detained. The most significant issue with keeping track of what is going on with the activities related to vessel traffic, however, is the expectations for VTS operators to participate in activities related to port operations. It was emphasized by more than half of the subjects that they devoted

more time, effort, and attention to activities not directly concerned with the ongoing vessel traffic, such as berth scheduling, negotiations with ship agents and ship operators, and port security matters.

## *4.3    Public Events so Far*

Some VTS centres keep a manual log of events and communications, although the formality of this log varies. One subject kept private notes which were used as a memory aid during work and when handing over to the next shift. Two subjects had been instructed to write detailed notes of every event and all verbal communication that takes place, which they thought was useful at times but it removed their attention from other tasks. The majority of subjects, however, described how their VTS centre used automatic recordings of equipment data and communication. Access to these recording was however limited so they were not frequently used by the operators. No record of events which is shared between participants in the MTS was however identified. One subject suggested such shared record could include information that have been exchanged between a vessel and VTS, and that it potentially could be facilitated through the electronic charts used by most participants.

## 5.   Conclusions

The results of this study support previous findings highlighting issues with the ability to form expectations about VTS. The establishment and operation of VTS varies considerably, and international recommendations and guidelines on VTS are often not fully implemented. This can lead to a discrepancy between 'VTS as expected' and 'VTS as experienced'. Results further indicate that VTS operators have similar issues with forming expectations about users of their services as these users may have varying levels of knowledge about local rules and procedures. Both these findings suggest that existing bases for initial common ground, such as international recommendations and guidelines and local rules and procedures, are not always relied upon. Instead results point to expectations being based on participants' nationality, language, professional background, and direct personal experiences. Such bases are not, however, always mutual, known, or available and can lead to discrepancies in common ground. Results also indicate that VTS often focus on activities related to port operations rather than vessel traffic, and that participants in the MTS do not always base interpretations of the current traffic situation on the same information. This again may lead to discrepancies in common ground, which is essential to any coordination effort. To overcome these issues it is important to facilitate the establishment of reliable shared bases among participants in the MTS. Given the international character of the MTS, international recommendations and guidelines have an important role to play in forming such shared bases. Drawing on the conceptual framework used in this study, it is therefore key that all participants have knowledge about the international recommendations and guidelines, and that they know that all other participants have the same knowledge. IALA's agenda to develop VTS awareness training for navigating officers is a step in this direction and could potentially be further extended to involve other participants and topics in joint training courses. This suggestion could facilitate the establishment of reliable shared bases for common ground, and hence better enable participants to coordinate.

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