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1 Summary

A questionnaire with 49 questions has been prepared and used to further identify user needs and experiences of VTS operators in the Baltic Sea countries. It has been distributed to VTS operators in Denmark, Finland, Norway, Poland and Sweden. The topics included are collision and grounding risks, warning systems and AIS data quality. The results are being used in the design process to develop a VTS decision support system for collision and grounding avoidance.

For "scoring" answers, average values and other statistics for the respondents have been determined. 13 VTS operators from 7 VTS centers responded to the questionnaire. Most of the questions were answered by all respondents. Some highlights:

- On average approximate 70 vessels pass the VTS areas each day
- Strong yes answer regarding possibilities to build a reliable automatic grounding warning system
- Weak yes answer regarding the possibilities to build a reliable automatic collision warning system
- A "probably yes" answer to: Can AIS position data of ships be misleading?
- A "neither yes nor no" towards "probably yes" answer to: Can RADAR position data of ships be misleading? In the comparison between the answers to the same question regarding AIS and RADAR, the RADAR got a 13% better result (out of 100% scale).
- In a ranking of different tools in daily work, VHF was ranked as the most important followed by RADAR and then AIS
- Strong yes answer to the question of whether low CPA / TCPA are commonly used and accepted as standard behaviour
- Strong support for the statement that the exchange of intended route between ship and VTS will make early detection of abnormal situations easier
- On average about 1½ grounding accidents occur per year in the VTS areas covered by the study
- On average about 9 near-miss grounding incidents occur per year
- On average about ½ collision accident occurs per year in the VTS area
- On average about 4 near-miss collision incidents occur per year
- On average the respondents state that about 1 ship out of 100 operates dangerously and has unacceptable behavior in the traffic area

- Four respondents answers that 1 ship out of 50 or 1 ship out of 25 operates dangerously and has non-acceptable behavior – which is interpreted as a serious message, pointing towards necessary further investigations.

The respondents gave interesting responses regarding

- what they see as the biggest problem in their work
- what characterizes a near-miss situation
- and what activities are included in "good VTS-service".

Almost all responses provided to the first two questions can be classified as different kinds of communication problems and the generic answer to the third question is also about communication: Correct information given at the right time.

2 Background

Within the BaSSy project SSPA has started the development of a VTS decision support concept for collision and grounding avoidance [1, 2]. To identify operational conditions and critical circumstances experienced VTS operators were interviewed. To gain insight into realistic time spans which can be used for a warning system, 160 different real cases of groundings/ contacts, collisions and near-collisions were also studied. In the present EfficienSea project two decision support tools for the VTS operators will be developed by SSPA and VTT aiming at two different applications. Chalmers has done a State of the art review and VTS investigation which forms a base in the analysis [3]. VTT and MSI Design have conducted a survey of the personnel working at a Finnish VTS centre [4]. The survey consisted of an extensive questionnaire covering a broad range of issues – from the physical work environment to working with the computer systems supporting the operator's tasks. 23 respondents answered the questionnaire. The following results from the Finnish study are especially interesting for the present study:

- 30 - 45 % of the respondents had no training on the use of primary VTS tools (for example VHF, RADAR and AIS)
- There was a certain degree of ambiguity in the instructions and guidelines. Unclear instructions were indicated as a major problem area in the operator interviews

The study provided a state of the art operators view of the situation at the VTS centre. The results were used in the development of the VTS centre, its equipment and operator training.

To further identify user needs and experience of VTS operators in the Baltic Sea countries a questionnaire has been prepared. The result from this study and the other studies above will be used to set criteria in the design development of the decision support system within EfficienSea WP6 Dynamic Risk Management.

3 Questionnaire design

The present questionnaire includes 49 questions. The results presented below include all questions except a few of more personal character. The questionnaire information given is anonymous and the collected data are mostly treated statistically including average or mean value, standard deviation, maximum and minimum values. The values are most often given in a 5 grade scale connected to the answering alternatives. Most of the questions were answered by all respondents. The questionnaire has been distributed to operators in Denmark, Finland, Norway, Poland and Sweden. In Denmark the questionnaire were sent to an unknown number of VTS operators at one VTS centre by Danish Maritime Safety Administration. Three VTS operators responded. In Finland and Norway the questionnaire were sent to an unknown number of VTS operators by Finnish Transport Agency and Norwegian Coastal Administration respectively. One VTS operator responded from each country. In Poland an unknown number of VTS operators were contacted at two VTS centers by Maritime University of Szczecin and Maritime Office Gdynia respectively. Three VTS operators responded from one VTS centre and one from the other. In Sweden the questionnaire were sent to an unknown number of VTS operators by Swedish Maritime Administration. Two VTS operators responded from one VTS centre and two from another. In total 13 VTS operators from 7 VTS centers responded to the questionnaire. The first part in the questionnaire deals with the VTS centre the respondent is working for and his/her personal experience. In the first two parts there are mainly open answer possibilities. In the last three parts a scale is used that usually has 5 possibilities like: (1) Strongly agree, (2) Agree, (3) Neither agree nor disagree, (4) Disagree, (5) Strongly disagree. There is also the possibility to provide comments for each of the questions included in the last three parts. The topics included in the questionnaire deals with:

- Collision and grounding warning system
- Collision and grounding risks
- AIS data quality

The reason for including AIS questions is that AIS is the primary information data source for the decision support system. Knowledge about the trustworthiness of the AIS data as experienced by the operators is therefore important.

4 Results and Analysis

This chapter follows the questionnaire with respect to division into five separate subchapters. These are

- General information about your VTS centre
- Potential of a collision and grounding warning system
- VTS system requirements for collision and grounding warnings
- Collision and grounding risks
- Quality of AIS data

The numbers of respondents belonging to different VTS´s and a rough estimation on the traffic are the following:

	Number of respondents	VTS traffic
Denmark	3	High
Finland	1	High
Norway	1	High
Poland 1	3	Low
Poland 2	1	Low
Sweden 1	2	Medium
Sweden 2	2	High

Due to the limited number of respondents it was considered most appropriate to generally present average values for all respondents. The VTS centers with more respondents will thus have a higher weight. The answers given are the respondents' personal interpretations and not necessarily facts and there are definitely different opinions among the respondents from the same VTS. The other alternative would be to present average values among the seven VTS centers. This alternative is not used due to the fact that three VTS´s are represented by only one respondent each. If this alternative had been chosen one respondent from this VTS representation type would get as much weight as two or three respondents from VTS´s with more representation.

4.1 General information about your VTS centre

1. Number of respondents: **13**

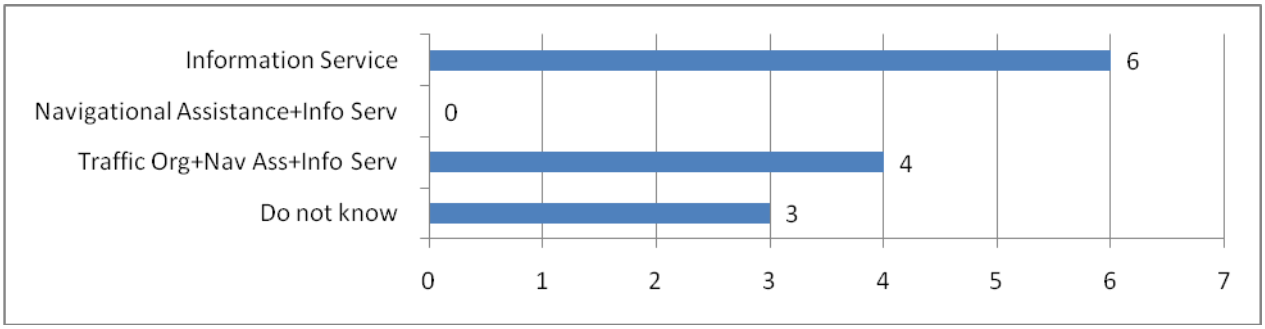
Maritime Authorities in Norway, Sweden, Finland, Denmark and Poland distributed the SSPA questionnaire to VTS operators in the countries respectively. The response rate was rather low but all the countries and seven VTS centers are represented among the respondents.

2. Number of employees at the VTS centre: **Average 17,2 (standard deviation 7.6, Max 42, Min 12, all respondents answered)**
   Only one of the VTSs represented in the investigation could be considered large. The largest has 42 employees whereas all the others have around 15. The average value presented is the mean value for all respondents. Some respondents come from the same VTS center giving these VTS´s a higher weight.

3. Number of VTS operator work-stations used at the same time: **Average 2.5 (standard deviation 0.9, Max 5, Min 2, all respondents answered)**
   Most of the answers stated 2, some gave 3 and one noted 5 (the large one). The average value presented is the mean value for all respondents. Some respondents come from the same VTS center giving these VTS´s a higher weight.

4. Approximate number of vessels passing the VTS area each day: **Average 71 (standard deviation 38, Max 120, Min 20, all respondents answered)**
   The average ship traffic is of "medium" intensity. Some respondents report a low intensity – around 25. The average value presented is the mean value for all respondents. Some respondents come from the same VTS center giving these VTS´s a higher weight.

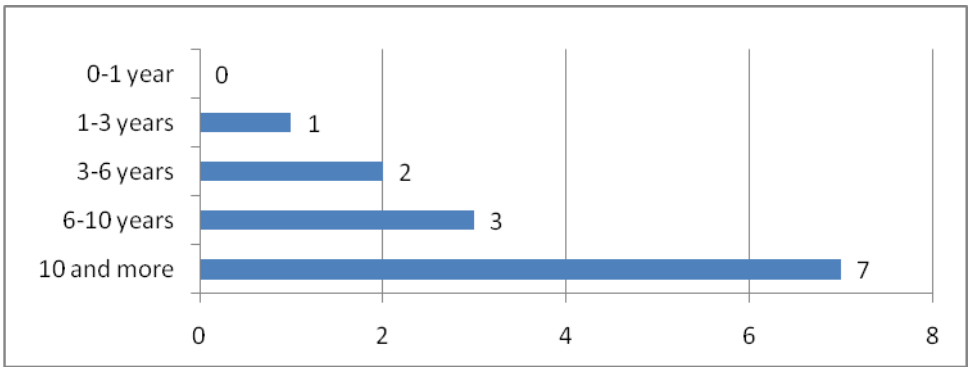
5. Which type of VTS centre, according to IMO, are you working for?



Different service levels are represented. Four respondents from Finland, Norway, Poland and Sweden declare that Traffic Organisation Service, Navigational Assistance and Information Service are offered. Another respondent from one of these VTS´s states that only Information Service is offered. Three respondents do not know the IMO classification of their VTS center.

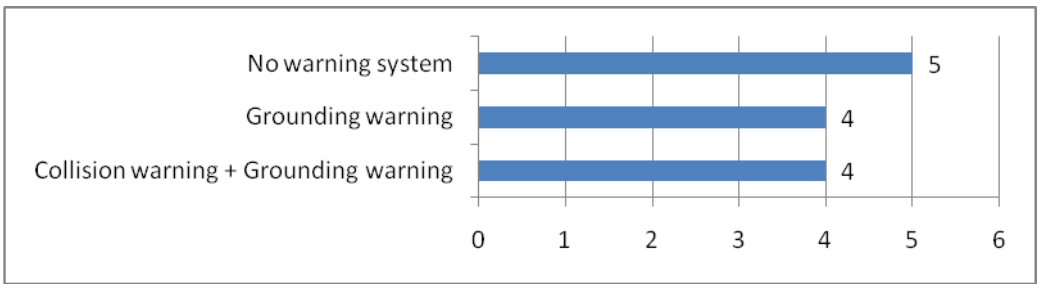
6. Years you have been working at a VTS centre: **Average 6.2 (standard deviation 6.3, Max 25, Min 1, all respondents answered)**
   The average number of working years is at a medium level. There is a big spread among the respondents with seven operators with max 3 years, four with medium (3 – 10) and two with more than 10 years experience.

7. Years of experience in the shipping industry:



   The respondents have quite a few years of experience from the shipping industry.

8. Is there an automatic collision and grounding warning tool implemented in the VTS system?



   Four respondents from Denmark, Finland, Poland and Sweden declare that there are Collision and Grounding warning systems installed. Another three respondents from two of these VTS´s disagree and state that there is only Grounding warning. There is also disagreement between two respondents from another VTS, one declaring Grounding warning and one No warning system. The remaining four respondents stating No warning tools belong to two VTS´s and there is no disagreement.

4.2 Potential of a collision and grounding warning system

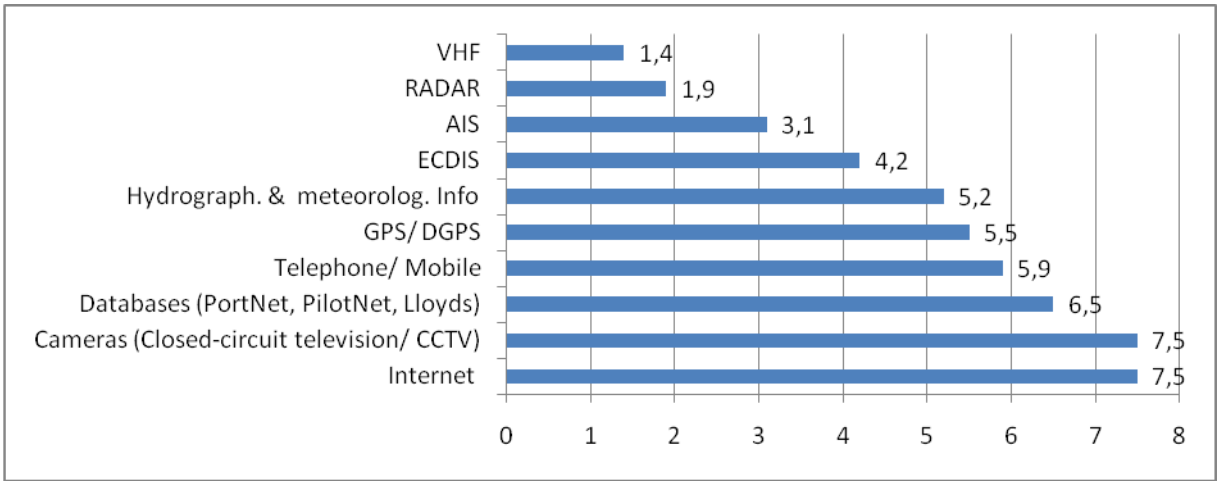
1. In consideration to complexity what is your opinion regarding the possibilities to build a reliable automatic **grounding** warning system?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 1.62 (standard deviation 0.87, Min 1, Max 4, all respondents answered)
   This is between "Probably possible" and "Definitely possible". This is seen as a strong yes answer regarding possibilities to build a reliable automatic grounding warning system. There is relatively good consistency; the spreading of answers is relatively small - small standard deviation.

2. In consideration to complexity what is your opinion regarding the possibilities to build a reliable automatic **collision** warning system?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 2.31 (standard deviation 1.32, Min 1, Max 4, all respondents answered)
   Corresponding to an answer between "Probably possible" and "Neither possible nor impossible". This is seen as a weak yes answer regarding the possibilities to build a reliable automatic collision warning system. The spreading of answers is clearly bigger than for Question 4.2.1 above – the standard deviation is bigger.

3. Rank the following tools according to their importance for your daily work! Which one is most important, which one least? (scale 1-10, 1 most important)



There are different ways of ranking among the respondents. Some use 1- 10 in ranking, some give the same ranking to more than one tool and some do not rank a few tools (in this case replaced by ranking 10 by the authors). The resulting comparison between the tools becomes therefore a bit rough among the lowest ranked tools. However the ranking trends are clear even for these.

VHF and RADAR are ranked the most important tools. VHF has the highest priority and RADAR is closely following. There is a gap in priority to AIS, but it has quite high priority. AIS and ECDIS are important, whereas Hydrographical / meteo info, GPS/DGPS and Telephone / mobile are of medium importance. Databases are of less importance. Internet and Cameras have the lowest priority.
Some more statistics:

Tool	Mean	Stand. dev.	Min	Max
VHF	1,38	0.87	1	4
RADAR	1,92	1.04	1	4
AIS	3,08	2.10	1	8
ECDIS	4,23	3.22	1	10

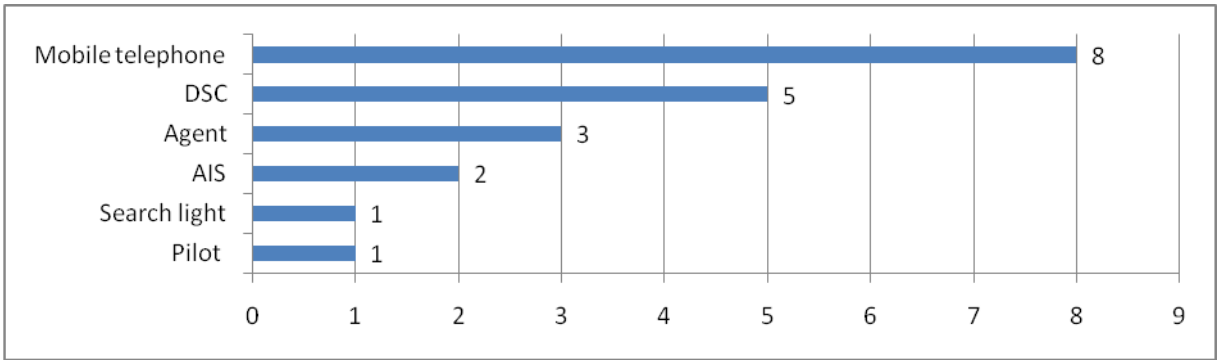
The consistency of the answers are highest for VHF and RADAR (small spreading - small standard deviation) whereas for AIS the spreading is clearly bigger and rather big for ECDIS.

In the study done by Chalmers [3] eight Finnish VTS operators from six different VTS centers (GoFREP, Helsinki, Bothnia, Archipelago, Kotka, Hanko) participated in a focus group interview and they were asked the same question. After the individual ranking all the operators were asked to do the same ranking as a group (consensus). The results were as follows:

Decision Support Tool	Individual Ranking	Group Ranking
VHF	1, 4	2
RADAR	1	1
ECDIS	2	4
AIS	3	3
CCTV	5	
Databases (PortNet, PilotNet, Lloyds)	5	
Hydrographic and meteorological information	6	
Telephone, GPS, Internet	Not ranked	

In the Chalmers study the RADAR was given the highest priority whereas in the present study VHF was number one. Individually the ECDIS got higher ranking, but in the group ranking it fall down two steps. The group ranking was nearer the results in the present study. The only difference is the change of order between the RADAR and VHF. On the other side the present ranking is near (half a step) and there was debate about the ranking of the first two candidates in the Chalmers study. Another difference is the lower priority of Hydrographical / meteo info and higher for CCTV and databases in the Chalmers study.

4. If you cannot reach the vessel by VHF do you contact the vessel by other means – by which tool?



The table presents the total number of proposals noted by the respondents. Some respondents gave more than one alternative. There is a number of alternative ways of trying to get in contact with the vessel if there is no response on the VHF radio communication. The most common alternative is the mobile phone, proposed by eight respondents and the next alternative is DSC (Digital Selective Calling) proposed by five respondents.

5. What do you experience as the biggest problem in your daily work as VTS operator?
   - Vague instructions and routines
   - Unclear instructions from authority for the work to be done
   - Lack of authority as a VTS-operator towards vessels (not mandatory)
   - Communication with some vessels
   - Navigators and pilots not following COLREGs
   - Poor VHF coverage in some regions, inadequate RADAR coverage
   - Language problems with the vessels in the VTS area, but also technical problems with the VTS system
   - When vessels do not reply on VHF
   - Some areas in the fairway need more buoys for safe navigation when vessels are not familiar with the area
   - No contact established
   - Problem with establish the connection
   - Any breakdowns of the system that is VHF, Telephone, RADAR, AIS
   - Cooperation with pilot

The first two comments regarding vague and unclear instructions are of fundamental importance. The service role and the working procedures of the VTS must be clarified in the organisation and for the operators. Lack of authority is also a central issue to handle in the future.
The other comments can be classified as different kinds of communication problems. It shows that the communication between the operator and the bridge is the key issue and measures to solve the communication problems are of high importance.

As noted above the VTT/MSID study [4] also high lightened that "Unclear instructions were indicated as a major problem area in the operator interviews".

6. What characterises a near-miss situation – an incident not leading to an accident?
   - Disagreement between ship and VTS
   - Bad or no communication
   - Navigational error on the bridge and an alert VTS operator on duty

   Also here communication can be a key issue. Shortcomings in communication may lead to a near-miss (and an accident) and good communication may make it possible to avoid an accident for a situation that is under way.

7. What activities are included in "good VTS-service"?
   - Correct info given at the right time.
   - Clear communicated traffic information given in accordance with rules and regulations.
   - Help in the creation of a safe and effective passage for the traffic that navigates the VTS area. Communication and pro-activity
   - Relevant information, reliable advices and instructions
   - Good informational service is the basis
   - Service to the vessels such as traffic situation in the VTS area, current and water level info, and other relevant info for a safe passage in the VTS area. Also tugboats operations and all not normal traffic situations in the VTS area are to be broadcasted
   - Provide the vessels with all information they need during passage for safe navigation. Monitor their passage and try to prevent dangerous situations from occurring, especially concerning other vessel movements and areas with shallow water
   - Be pro active
   - Procedures, personnel and equipment for traffic monitoring
   - To watch over safety on VTS area, information of current situation on fairway, hydrographical and meteorological information, intensity traffic, devolution of navigation caution, planned vessel traffic, planned time of departure and entrance to VTS area

   The respondents focus on the main service for the VTS, which is communication of information. The amendment of "given at the right time" is of outmost importance. It should not be given too early to avoid overload and possibly not relevant when being there and of course it should not be given too late. The information should be given with the aim to be pro active and give good prerequisites for such a behavior.

   In the Chalmers study referred to earlier [3] the operators were asked the same question; definition of good VTS service. The operators stated different aspects like:
   - Good technical equipment
   - Satisfied VTS staff
   - Clear rules for the interaction between VTS operators and others
   - A high degree of domain knowledge consisting of
     - Operators should have a background as a mariner to be able to handle different kinds of situations

  - The operator should participate in refresh-courses to gain new knowledge
  - On-the-job training
- The traffic is fluent without any congestions
- The personal chemistry between the different players (VTS, pilots, vessels etc.) in the maritime sector is good

Again the importance of clear rules in the interaction / communication between the actors is highlighted.

4.3 VTS system requirements for collision and grounding warnings

1. Do you experience very dense traffic situations in the area you supervise, compared to the fairway capacity?
   Very often (1), Often (2), From time to time (3), Seldom (4), Very seldom (5)

   Average 2.62 (standard deviation 1.12, Min 1, Max 5, all respondents answered)
   Corresponding to a situation between "From time to time" and "Often". The average answer is a bit towards the middle of the range, but there is a spread. Three answered "very often", two of them coming from the same VTS.

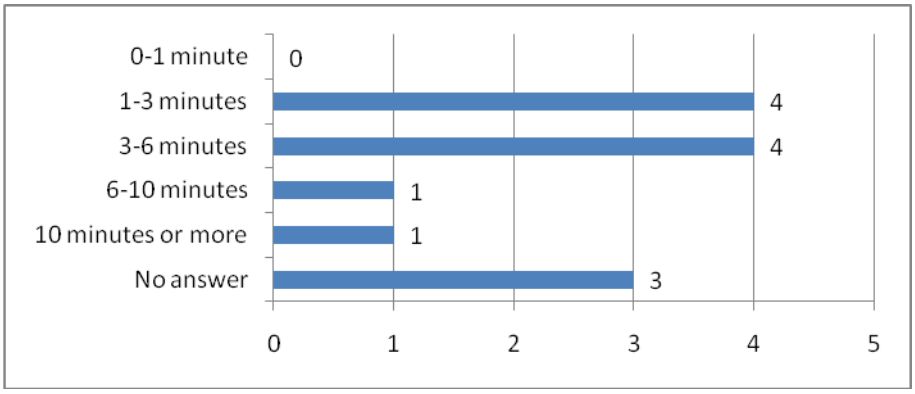
2. Do you think it is possible for you to manually detect all inappropriate traffic situations in the area you supervise?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 3.38 (standard deviation 1.45, Min 1, Max 5, all respondents answered)
   Falls between "Neither possible nor impossible" and "Probably impossible". The average answer is in the middle of the range. There is a big spread in answers.

3. Do you think an exchange of intended route between the ship and the VTS centre will make early detection of un-normal situations easier through comparison of actual route to the intended route?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 1.62 (standard deviation 0.65, Min 1, Max 3, all respondents answered)
   Falls between "Probably possible" and "Definitely possible". This is seen as strong support to earlier detection in case of route exchange. There is good consistency - small spreading of answers.

4. What is your estimate of an average time to realise an un-normal condition until a **grounding** accident happens?

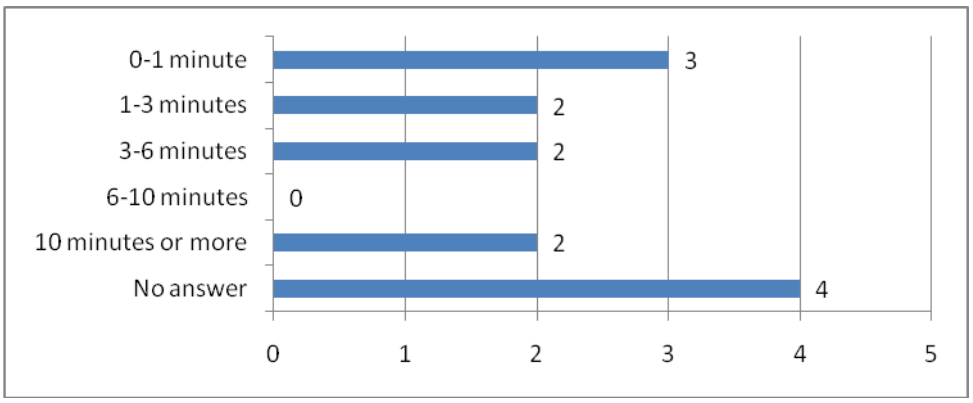


The average response is the 3-6 minutes interval but the deviation is big. Only two respondents give time margins over 6 minutes before grounding. The average response indicates that there are no big time margins for detecting an abnormal situation before a grounding occurs. The four respondents that note 1-3 minutes interval correspond to relatively intensive traffic VTS areas where groundings occur on average once every half year (according to Question 4.4.1 below). The two respondents noting over 6 minutes correspond to one with high intensity and one with low, both noting that groundings occur less than once a year (according to Question 4.4.1 below). Hence the answers show a correlation between time to grounding and grounding frequency and to some extent traffic intensity: Short time to grounding – Higher grounding frequency - Relatively intensive traffic. Long time to grounding – Lower grounding frequency.

5. Is this enough time (in Question 4) for you to alert the ship?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 2.77 (standard deviation 0.60, Min 2, Max 4, all respondents answered)
   Falls between "Neither possible nor impossible" and "Probably possible". The answer shows no strong opinion. There is good consistency - small spreading of answers.

6. What is your estimate of an average time to realise an un-normal condition until a contact **collision** accident happens?



The average answer is in between the 1-3 to the 3-6 minutes interval but the deviation is very big. Two respondents give time margins over 10 minutes before a collision whereas five give margins under 3 minutes. All answering respondents except one correspond to relatively intensive traffic VTS areas. All except one also assert that collisions occur less than once a year (according to Question 4.4.3 below). No clear correlations are found. The respondents must refer to different situations and interpretations.

7. Is this enough time (in Question 6) for you to alert the ship?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 3.08 (standard deviation 1.04, Min 2, Max 5, all respondents answered)
   Corresponding to an answer almost precisely expressed as "Neither possible nor impossible". The answer shows no strong opinion. There is no big spreading of answers.

8. Based on your experience, do you think that it is possible to design an automatic warning system that only gives alarms for critical situations and still enables time for counter measures?
   Definitely possible (1), Probably possible (2), Neither possible nor impossible (3), Probably impossible (4), Definitely impossible (5)

   Average 2.92 (standard deviation 1.19, Min 1, Max 5, all respondents answered)
   Corresponding to an answer almost precisely expressed as "Neither possible nor impossible". The answer shows no strong opinion. There is a spread in answers.

4.4 Collision and grounding risks

1. How often does a **grounding** accident occur in your VTS area?
   Less than once a year (1), About once a year (2), About once every half year (3), About once every month (4), More often than once a month (5)

   Average 2.38 (standard deviation 0.77, Min 1, Max 3, all respondents answered)
   This falls between "About once a year" and "About once every half year". The answer shows that groundings do occur more than once a year. There is good consistency - small spreading of answers.
   To check the result against real statistics the Sound VTS area was chosen. Here there exist very extensive data that has been collected during several years regarding real groundings, collisions and incidents which are reported in the BASIES project [4] as well as data received from the Swedish Maritime Administration. The number of groundings in the area per year was on average 3.5 (2008 – 2009). The respondents referring to this area all stated the number of groundings to be "About once every half year". The real number was higher but did not reach the next alternative "About once every month", so the interpretation is that the respondents answered correctly. It is also obvious that the answering alternatives given were not complete, which is seen as a shortcoming. The result from this question (and the coming three) can only be seen as rough estimates.

2. How often does a **near-miss grounding** incident occur – a situation almost leading to grounding in your VTS area?
   Less than once a year (1), About once a year (2), About once every half year (3), About once every month (4), More often than once a month (5)

   Average 3.67 (standard deviation 1.22, Min 2, Max 5, 9 respondents answered)
   This falls between "About once every month" and "About once every half year". The answer shows that near-miss grounding incidents occur often. There is relatively big spreading and four missing answers.
   To check the result against real statistics the Sound VTS area was chosen here as well. The number of groundings incidents in the area was in average 2 every month (2008 – 2009). The respondents referring to this area all stated the number of groundings to "More often than once a month". Also here the selected respondents answered correctly.

3. How often does a **collision** accident occur in your VTS area?
   Less than once a year (1), About once a year (2), About once every half year (3), About once every month (4), More often than once a month (5)

Average 1.58 (standard deviation 0.86, Min 1, Max 4, all respondents answered)
This falls between "About once a year" and "Less than once a year". The answer shows that collisions seldom occur. There is good consistency - small spreading of answers.
The test against real statistics in the Sound VTS area was done. The number of collisions in the area was in average 1.5 every year (2008 – 2009). The respondents referring to this area stated on average the number of collisions to relatively near the statement "Less than once a year" (the total average answer for this question was as noted 1.58, whereas this selected group noted 1.33). So in this case the selected respondents gave an underestimation of the number of collisions in the area.

4. How often does a **near-miss collision** incident occur – a situation almost leading to a collision in your VTS area?
Less than once a year (1), About once a year (2), About once every half year (3), About once every month (4), More often than once a month (5)

Average 3.22 (standard deviation 1.09, Min 2, Max 5, 9 respondents answered)
This is between "About once every half year" and "About once every month". The answer shows that near-miss collision incidents occur rather often. There is no big spread in the answers but there are four missing answers.
The test against real statistics in the Sound VTS area was done. The number of collision incidents in the area was in the range of one every second month (2008 – 2009). The respondents referring to this area stated in average the number of collision incidents to a bit less than "About once every month" (the selected group noted 3.67). Also here the selected respondents answered correctly.

5. Do you think that low Closest Point of Approach (CPA)/ Time to Closest Point of Approach (TCPA) are commonly used and accepted as standard behaviour?
Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

Average 1.46 (standard deviation 0.66, Min 1, Max 3, all respondents answered)
This is between "Definitely yes" and "Probably yes possible". There is a strong yes answer to commonly used low CPA/TCPA. There is good consistency - small spreading of answers.

6. Do you think, for you as a VTS operator that time margins to avoid ship collisions are larger in overtaking situations compared to other passages?
Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

Average 2.62 (standard deviation 0.65, Min 2, Max 4, all respondents answered)
This is between "Neither yes nor no" and "Probably yes possible". The answer shows no strong opinion. There is good consistency - small spreading of answers.

7. Do you think that there are parts of the fairways you supervise where overtaking or other passages are unsuitable?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 2.04 (standard deviation 1.52, Min 1, Max 5, all respondents answered)
   Corresponding to an answer near to "Probably yes possible". The answer is a combination of 8 respondents answering "Definitely yes" that in some cases overtaking is unsuitable and some operators who find it suitable. There is a big spread in answers.

8. Do you think that the communication between the ships before the occurrence of collisions often is insufficient?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 2.19 (standard deviation 1.07, Min 1, Max 5, all respondents answered)
   Corresponding to a response between "Probably yes possible" and "Neither yes nor no". The answer shows an opinion that in some cases communication between ships is insufficient. There is no big spread in the answers.

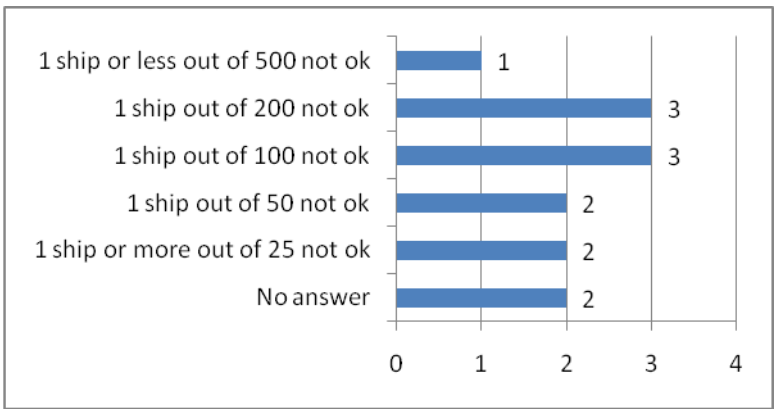
9. Do you think that the communication between the ships and the VTS often is insufficient prior to grounding or collision?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 2.31 (standard deviation 0.75, Min 1, Max 3, all respondents answered)
   Corresponding to an answer between "Probably yes possible" and "Neither yes nor no". The answer shows an opinion that in some cases communication between ships and VTS is insufficient. There is good consistency - small spreading of answers.

10. Do you think it is possible to recognise an upcoming grounding situation at an earlier stage compared to an upcoming collision situation?
    Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

    Average 2.77 (standard deviation 1.42, Min 1, Max 5, all respondents answered)
    Corresponding to an answer between "Neither yes nor no" and "Probably yes possible". The answer shows no strong opinion. There is a big spread in answers.

11. According to your opinion what share of the traffic in your area operates dangerously and has non-acceptable behavior?



The average opinion is that close to 1 ship out of 100 are not ok. No correlation between intensive traffic in the VTS area and the share of traffic experienced as dangerous could be found. On the contrary the traffic is judged different by various respondents working in the same area. It seems that what is classified as dangerous and non-acceptable is clearly personal.
Seven respondents answered that 1 % or less of the ships are not ok. That may be an acceptable level? There are two respondents answering that 2% are not ok and two answering that 4% or more are not ok – operate dangerously. These four respondents experience a high percentage of the ships being dangerous. This is a serious message that should be considered rigorously. It points towards the need for further investigations.

4.5 Quality of AIS data

1. Have you ever experienced that the AIS signals of ships disappear?
   Experienced very often (1), Experienced often (2), Experienced from time to time (3), Experienced seldom (4), Never experienced (5)

   Average 2.92 (standard deviation 0.64, Min 2, Max 4, all respondents answered)
   Corresponding to an answer very near "Experienced from time to time". The disappearance of the AIS signal occurs and even if it is not often, it is something to take serious and try to find measures for improvement. There is good consistency - small spreading of answers.

2. Have you ever experienced that the AIS positions of moored vessels "move around" at quays?
   Experienced very often (1), Experienced often (2), Experienced from time to time (3), Experienced seldom (4), Never experienced (5)

   Average 2.31 (standard deviation 0.85, Min 1, Max 3, all respondents answered)
   Corresponding to an answer between "Experienced often" and "Experienced from time to time". The answer shows a quite high experience. This exposes most probably a problem inherent in the GPS technique. The problem may be solved with DGPS. There is good consistency - small spreading of answers.

3. Can AIS position data of ships be misleading?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 1.96 (standard deviation 1.49, Min 1, Max 5, all respondents answered)
   Corresponding to an answer very near "Probably yes possible". The answer shows a quite high experience of misleading AIS position data. This ought to imply actions for improvement. There is a big spread in answers.

4. Can RADAR position data of ships be misleading?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 2.61 (standard deviation 1.33, Min 1, Max 5, all respondents answered)

Corresponding to an answer between "Neither yes nor no" and "Probably yes possible". The question is formulated exactly the same as the previous with the exchange of AIS by RADAR. In the comparison between the answers to the same question, the respondents show higher confidence in the radar compared to the AIS but there is not high confidence in the RADAR either. The difference in opinion about the RADAR and the AIS is not that big. The scale difference is 0.65 "better" for the RADAR compared to AIS on the 5 grade scale. There is a big spread in answers. The result can be interpreted as there are real problems with AIS as well as the RADAR. The RADAR has been used for a very long time and the limitations are known, whereas AIS is proportionately new and there is uncertainty in its reliability.

5. Are the dynamic AIS messages of better quality than the static AIS messages?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 2.92 (standard deviation 1.00, Min 1, Max 5, 12 respondents answered)
   Corresponding to an answer very near "Neither yes nor no". The answer shows no strong opinion. There is no big spreading of answers.

6. Do you find the draught information from AIS is trustworthy?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 3.08 (standard deviation 1.55, Min 1, Max 5, all respondents answered)
   Corresponding to an answer very near "Neither yes nor no". The answer shows no strong opinion. There is a big spread in answers.

7. Do you find the COG information from AIS more reliable than the heading information?
   Definitely yes (1), Probably yes possible (2), Neither yes nor no (3), Probably no (4), Definitely no (5)

   Average 2.92 (standard deviation 1.44, Min 1, Max 5, all respondents answered)
   Corresponding to an answer very near "Neither yes nor no". The answer shows no strong opinion. There is a big spread in answers.

8. It has been reported that "phantom" ships are visible from time to time. According to your experience, is this phenomenon occurring?
   Experienced very often (1), Experienced often (2), Experienced from time to time (3), Experienced seldom (4), Never experienced (5)

   Average 3.08 (standard deviation 0.86, Min 1, Max 4, all respondents answered)
   Corresponding to an answer very near "Experienced from time to time". The experience of "phantom" ships occurs and even if it is not often it is something to take

serious and try to find measures for improvement. There is good consistency - small spreading of answers.

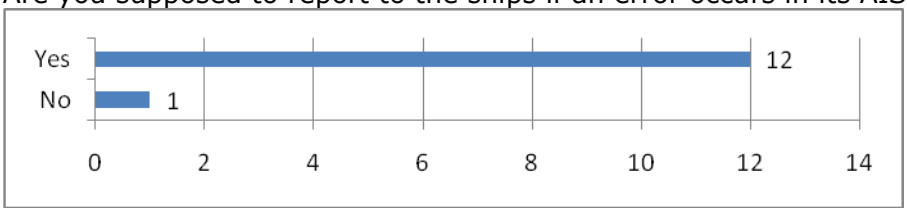
9. Shadowing effects of bridges, larger structures and big ships can give misleading AIS signals. According to your experience, is this phenomenon occurring?
Experienced very often (1), Experienced often (2), Experienced from time to time (3), Experienced seldom (4), Never experienced (5)

   Average 3.38 (standard deviation 1.61, Min 1, Max 5, all respondents answered)
   Corresponding to an answer between "Experienced from time to time" and "Experienced seldom". There are experiences of shadowing effects although not that frequent. Techniques for improvement are welcome. There is a big spread in answers.

10. Based on you experience, has the trustworthiness of AIS data improved in the recent years?
Improved significantly (1), Improved slightly (2), More or less the same (3), Worsened slightly (4), Worsened significantly (5)

    Average 2.15 (standard deviation 0.80, Min 1, Max 3, all respondents answered)
    Corresponding to an answer between "Improved slightly" and "More or less the same". The answer shows that the opinion is that the trustworthiness of AIS has improved a bit during the recent years. There is good consistency - small spreading of answers.

11. Are you supposed to report to the ships if an error occurs in its AIS message?



Only one respondent claims that no report is demanded, all the others do.

12. How do you think that AIS data quality could be improved?
The following actions were proposed:
    - More frequent update of draught and destination
    - Better control of equipment from authorities
    - Improved use of binary messages
    - Better training of navigators
    - Periodic testing onboard
    - Mandatory reports from VTS
    - Follow up of reported misinformation

    All the ideas expressed for how to improve AIS data quality are good and can be investigated for possible implementation.

5 Conclusions

The 13 respondents representing VTS operators in the Baltic Sea countries Denmark, Finland, Norway, Poland and Sweden have given their views on topics about collision and grounding risks, warning systems and AIS data quality. The results are useful in the design process for developing a VTS decision support system for collision and grounding avoidance.

The number of respondents is not high and a good statistical base is not established. However, five countries and different conditions are represented and interesting aspects are put forward. The response is considered of good quality and all respondents answered all the questions with a few exceptions. In some cases the answers are in accordance whereas others show big differences probably due to completely different actual circumstances. To get a comprehensive analysis of the "scoring" answers, average values for the respondents have been determined. It has not been seen as meaningful to present any standard deviations of the data. However many of the answers with big spreads are shown in diagrams displaying the complete results.

Below some general conclusions are formulated:

- There is a stronger belief in the possibilities to build a reliable automatic grounding warning system than a collision warning system.
- There is a clear scepticism regarding AIS data quality.
- There is also to a lesser degree scepticism regarding RADAR data quality. In the comparison between RADAR and AIS, the RADAR got a 13% better result (on a 100% scale). These results show not that big difference in attitude between the two techniques regarding data quality. In discussions with bridge operators the RADAR is often put forward as the "truth". In this study there is a weak tendency that RADAR position data can be misleading. The big difference between the RADAR and the AIS is that he RADAR has been used for a very long time and the limitations are known, whereas AIS is proportionately new and there is uncertainty in its reliability.
- Communication is essential and the VHF radio was ranked as the most important tool in the daily work for VTS operators. The second most important tool was the RADAR and the third was AIS. The high scoring for VHF and RADAR are in line with earlier studies, whereas AIS got maybe a higher mark than expect.

- There are relatively few grounding and collision accidents per year in the represented VTS areas. The rough average figure is 1½ groundings and ½ collision, whereas there are more than 5 times more near-miss grounding and collision incidents a year.
- There were big spreads in the opinion about the ratio of ships that operate dangerously and have unacceptable behavior in the traffic area. Four respondents experience 1 ship out of 50 or 1 ship out of 25 as being dangerous. We interpret this as a serious message, pointing towards the need for further investigations and probably actions to cope with this issue.
- Communication problems were put forward as the biggest problem in the respondents' work. Vague instructions and routines for the work were stated. This is probably connected to the sometimes unclear role of the VTS service. This issue is also serious and has to be taken care of and further investigated.
- Correct information given at the right time was the concluding answer to what activities are included in "good VTS-service". It comprises the main functionality of the VTS service which is communication of information. The amendment, "given at the right time", is of outmost importance to avoid overload and the provision of possibly not relevant information being given too early and of course it should not be given too late. It should be given with the aim to be pro-active.
- Communication problems were also put forward as the key issues to "what characterizes a near-miss situation". Shortcomings in communication may lead to a near-miss or an accident, and good communication may prevent an accident that is close to occurring.

This study represents an attempt to identify user needs and experiences of VTS operators in the Baltic Sea countries. Several interesting conclusions have been drawn but the analysis is limited with respect to few respondents and it would be interesting to do more thorough studies of identified problems.

6 References

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