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A cost benefit analysis of the AIS [Automatic Identification System] system in Sweden

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A COST BENEFIT ANALYSIS OF THE AIS SYSTEM IN SWEDEN

By

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Declaration

I certify that all the material in this dissertation that is not my own work has been previously identified, and that no material is included for which a degree has previously been conferred to me.

The contents of this dissertation reflect my own personal views and are not necessarily endorsed by the University.

(Signature):. 

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Abstract

Title of Dissertation: **A Cost Benefit Analysis of the AIS system in Sweden**

Degree: **MSc Maritime Administration**

The dissertation is a study of the costs and benefits associated with the AIS system in Sweden and the chosen method is <u>to interview key persons in the SMA and in the SCG</u> since these authorities are important stakeholders.

First, the topic is introduced and the background to and the purpose of the study are described. Then the stakeholders themselves are described together with a theoretical framework consisting of the AIS technology. Also, the reason for how and why a Cost Benefit Analysis can be a helpful tool <u>while determining if the AIS system is beneficial in Sweden and contributes to the common welfare in our society is presented.</u>

The results shows that the SMA and the SCG see quite many benefits with the AIS system; such as <u>enhanced efficiency in SAR operations and that it helps the SCG in their surveillance of the Swedish coast, and brings lowered fuel costs for ice breakers.</u> But most benefits are in spoken words and not quantified in terms of saved lives or prevented accidents where the environment remains unpolluted.

The concluding chapter states that it is hard to determine if the AIS system in Sweden <u>make some of the stakeholders better off without making some others worse off</u> (a so-called Pareto improvement in new welfare economics). Several of the respondents express benefits with the system which are beneficial for safety and environmental protection but there is a lack of quantitative measures.

<u>More studies need to be conducted</u> to decide if the AIS system is beneficial in monetary terms or in terms of e.g. saved lives or prevented accidents in the Baltic Sea.

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List of Abbreviations

SMA: Swedish Maritime Administration

SCG: Swedish Coast Guard

CBA: Cost Benefit Analysis

PSSA: Particularly Sensitive Sea Area

HELCOM: The Helsinki Commission

IMO: International Maritime Organization

AIS: Automatic Identification System

VTS: Vessel Traffic Service

IDABC: Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens

SAR: Search and Rescue Operation

IALA: The International Association of Marine Aids to Navigation and Lighthouse Authorities

TDMA: Time Division Multiple Access

DSC: Digital Selective Call

GNSS: Global Navigational Satellite System

SOTDMA: Self-Organizing Time Division Multiple Access

ECDIS:

GPS: Global Positioning System

BIM: Baltic Ice breaking Management

BSIS: Baltic Sea Ice Service

EMSA: European Maritime Safety Agency

VDR: Voyage Data Recorder

Chapter 1
INTRODUCTION

The Automatic Identification System (AIS) technology is beneficial and is used in Vessel Traffic Service (VTS) centrals (ship to shore) and as ship to ship identification system in the Baltic Sea as well as in other parts of the world. Benefits like the simplification it brings to identification of vessels carrying the system makes it powerful. This study only investigates the potential of the AIS system in the hands of the Swedish Maritime Administration (SMA) and the Swedish Coast Guard (SCG). The use in VTS centrals, but also other benefits will be presented together with the costs. The joint venture of Helsinki Commission (HELCOM) is one of the most important organisations caring for the marine environment in and adjacent to the Baltic Sea. So, there are many efforts to preserve the Baltic Sea, recently appointed as a PSSA (Particularly Sensitive Sea Area) by the International Maritime Organisation (IMO). On the other hand, there are several reasons for shipping activities in the area. Indeed, even the probability for increased trade in the Baltic Sea- partly due to expected increase in the amount of oil transport- is beneficial for the economies in the countries surrounding the Baltic Sea.

A good reason for continuous westbound oil transport from the large ports from the Gulf of Finland is the prize of crude oil. A new record was set on July 8, 2006 when the price was more than USD75 and 78 cent per barrel for crude oil which will be delivered in August (Swedish Radio, 2006). But also many other types of cargo vessels represent a considerably large part of the traffic moving in the area, all year round all around the clock, now and most probably in the foreseeable future.

The AIS technology is based on the VHF communications network which consists of transmitter/receiver on ships and ashore. But why does it seem extra beneficial for coastal states in their effort of trying to monitor traffic passing their coastline? What are the potential costs and benefits with the systems when used like this? There are several reasons why the AIS and the VTS systems were introduced and are used. The AIS is mandatory for most merchant vessels by the IMO and it is also stated in SOLAS, chapter V, regulation 12:2 that “Contracting Governments undertake to arrange for the establishment of VTS where, in their opinion, the volume of traffic or the degree of risk justifies such services.” SOLAS, chapter V, regulation 12:3 explains that Governments in this work shall follow the guidelines developed by the IMO. The use of VTS may only be made mandatory in the sea areas within the territorial seas of a Coastal State.” This leaves the floor open for less mandatory communication between VTS and vessels in the parts of the Baltic Sea outside the coastal states’ territorial seas. Anyway, the coastal states put a lot of effort into trying to monitor and survey the traffic in the Baltic Sea using the AIS technique and have also succeeded in their aim; to cover the whole Baltic Sea traffic by installing AIS base stations all around the sea.

By also using AIS in the VTS centrals around the Baltic Sea, the coastal states get an even better picture of the traffic situation. There are several reasons why the AIS may and should be implemented and used as a safety tool in the VTS system. The objective of a VTS central is to get an overview of the traffic in the area and be able to respond to various situations which might occur. The preventive part is of major interest as it shows how to act in order to prevent an accident. Due to time constraints, this study will be restricted only to the Baltic Sea, and not only that, only to the Swedish part of the area. Still, many efforts which have been made real in the aim of protecting the Baltic Sea from pollution, not only from ships, are multilateral in this area. Examples of these are a great number of HELCOM projects and also the EU project Safeseanet (described in chapter 3).

After the Prestige accident outside Spain it was obvious that all efforts must be made to protect the coastlines in case of an oil spill and most of all the work of prevention must continue also in the future. The AIS systems are among other things also included in a computerized system up and running in all EU member states, in a system called Safeseanet. The objective of the system is to collect data of marine traffic in the waters of the European Union. The oil spill from Prestige put some action into these ideas and today all EU countries will immediately be informed if for example a single hull tanker carrying crude oil (banned by the IMO and single hull tankers to be faced out by 5 April 2005) travels westbound in the Baltic Sea (MSEP Committee - 50th session: 1 and 4 December 2003). According to Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens (IDABC), the first information of the vessel itself is achieved by using the AIS system and then contact the vessel to control the information. If it is a vessel representing a potential threat to the marine environment, then the information can be put forward to all EU member countries (plus Iceland and Norway being part of the system). This means that all countries the vessel will pass within the union will be noticed (IDABC, 2006).

According to HELCOM, the maritime activities in the Baltic Sea makes the fairways busy while the economies of the surrounding States are growing. "This can lead to increased pollution and a threat to the marine environment. The risk of a potentially disastrous oil spill is particularly rising as traffic intensifies "(HELCOM, 2006). Speaking of risks, HELCOM considers that the increased traffic means that the risk of a potentially calamitous oil spill rises. The objective must be to continue shipping and off shore activities but make sure everything is done in an environmentally friendly way to reduce accidents to a minimum and so that the maritime activities leave lowest possible harm to the Baltic Sea. The way of achieving this is to reduce emissions and illegal discharging of waste from ships, strengthening maritime safety and the readiness of response to maritime accidents (HELCOM, 2006).

Still, the risk of pollution might be considerable, but the risk of pollution through an oil spill is under debate. There is no doubt that there is a great risk for such an accident today, and the risk may increase in the future. According to HELCOM, the risk for pollution (in 2015) from a large oil spill involving over 10,000 tons of oil has been estimated to increase by 35 per cent for the whole of the Baltic Sea, and by 100 per cent for the Gulf of Finland due to increased oil transports in the coming years. Scholars are questioning how large the risk of an oil spill really is at the moment, and also how it will change over the coming years since oil transport in the Baltic Sea is supposed to increase considerably from principally the Russian ports in the Gulf of Finland (Schröder, 2006).

But since the area of interest in this study is dedicated to the possible costs and benefits of the AIS system in Sweden, whereby the aim is to show how it might be used to prevent accidents from occurring the focal point will be only Sweden. The SMA is constantly working with research-, development- and demonstration activities within the special areas of the Administration, such as ice breaking, hydrographic survey, positioning determination and communication among other things. These are some of the areas of interest for the SMA, and are at the same time areas where the AIS technique might be useful (SMA, 2006). Being a governmental institution, the pure existence of the SMA is based on the following quota from the organization itself. "The Swedish Maritime Administration shall work towards creating favourable conditions for shipping in Sweden and for Swedish shipping" (SMA, 2006). Notable is also the fact that to achieve this objective one major concern for the SMA is to work preventive with safety matters, for example to constantly develop the knowledge of how to prevent an accident. The money spent by the Administration is mostly covered by user fees. But in the aim of showing benefits with the AIS, primarily as a preventive tool, a Cost Benefit Analysis (CBA) will be conducted. The objective of a CBA is to show if there are any utility achieved for the society as a whole when an AIS system is implemented.

A CBA is one way to evaluate AIS in an economist’s point of view and in this study at least the benefits of the AIS system might be tricky to quantify. This is not necessarily a bad thing; on the contrary, the discovered benefits will primarily be presented in a qualitative form. The conclusions in this study will come from several trustworthy sources including scholar papers and other written material as well as from several interviews with employees in the SMA. Still, if possible, also a quantitative CBA will be conducted because this is needed to express the benefits in e.g. monetary terms or expressed in the amount of time saved or even in the number of spared lives thanks to the AIS system.

One of the aims in this study is to bring an up to date report on the use of AIS in Sweden with focus on the use in shore based facilities belonging to the SMA like VTS centrals but also for hydrographical surveys, Search and Rescue (SAR) and ice breaking units. In other words, benefits and costs identified will only be those belonging to the SMA and the SCG, even though other stakeholders can contribute to a study like this one. Unfortunately lack of time is a hindrance and also a reason for narrowing the study to costs and benefits in the SMA and the SCG. However, hopefully this study will also be of interest for the Administrations and Coast Guards in the other coastal states of the Baltic Sea since it is a common interest to protect the Baltic Sea from pollution, which is the overall reason for this study.

Chapter 2

Method

In this chapter the method which the study relies upon will be described. The decisions along the way will be motivated since these always have some impacts on the results and will affect the outcome of the study.

The chosen path

A qualitative approach

The purpose of this study is to identify costs and benefits with AIS. One major concern is naturally to examine the system primarily in terms of how to prevent accidents since the system was introduced mainly because it was supposed to enhance safety. Safety can be a benefit for vessels at sea but also for shore based VTS centrals while monitoring traffic. The AIS information might also be beneficial indirectly. AIS information can be beneficial for ice breakers and for hydrographical purposes which arguably can be beneficial and enhance safety.

An interesting part in this CBA will probably be to see how the selected users consider the systems as costs or benefits. When making an analysis like this, it is important that both the costs and the benefits are described by the users in a proper and explicit way during the research work if possible. This can be done with an interview guide or a questionnaire. In this case, it might be easier to quantify the costs in comparison with the benefits. The benefits of the system may sometimes be hard to quantify because it is difficult to specify how the systems for example, are saving money due to more efficient use of ice breakers, for hydrographical surveying and how the systems may save money in the prevention of an oil spill. For this reason, the study is qualitative to its nature.

Limitations

However, since the purpose is to increase the utility in the society or in other terms to increase the welfare, all stakeholders should be considered. The ship owners are obliged to implement the system (but their opinion is important, however not included in this study due to lack of time) and the users in the SMA and the SCG has chosen two implement the system. But not only the users are of interest, all stakeholders, like other organizations (e.g. organizations concerned with the environment in the Baltic Sea) and indirectly also the people of Sweden can be affected by the use or nonuse of the system. But there is also a need to be concerned of people from other countries in the vicinity of the Baltic Sea who might be affected of the use or non use of the AIS system. Its influence on safety and environmental protection in that area is the major concern in this study. For that reason, the international cooperation regarding the AIS system in the Baltic Sea area is described in the theoretical framework of this study as well as by the interviewed key persons. However, lack of time limits this study to Sweden and interviews of key persons in the SMA and the SCG.

The interviews

Since the opinions of the some of the users are of interest in this study and the author is employed by the SMA, interviews were chosen as a suitable method to gather information from the SMA and the SCG. 13 interviews were carried out in total. Ten of the respondents were interviewed with an interview guide and two additional interviews were conducted with staff members of the SMA (Gunnar Eriksson, Markus Lundkvist). The last interview were conducted with a representative of a firm (Kent Sylvén, Adveto) to get fresh information about the market and prizes of AIS systems in Sweden. The two staff members of the SMA were interviewed partly with the interview guide and this was (together with other collected data in written form) most helpful in understanding the problem (the costs, benefits, implications and risks with the AIS system). They were, in other words, not subject for the interview guide as a whole, and their views gave the author an insight in the problem. The ten respondents who completed the whole interview guide were chosen since they represent different part of the SMA and the SCG and were considered most suitable for answering the questions. The two staff members, together with my supervisor, helped in choosing the ten respondents, and also gave advices and discussed other matters concerning the structure and aim with the project. The ten interviews with the respondents were conducted over the phone and lasted for about one and a half hour each.

The design phase of the questionnaires was structured into some different categories;

- Present benefits of the AIS technique
- Future benefits of the AIS technique
- Present cost of the AIS technique
- Future costs of the AIS technique

According to Sproull (Sproull, 2002) the interview over telephone may be used when you need to save costs. This was also one of the reasons to choose it. Another reason was that it was far more practical to do it that way since the interviewed staff from the Administration and also the one representative from the SCG are located in different cities. The interviews could therefore never be performed at the same time and several trips would be needed just to complete the interviews. The four categories of questions were complemented with additional questions within the area of interest for that particular key person chosen to participate in the study. Since the different key persons had different responsibility areas the interview guide were only divided into these four categories to avoid excluding something of interest in the study due to a too narrowly designed interview guide. See appendix 7 for the exact questions within the categories. However, quite some additional questions were asked to the different key persons during the interviews. When the interviews were completed, all respondents got a copy of the text from the interview and had the possibility to correct eventual misunderstandings. Some of the interviews were also complemented with one or several additional phone calls to once again make sure that there were no misunderstandings between the interviewer and the respondents in the study. Furthermore, the key persons in this study expresses their opinions as experts at the SMA and the SCG, sometimes this means that suggestions about what should be done in the future may not always be coherent with the official point of view of the organization they represent. Naturally, sometimes the suggestions made will take place in the near future since the key persons in some cases also have the authority to do so. Finally it should be noted that a key person reflects only one persons opinion which means that there is always a possibility that some interesting part is missing. But it is in the author's opinion that the key persons are most suitable as respondents in a study like this one.

The additional data collection

In addition to the interviews, extensive amount of information about the AIS system and the possible use of it have been collected. This is explicitly shown in the theoretical framework of this study and also in the first chapter where recent research and opinions about the AIS system in terms of why and how it is beneficial for the users; especially for a coastal states Maritime Administration. However, the major part of the literature review may be found in the third chapter about the AIS system and where it might be used. That chapter also contains information about some economical principles of welfare and how to conduct a proper CBA, but there will also be a description of the SMA and the SCG.

Chapter 3

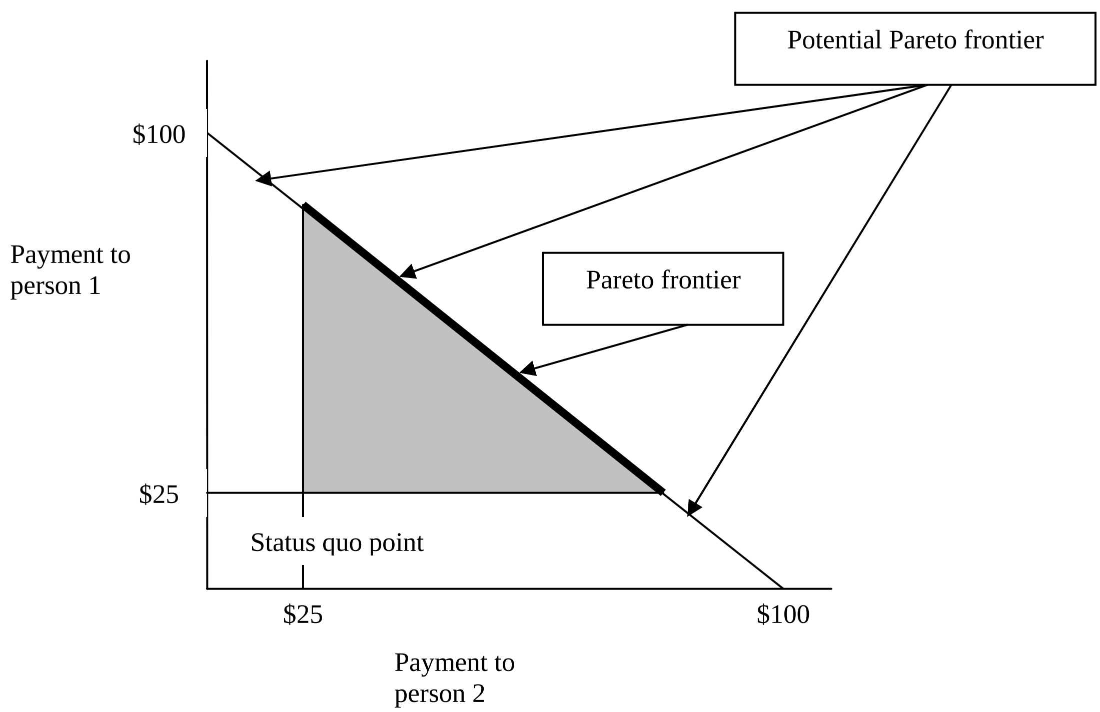
Cost Benefit Analysis

In this study it is of outmost importance to present the theoretical framework of the CBA. This is a technique widely used to determine in quantitative or qualitative terms if a new project or investment in for example the public sector should be established or not. In CBA, like other measures in economic theory it is assumed that all resources in a society are limited. For that particular reason, a project in SMA worth investing in will also be a project which will be beneficial for the society in which it is implemented. The benefits for the members of a society can be described quantitatively or qualitatively and are expected to increase the welfare for at least some members of the society. The CBA shows if a project increases or decreases the welfare in a society. However, if necessary, it is wise to complement a CBA with other techniques which might influence the utility or welfare in a society. The purpose of this study is to present the costs and benefits of the AIS system in Sweden and CBA is the method chosen to evaluate and estimate how Sweden benefits from the AIS technique which will also be described later in this study. All together, this is the theoretical framework upon which the results from the interviews from personnel in the SMA and the SCG and the analysis will be based on.

Welfare in a society

To study economy is to study the society this will help in making decisions. According to Case, Fair, Gärtner and Heather (1999) economics has deep roots in social philosophy where one eternal question is why some people are rich and some people are poor; a question about distributional justice. CBA does not deal with income distribution or economic justice, but is definitely a tool designed for the decision making process of how the resources should be distributed to benefit members of a society. Regardless of the present welfare among the members of a society, all projects (e.g. an investment, but could also be used for evaluating new laws or policies) in the public sector (bridges, tunnels, new railways or an AIS system) should only be implemented if it is supposed to increase welfare for the society. A new project might increase the welfare (if one person is made better off) for one individual, but might at the same time make someone else worse off. This means that maximum well-being has been reached and the system is *Pareto efficient*. Pareto efficiency is one of the fundamental pillars upon which new welfare economics approach –the theoretical base for all policy economics- is based on and can be practiced in all branches of the public sector of a society (Case, et al. 1999). Pareto efficiency is usually expressed in the following way:

FIGURE 1 PARETO EFFICIENCY



Source: Boardman, Greenberg, Vining, Weimer 2001

In the figure, a fixed amount of money ($100) shall be allocated between two persons. The potential Pareto frontier represents all the feasible splits where the entire $100 is allocated. The part of the potential Pareto frontier which gives at least as much as the status quo is called the Pareto frontier and the shadowed area represents all possible allocations where at least one of the persons will be better off than the status quo without making the other worse off. The conclusion is that the status quo is not Pareto efficient but any point in the shadowed area is a Pareto improvement. But only a Pareto improvement which reaches up on the potential Pareto frontier is Pareto efficient (Boardman, Greenberg, Vining, Weimer 2001).

If a policy, for instance a decision to implement the AIS system, has positive net benefits it means that it is possible to make at least one person better off without making anyone else worse off. The method sometimes used while conducting a CBA is called the Kaldor-Hicks criterion. This is an economic principle underlying the CBA. If an AIS system, with the intention (among other things) to prevent incidents at sea, and the present and future benefits exceed the present and future costs of the system it shall be implemented. But, in real life it is hard to implement for instance a policy since where some may benefit from it; it might impose losses on someone else. This is why the Kaldor-Hicks criterion is often being used and it can be expressed as follows: “Invest in all options where the beneficiaries can and will compensate the losers, such that there is a residual excess of benefits” (Walshe, Daffern 1990). But, in reality, this criterion requires only that policies have the potential to create Pareto improvements. The arguments behind this are the idea that different people bear costs under different policies which means that few will actually bear net costs. If there appear to be net losers, they can also be compensated through redistribution of income or wealth (Weimer, Vining, 1999).

How to determine the costs and benefits

There are three existing methods of expressing the benefits and costs of a project. Net Present Value (NPV) is a method where all present and future costs and benefits are included. Future costs and benefits are discounted to a present value. The formula is as follows: $NPV = NB_0 + [NB_1 \times 1/(1+r)^1] \ldots + [NB_N \times 1/(1+r)^N]$ where NB is the Net Benefit in periods 0, 1…to N; and r is the discount rate. Another method is the cost/benefit quota where a project should be implemented as long as the ratio is more than 1 and a third commonly used method is to calculate the internal rate of return on the project. While conducting e.g. an NPV calculation, it should be complemented with a sensitivity analysis. This means that the calculation will be conducted a couple of times but with different discount rates to present a range of possible NPVs (Walshe, Daffern 1990).

If there is a lack of ability to quantify the results in a study, still a lot can be done. So called non-economic factors can broaden the analysis and are not be considered as less valid since all the effects in "…an investment choice may be regarded as having costs or benefits (or both). On this view it is wrong to separate out any particular effects as 'non-economic'" (Walshe, Daffern, 1990).

Also, the opportunity cost of a project must also be taken into consideration. The opportunity cost of a project equals what could have been done with the resources if it was not invested in a particular project. As long as the project will affect a potential Pareto improvement compared with the present situation, and as long as the value of the outcome of that project exceeds the opportunity cost it should be realized (Mishan, 1984). This approach is extensively practiced in health care analysis where the primarily evaluation method is CBA and when there is hard to estimate quantifiable benefits, qualitative benefits expressed in terms of effectiveness or utility. Some examples could be to evaluate "…quality of life issues such as pain and suffering; something which CBA often fails to incorporate" (Brent, 2003).

Why a CBA on the AIS system in Sweden?

One major concern (apart from safety) in this study is environmental protection. The AIS system might promote safety but the system might also have some positive effects on the protection of the environment. This can be expressed in terms of reduced pollution in the area of concern; the Baltic Sea. Everyone wants a clean environment as long as someone else pays for it. According to Varian, "…there is still the problem of determining the most cost-effective way to achieve the targeted reduction" (Varian 2003). One interesting part of the CBA on the AIS system in Sweden is to examine if the system is a beneficial instrument in determining the most cost-effective way of reducing pollution from the shipping industry. The SMA should among other things supervise the maritime safety, plan the infrastructure and services regarding fairways, contribute to ecologically sustainable development of shipping and assume responsibility for the co-ordination of maritime geographic information. The main income source for the SMA is user fees since the Administration while exercising its objectives is organized as a self-financing organization. The ship owners on the other hand, cannot – no matter how much they appreciate it- decide whether or not they want the system on their vessels since it is mandatory for most ships. They are obliged to have a demand for the system and can only choose between different brands, buy the equipment and install it. But the SMA and the SCG has to decide how they want to use the system, e.g. in their surveillance centrals, and can choose whether they want it or not. Since there is no free market that can express demand for the AIS system, CBA is often the only method to allocate resources. However, also the costs and benefits for the ship owners are of interest if the objective is to see if the system is beneficial for the society. But this CBA will focus on the costs and benefits for the SMA and the SCG. And this is a good start to decide if the system is beneficial and if it was a good idea to install it some years ago. Still, it should be complemented with additional studies presenting the benefits for the other stakeholders.

AIS technology and the stakeholders

Throughout history, technique has always improved. Today, two very important tools in the aspect of monitoring traffic from ashore are AIS and VTS technology. The AIS technology is used to send and receive information both as ship to ship as well as for ship to shore. The VTS centrals are used for surveillance and monitoring of traffic in a certain area. In this study the VTS will be described as one of the more important features within which the AIS technology can be applied. The AIS was introduced in Sweden 2001, since the system is outstanding when it comes to identification of vessels in a certain area it is assumed that the AIS contributes to reduce accidents and also contributes to maritime safety and environmental protection in the Baltic Sea.

AIS –how is it being used?

The AIS technology is based on the VHF communications network which consists of transmitter/receiver on ships and ashore. The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) describes the system in brief words as a way of monitoring ships from other ships as well as from the shore with certain base units. The technique behind the system is that vessels with AIS transmit messages including vessels position, course and speed over ground and heading. If two vessels meet each other they will identify each other and keep an eye on each others course, speed and heading without any help from the shore based system since the shipboard equipment functions without help from ashore (IALA, 2006). But also the shore based stations are individual units which can monitor the traffic within a certain area. This means ship and shore based technology is not dependant on each other, but may indeed be used as complement to each other. When there are vessels in an area equipped with AIS base stations, the shore central receives the same vessel information as all the AIS equipped vessels. The AIS combines strong situational consciousness and the ability to find other vessels in the surroundings which is a great contribution to safer navigation (IALA, 2006). It surpasses radar when it comes to functions such as detecting another vessel hidden behind a curve in a river (due to longer wave length) for instance by utilising the VHF network. However, this ability might be reduced if the surrounding landscape in a river for instance consists of high mountains. The coverage area of the AIS system is like other VHF based systems dependant upon where the antenna is situated, i.e. the higher the antenna, the larger the area which the AIS system covers. The problem with radar equipment not giving reliable data of surrounding vessels in heavy rain as well as due to sea clutter is a non existing problem while using the AIS technique (IALA, 2006).

The information in the system according to *the IMO Resolution MSC.74 (69) Annex 3, Recommendation on performance standards,* consists of four categories: static, dynamic and voyage related information and short safety related messages:

Static information:

- IMO number (where available)
- Call sign & name
- Length and beam
- Type of ship
- Location of position-fixing antenna on the ship (aft or forward part of the ship and port or starboard of centerline)

Dynamic information:

- Ship's position with accuracy indication and integrity status
- Time in UTC
- Course over ground
- Speed over ground
- Heading
- Navigational status (e.g. NUC, at anchor, etc. - manual input)
- Rate of turn (where available)
- Optional - Angle of heel (Field not provided in basic message)
- Optional - Pitch and roll (Field not provided in basic message)

Voyage related information:

- Ship's draught
- Hazardous cargo (as required by competent authority)
- Destination and ETA (at masters discretion)
- Optional - Route plan (waypoints) (Field not provided in basic message)

Short safety-related messages

These categories of information are being up dated but not at the same periods in time. This means that static and the voyage related information which is being updated every six minute has another period of validity than the dynamic information which is updated more frequently. Safety related messages can be updated as required. See Table 1 for update intervals of the dynamic information:

Table 1: Reporting intervals for different type of ships

Type of ship	**Reporting interval**
Ship at anchor	3 min
Ship 0-14 knots	12 sec
Ship 0-14 knots and changing course	4 sec
Ship 14-23 knots	6 sec
Ship 14-23 knots and changing course	2 sec
Ship > 23 knots	3 sec
Ship > 23 knots and changing course	2 sec

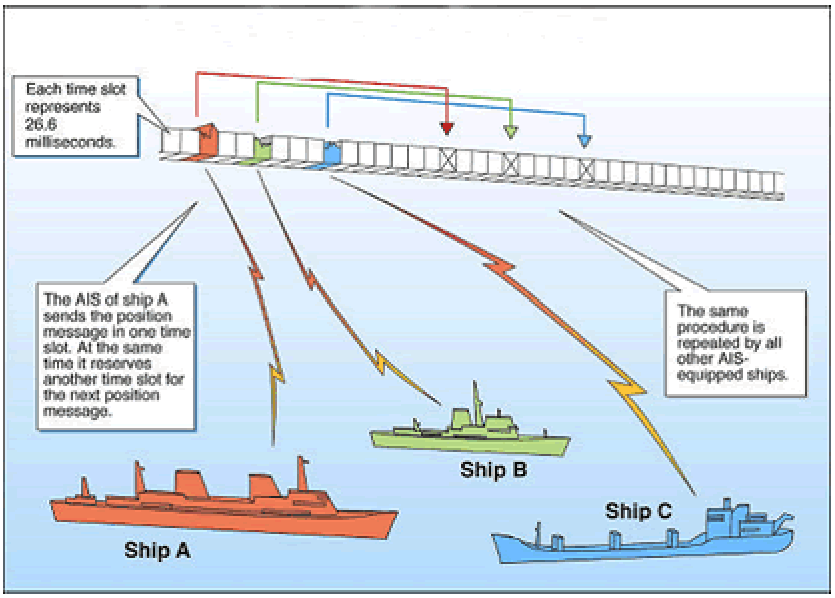
Source: IALA 2006

The technique behind – a brief description

Each and every AIS system contains some different parts; these are one VHF transmitter, two VHF TDMA (Time Division Multiple Access) receivers, one VHF DSC (Digital

Selective Call) receiver and also marine electronic communication links to display pictures on the bridge and for the sensors. Information such as position information is derived from a global navigation satellite system like the GPS receiver. In addition there is a need for another type of receiver, a Global Navigation Satellite System (GNSS) receiver working on another frequency to get an accurate position in coastal waters (IALA, 2006).

Figure 2: The SOTDMA technology



Source: US Coast Guard 2006

The system requirement by the IMO is 2000 time slots per minute but has the capacity of being overloaded and truly provides 4500 slots per minute thanks to the SOTDMA (Self-Organizing Time Division Multiple Access) broadcast mode. The technology provides sharing of time slot which apart from the capacity of overloading and still keeping an almost 100 per cent usage for ships closer than 8 to 10 Nautical Miles to each other (ship to ship mode) (US COAST GUARD, 2006). The range of the VHF antenna at sea is nominally 20 nautical miles. However, the usage of shore based repeater stations, like it is done in the Baltic Sea, means that the area of coverage for vessels as well as for shore line VTS centrals will be improved considerably. Another quality of the system is that it is backwards compatible with digital selective calling systems. This means that the Global Maritime Distress Safety Systems (GMDSS) on shore may start AIS operating channels where AIS equipped vessels can be identified and tracked.

AIS is mandatory

The AIS system is mandatory for certain ships since SOLAS chapter V, regulation 19 2.4 explains the conditions for which vessels need to have an AIS installed aboard. “All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS)” (SOLAS, 2004).

The explicit conditions are as follows in Regulation 19 2.4.1- 2.4.7 where it is stated that all ships constructed on or after 1 July 2002 or ships engaged on international voyages constructed before 1 July 2002 (passenger ships, not later than 1 July 2003, tankers, not later than the first survey for safety equipment on or after 1 July 2003). Ships other than passenger ships and tankers, of 50,000 gross tonnage and upwards, not later than 1 July 2004 (30,000 gross tonnage and upwards but less than 50,000 gross tonnage, not later than the first safety equipment survey after 1 July 2004 or by 31 December 2004). For ships not engaged on international voyages constructed before 1 July 2002, not later than 1 July 2008. According to SOLAS chapter V, regulation 19 2.4.2- 19 2.4.4, it is also stated as follows:

2.4.2 AIS shall:

.1 provide automatically to appropriately equipped shore stations, other ships and aircraft information, including the ship’s identity, type, position, course, speed, navigational status and other safety-related information;

.2 receive automatically such information from similarly fitted ships;

.3 monitor and track ships; and

.4 exchange data with shore based facilities;

2.4.3 the requirements of paragraph 2.4.5 shall mot be applied to cases where international agreements, rules or standards provide for the protection of navigational information; and

2.4.4 AIS shall be operated taking into account the guidelines adopted by the Organization (refer to the Guidelines for the on-board operational use of ship borne AIS adopted by IMO by resolution A.917 (22), as amended by resolution A.956 (23). Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.

IALA NAVGUIDE states the purpose of the system as "…identifying vessels, assist in target tracking, simplify and promote information exchange, provide additional information in order to assist in collision avoidance and reduce verbal mandatory ship reporting" (IALA, 2001). According to IMO Performance Standards for AIS, it will also be a tool for providing safer navigation as a part of the shipboard safety system, contribute to preservation of the marine environment, and also be a part of an efficient VTS central. This will be done by operating as a ship-to-ship and as a ship to shore tool (IALA, 2006).

Costs of the AIS

The costs of the AIS system are of course of great importance since this is a system mandatory for a great number of vessels. However, the costs of an AIS system are, considering the previously mentioned necessary onboard equipment, at least not very expensive, but the costs will be quite high if the vessel decides to invest in top of the line equipment and use the AIS incorporated in an ECDIS system on the bridge. Some examples of prizes of the equipment will be presented later. The shore based equipment costs for an administration includes cost for maintenance and transmission costs. Radar is considered to be cheaper compared to radar for receiving the same coverage (SMA, 2006). Costs for the AIS system in Sweden, the author's area of interest, are shown explicitly later in this chapter. However, there might be some risk with the AIS system. The reduced communication between vessels equipped with AIS, can be considered as a loss of communication for all other vessels *not* equipped with the AIS system. Notably is the AIS system has the same vulnerability as the VHF-FM network (Blomberg, 2005). There is also a risk of becoming overly dependent on AIS and forgetting other navigational equipment like radar is another possible risk. Also there is a fear that "…pilotage and VTS might become superfluous" (Berking, 2003).

Benefits of the AIS

The establishment of shore based VTS stations with AIS technology is up to the coastal state, though recommended by the IMO for states who see benefits and not only costs associated with the system. Naturally, the identification data about the vessel provided by the system together with improved vessel tracking (very few radar shadow areas and real time manoeuvring data) are truly beneficial. Also, "It (AIS) will also make it possible to identify, track and supervise ships from shore with a much higher and more sustainable accuracy than with a shore based radar" (Pettersson, The Swedish Club letter 2001). But also information about dangerous cargo and the reduction of voice messages, electronic transfer of sailing plan information or safety messages is considered beneficial. Also the possibility of recording and archiving AIS information is beneficial (IALA, 2001). Still, it is not proved that the AIS make the vessel equipped with AIS to communicate less. But if this is the case there is most likely a reduction in navigational matters rather than in "social chatter" (Blomberg, 2005). Other areas of potential benefits for the AIS system is the statistical data collected in the system which might be most helpful for hydrographical surveys, ice breaking and SAR operations (IALA, 2006).

Vessel Traffic Services

VTS is an important tool for a coastal state for the purpose of monitoring and surveillance of traffic in an area. VTS is also important within the framework of this study since the AIS systems in numerous countries are incorporated in the VTS centrals and functions, together with other modern technologies such as ECDIS, Radar and GPS.

Definitions and purpose

According to the US Coastguard, there are two main types of VTS centrals; the ones with surveillance and the ones without surveillance. The ones with surveillance systems consist of sensors along the coastline. These sensors give away signals to a centre from which the movement of the vessel traffic in an area may be managed and monitored. A central without surveillance only uses reporting points for the traffic in the area where they have to report their identity, course, speed and so on (US Coastguard, 2006). However, "The same type of VTS system cannot achieve the same degree of risk reduction in all waterways" (Vessel Traffic Services 1984). The geography of the waterway, the intricacy of vessel interaction and the chosen systems in the VTS will be the key factors to determine how effectively the risks have been reduced (Vessel Traffic Services 1984. Furthermore, there are according to IALA VTS Manual, three different levels of VTS centres (IALA VTS Manual, 2002). The competent authority in the country must decide if they want and think they need an information service, navigational assistance service or traffic organisation service. The information service provides information to facilitate the shipboard navigation. The navigational assistance service is also meant to assist the navigation process on the vessels under certain complex situations. The VTS operator can also participate in the decision making process and monitor the effects in for instance, an area with very dense traffic. The third level, to have a traffic organisation service, serves the purpose to "…prevent the development of dangerous situations and to provide for the safe and efficient movement of traffic within the VTS area" (IALA VTS Manual, 2002). This may include speed limits, special routes to be followed and decision on the priority of movements in the area. The VTS system is also described in SOLAS 5:12. "VTS contribute to safety of life at sea, safety and efficiency of navigation and protection of the marine environment, adjacent shore areas, work sites and offshore installations from possible adverse effects of maritime traffic." Further on the regulations state that the VTS establishment shall follow IMO guidelines and that the VTS can only be mandatory for the traffic in the area if the area is in the Coastal States' territorial seas and if supported by the IMO.

Costs of the VTS

To establish a VTS central is costly, and also the running costs are quite high (IALA VTS Manual, 2002). While determining costs for a VTS it is done in quantitative and monetary terms. Anyhow, the potential costs of a VTS are difficult to estimate. However, the costs should include investment costs (feasibility studies, buildings, equipment, organisation set-up and project management), operational costs (maintenance and repair of buildings and equipment, personnel, consumables such as power, water, communication). Costs for VTS centrals in Sweden are shown later in this chapter. It can be seen that the costs of a VTS widely exceed the costs of the AIS system in Sweden.

Benefits of the VTS

The benefits are several and somewhat implicit in the explanation of the different types of centrals described in the previous section. Anyway, it is considered to be even harder to estimate the potential benefits from a VTS than the potential costs. To describe the potential benefits it should probably include reduced risk for damage to life, infrastructure and environment, which might be the hardest to determine. Benefits can also be both for vessels in an area and for the area (other vessels and other activities in the vicinity) itself. These indirect benefits are very tough to determine. But if a VTS helps in the process of preventing or limiting the consequences of grounding or a collision, this is naturally a benefit and assessment should be made to determine how many incidents the VTS might have prevented. The same should be done to determine when the negative consequences might have been reduced by the VTS (IALA VTS Manual, 2002). Another area of benefits could be an improved economic performance. This might be expressed in the reduction of time or improved efficiency in a VTS area in terms of bringing vessels to port, which also is beneficial for all parts involved and saves time for loading and discharging of cargo (IALA VTS Manual, 2002).

AIS in the VTS

But do IMO put any requirements on a coastal state to implement a VTS or to implement the AIS system in potential VTS centrals along the coastlines? The answer is no but the organization certainly takes the opportunity in its Performance Standards of the AIS system to enlighten interested Governments and other stakeholder that the system will be most helpful if implemented. The Performance Standards for AIS from *the IMO resolution MSC.74 (69) Annex 3, Recommendation on performance standards* says that:
"1.2 The AIS should improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS)" (IMO, 2006). This shall be done in a ship to ship mode to avoid collisions, for littoral States to get information about ship and cargo, and also as a ship to shore tool for traffic management purposes. The system should also provide ships and competent authorities with information from the ship so it can be tracked (IMO, 2006).

An implementation of AIS in the VTS does not only improve the surveillance capacity but will also be able to respond to various situations which might occur. A VTS operator can immediately see what vessels are approaching the area and where it is situated (IALA VTS Manual, 2002). If a compulsory call is forgotten at a reporting point the VTS central will know what vessel is approaching unidentified. This is a real benefit since unidentified vessels in the system might create a danger to itself and to vessels in the close vicinity as well as for the coastal states if there is a collision or an oil spill occurring in the fairway. So, the AIS technique "…will help to overcome the safety weaknesses and time consuming procedures, inherent in the present arrangements" (IALA VTS Manual, 2002). In other words, AIS might reduce communication via VHF. If this is true, there is also a reduced risk for misunderstandings due to language problems (IALA VTS Manual, 2002).

Also issues as the range of which the vessel might be detected are of interest when introducing the AIS in the VTS. The signals from the AIS systems reach the VTS from other vessels, as well as from shore based stations. This means that the AIS covers a larger area or distance than the radar, since it is limited only by the range of the VHF network. In addition, "…extended VTS detection range may be achieved by the installation of additional base or repeater stations connected into a network at much lower cost than radar equipment" (IALA VTS Manual, 2002). AIS can also be integrated with an electronic chart and with radar .This can be beneficial for the VTS as this provides sufficient features in the VTS central for monitoring of the traffic in a very efficient way (IALA Guidelines on AIS as a VTS Tool).

According to Schröder, VTS and the AIS system are also considered to be an essential part of the land based safety systems in waterways management where the concerns are risk avoiding and consequence reducing measures. VTS and AIS are primarily risk reducing tools which may e complemented with on board safety systems (navigational systems, e.g. AIS as an onboard navigational system) and different measures to influence the behaviour in the shipping industry (e.g. IMO Conventions). The consequence reducing measures are technical (naval architectural) systems, organizational measures (e.g. fire fighting) and economical-humanitarian measures like SAR, salvage and emergency repairs when the accident already has taken place and something must be done (Schröder, 2006).

Swedish Maritime Administration

To increase the knowledge about the area of interest in this study, the Swedish part of the Baltic Sea, the objectives of the SMA and how they work with AIS and VTS in Sweden and adjacent waters (Malmö/Drogden, Flintrännan) will be briefly described. The purpose is also to show the potential benefits of AIS in different parts of the Administration to be able to show how AIS is beneficial in Sweden for the SMA.

The SMA should:

- Exercise supervision of maritime safety
- Identify requirements and plan the infrastructure and services for shipping regarding fairways, pilotage, ice-breaking
- Assume responsibility for maritime search and rescue services,
- Promote an ecologically sustainable development of shipping,
- Ensure that the needs of disabled people are taken into account in shipping,
- Assume responsibility for crisis management planning for maritime transport,
- Assume responsibility for the co-ordination of maritime geographic information,
- Provide information and advice regarding safety for leisure craft
- Report and document Sweden’s territory at sea and assume responsibility for maintaining and supervising the demarcation of these frontiers
- Monitor the competitive situation of the Swedish shipping industry

The organization of the SMA includes Maritime Safety Inspectorates. They are situated in Göteborg, Malmö and Stockholm, with the headquarters in Norrköping. The inspectorates are responsible for the supervision of maritime safety in Sweden. According to the SMA, 95 per cent of Swedish foreign trade is seaborne. Sweden as a society “…is dependant upon merchant vessels approaching our ports. And the Swedish Maritime Administration is responsible for this round the clock, all year.” (SMA, 2006)

Use of AIS technology in the SMA

The AIS technology has been used for quite some time in Sweden. Why does Sweden use it? Most of the global merchant fleet uses it because it is mandatory and they also have to pay for it. But another reason is because AIS is considered to be a helpful tool from ashore. The system was built up by Telia Mobile in 1996 and continuously over a couple of years. When Telia was privatized, the SMA took over everything. Since the Baltic Sea is a PSSA, a coastal state like Sweden can also strengthen regulations for discharging, route planning and mandatory reporting points and mandatory pilotage (SMA, 2004). The AIS system has some benefits for the SMA, some of which are also beneficial for preserving the Baltic Sea, which is important since the SMA is one of Sweden's authorities concerned with the status of the Baltic Sea. Coastal states like Sweden benefit from the AIS in VTS centrals in particular since they are supposed to monitor the traffic. The technique is also used for hydrographical information purposes. The information provided in the AIS system about where the vessels transit can be used to know where and when to conduct hydrographical surveys in a particular area. Today, not more than 35 per cent of Swedish waters have been hydrographically surveyed with modern methods, but the present operations are indicating that 55 per cent will be surveyed up to 2014. According to the SMA, the AIS system is also used during ice breaking and SAR operations. The SMA owns four ocean-going icebreakers and one small icebreaker. From January to March, three more icebreaking vessels are available when required via a contract with a private company (SMA Annual Report, 2005). To sum up, the use of AIS in Sweden is beneficial for the SMA and for all vessels using the system and is contributing in protecting the Baltic Sea from pollution. According to HELCOM, the technique can indeed be used in a wider scope but if the focus is to preserve a particularly sensitive area like the Baltic Sea, the AIS system is a helpful tool (HELCOM, 2006).

Coverage of the AIS system in the Baltic Sea

So, what about the range of coverage for an AIS network of base stations along a coast line? The range of the VHF is primarily also the range of AIS. Many of the shore based stations (transmitters/receivers) are located in masts with an altitude of about 300 meters. Rolf Zetterberg points out that the weather has a major impact on the coverage area of the

AIS; a high pressure for instance means full coverage of the Baltic Sea. If the weather conditions on the other hand are unfavorable there will not be full coverage. And even if the weather is perfect, there are some spots in the south east part of the Baltic Sea which are not covered (outside the coast of Poland and Lithuania) due to poor mast coverage. On the other hand, the most important fairways (e.g. outside Blekinge, Gotland and all the way to the Gulf of Finland) the traffic can always be followed all the way.

Costs for the AIS in Sweden

The AIS system is mandatory for certain Swedish ships and the system is also used as a shore based tool by the SMA and the SCG. The purpose of the system and how it is supposed to function in practice and how it is being used in Sweden is outlined in the previous part of this chapter. Some benefits with the AIS system are also described. These benefits will be extensively complemented when the results from the conducted interviews are presented together with some risks and possible costs (in qualitative terms; i.e. in words) with the AIS system will be described by the respondents in Chapter 4 of this study. But what about the costs in monetary terms of the AIS system then, is it expensive? It is now time to present the major costs for the SMA and the costs associated with the AIS system.

The costs for the SMA operations (budget 2006) are:

1. Pilotage 400,4 millions
2. Fairways 262,0 millions
3. Icebreaking 192,1 millions
4. Maritime SAR 148,8 millions
5. Maritime Safety Inspectorate 102,3 millions
6. Hydrogeographic information 49,6 millions
7. Maritime traffic information 46,8 millions

The costs for the AIS network in Sweden are accordingly:

Table 2: Costs for AIS network in Sweden

Type of cost	Cost 2005, SEK	Budget 2006
Capital cost (interest on the initial investment)	1 140 608	1 188 058
Transmission (rent for communication between masts and centrals)	988 520	973 158
In placements (rent for use of masts owned by Teracom, including premises hosting AIS equipment)	295 869	274 713
Cost of operation + support	2 566 525	2 553 843
SUM*	4 991 522	4 989 771

Source: SMA 2006

*50 per cent of the annual cost of the AIS network in Sweden is paid according to an agreement by the Swedish Defense. The total cost for AIS in Sweden 2005 for the SMA is therefore SEK2, 495, 761 (The Swedish Defense pays 50 per cent because they are interested in the information provided within the AIS network since it helps them to identify vessels along the Swedish coast). The total cost for the AIS system in Sweden has been more or less the same as in 2005 for the last five years (SMA, 2006). According to Rolf Zetterberg, SMA, some 30 base stations (out of the total numbers which is 35) along the coast will be replaced in the near future. The cost of replacement for one unit is SEK60 000 (Zetterberg, 2006).

Furthermore, the costs of the AIS network in Sweden are naturally also divided on different users (and not only on type of costs) within the organization and it is the costs for these 30 terminals which are divided. A terminal is not the same thing as a base stations, instead this is the name for the system displayed on a screen, e.g. in a VTS central there is at least one terminal in Sweden. Unfortunately, the figures of the number of terminals in the different MTAs are not completely correct since the MTAs have been rearranged and new VTS centrals have been established as previously mentioned (the figures are from 2003). However, the number of terminals is still the same and the costs are accurate. The costs for one terminal are SEK 83 607 per year and the annual costs for the different users are divided as follows:

Table 3: Costs for the AIS divided on the different users 2003

	Number of terminals	
MRCC	13	1 086 891
Bay of Bothnia	1	83 607
Bothnian Sea	1	83 607
Stockholm/Mälaren	5	418 035
East coast	2	167 214
South coast	2	167 214
West coast	4	334 428
Lake Vänern	1	83 607
Ice breaking	1	83 607
Sum	30	2 508 210

Source: SMA 2006

Uses and costs of the VTS in the SMA

In Sweden, there are six VTS centrals along the coast, established within the different Maritime Traffic Areas (MTA) of Sweden. Sweden has seven MTAs and VTS centrals in Luleå, Gävle, Södertälje (VTS East Coast), Malmö (VTS South Coast), Göteborg (VTS West Coast) and Trollhättan. VTS South Coast is responsible for pilotage not only on the South Coast of Sweden but also on the east coast until slightly north of the second largest island in Sweden, Öland, and the waters surrounding the island. The largest island, Gotland, is part of VTS East Coast. The VTS centrals are also responsible to receive requests for pilot assistance. Costs of VTS in Sweden are significantly higher than costs for the AIS system in Sweden. Budget for VTS information this year (2006) is SEK46, 283, 000. This includes all MTAs as well as expenses from the department of Marine Traffic Information at the Swedish Maritime Administrations headquarters in Norrköping. The costs of VTS will not be implemented in the CBA, only costs of AIS. Costs of VTS are presented in appendix 2 to give an overview. However, since AIS is implemented and integrated as a surveillance tool in the VTS central, these implementation costs are of interest (see costs for AIS in Sweden in Table 2) (SMA, 2006).

The planning process of a new common VTS in Malmö (Denmark/Sweden) for monitoring of the sea traffic in Öresund is taking place right now. During the autumn this year, the new central is supposed to provide sea traffic information in Drogden fairway (outside Copenhagen) and Flintrännan (outside Malmö). In addition to this new VTS (VTS South Coast), the SMA will later on also organize sea traffic information for the southern part of the Baltic Sea. The price of establishment is not publicly known yet since negotiations about contracts with different firms are taking place at the moment (SMA, 2006).

Costs for ship owners

The cost of the AIS system for the users, the vessels may vary a lot depending upon how much they are willing to spend on the equipment. According to Kent Sylvén at Adveto, a major firm on the Swedish market, prices for some different equipment packages may be as follows. If a vessel only needs the AIS transponder (including installation) the price will be about SEK30 000. If they wish to buy a complete and certified package of ECDIS (Electronic Chart Display and Information System) including AIS technique the price is from 80 000 to 200 000 depending on the quality of the equipment and the number of functions included (Adveto, 2006).

Swedish Coast Guard and the use of AIS

The SCG works for cleaner seas, enhanced safety and for sustainable fishing. This is done for the citizens of Sweden, neighbouring countries and for the EU. The SCG can with short notice perform advanced SAR or combating of marine pollution along the Swedish coast and in the internal waters of the country. The Coast Guard vessels are equipped with AIS as well as SCG surveillance centres (SCG, 2006). However, the SCG do not pay for the use of AIS. The SCG, like the Swedish Defence which pays 50 per cent, is an authority being part of the Ministry of Defence. The reason why the SCG is not paying is totally a political decision. Anyhow, 50 per cent of the costs are located under the Ministry of Defence and the other 50 per cent are paid by the SMA.

Figure 3: Bulk carrier Fu Shan Hai is sinking north of Bornholm

Source: SCG 2006

Bulk carrier Fu Shan Hai was rammed by container vessel Gdynia north of Bornholm on 31 May 2003. The SCG vessel KBV-048 tried to tow her to a Place of Refuge but did not succeed in the operation. Fu Shan Hai was carrying 66 000 MT fertilizers and 1825 tons of oil. Unfortunately 1200 tons leaked out when she sunk (HELCOM, 2003). Three years later, a traffic separation scheme entered into force (on 1st July 2006) in the area north of Bornholm.

Cooperation in the Baltic Sea region

The Baltic Sea is a sensitive sea area which has been exposed to pollution for many years. But many initiatives exist to protect and restore the Baltic Sea. HELCOM is a very important organization in keeping the Baltic Sea protected. According to Swedish Environmental Protection Agency (SEPA), the Baltic Sea is, despite 30 years of efforts, still suffering from many pollutants (even though truly the major part comes from ashore) and need more concern (SEPA 2006). One way to do this is to monitor the sea traffic and avoid pollution from vessels. This is –together with enhanced safety in shipping- truly the overall major concern in this study. According to HELCOM, the AIS system is beneficial since it contributes to the protection of the Baltic Sea from ship borne pollution and improves the safety of navigation.

HELCOM

The concern of the Baltic Sea is of outmost importance to the coastal states surrounding this inland sea. The Helsinki Commission (herein after HELCOM), is the leading body which is concerned with the Convention on the Protection of the Marine Environment of the Baltic Sea area" (HELCOM, 2006). This convention entered into force on 3 May 1980, then being revised due to political changes and also changes in international environmental and maritime law into a new convention in 1992. According to HELCOM, all states surrounding the Baltic Sea, as well as the European Union, signed the new revised convention which, after ratification, entered into force on 17 January 2000. The convention covers all sources of pollution into the Baltic Sea, where even inland waters and the sea-bed are included. Even pollution from land-based sources is considered since the whole catchments area of the Baltic Sea is included to lower this type of pollution as well. According to HELCOM, the Baltic Sea area within A1 sea area is totally covered by shore stations using AIS technique to monitor ships in the Baltic Sea (HELCOM, 2006). In HELCOM´s point of view, the "…AIS information will improve the safety of navigation via real time information as well as statistical information on shipping in the Baltic Sea. The AIS information will also be used to identify offenders of anti-pollution regulations" (HELCOM 2006). The SMA and all other coastal states of the Baltic Sea use the AIS system. In 2001, these countries decided to establish national AIS land based surveillance systems. These systems have then been integrated into a common AIS network which identifies and monitors merchant shipping, for instance all oil tanker traffic in the Baltic Sea. HELCOM is the body which consists of these States and when it comes to prevention of accidents HELCOM is by all means a very important organization since it was created to protect the Baltic Sea from pollution. It was the body of HELCOM which discussed and decided about the needs and possibilities of a joint AIS surveillance system. Today all of the Baltic Sea area is covered by this network.

In wider terms, HELCOM’s task is to safeguard the marine environment of the Baltic Sea from pollution and this is done by international cooperation in the area. The coastal states being part of the Helsinki Convention is Sweden, Finland, Germany, Denmark, Estonia, Latvia, Lithuania, Poland, Russia and also the European Community. Since the very beginning of the project the participating countries have worked with environmental protection. The project has been carried forward by the specific concerns from the environmental, economic and social situation in the area. The present work of HELCOM to achieve the objective is as follows:

- HELCOM should be a policy maker for the area when it comes to environmental issues. This shall be achieved by a joint approach when determining the environmental objectives and efforts.

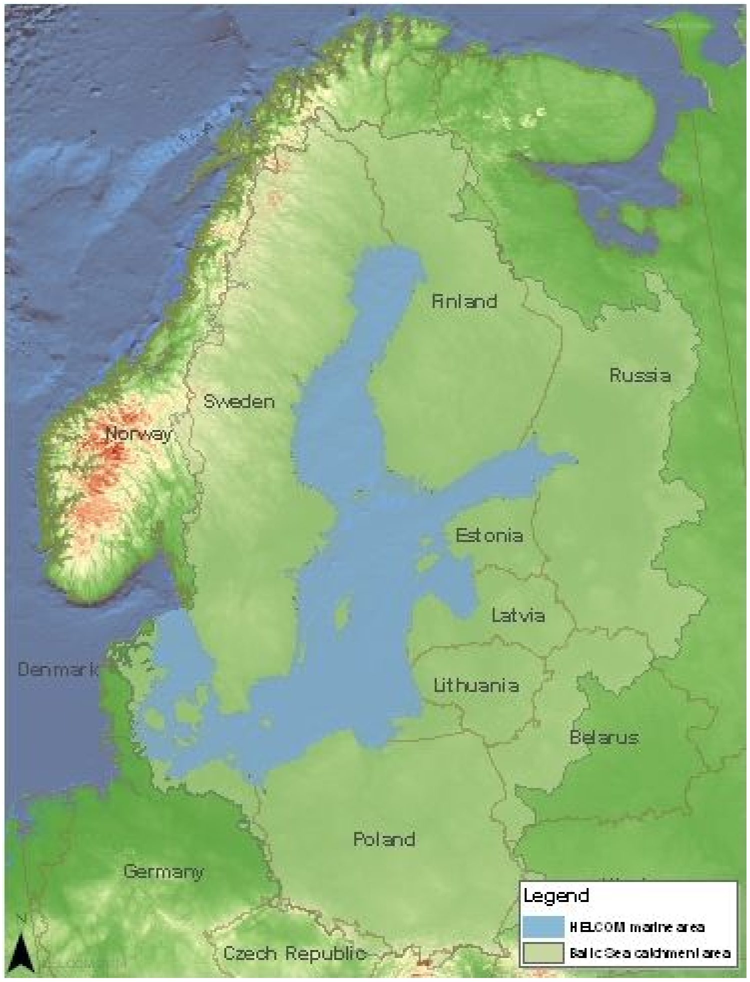
- HELCOM should be the focal point in environmental issues and have available information resources and the predicted tendencies in the marine environment. They should also have the skill to safeguard the environment and take initiative and positions representing the member States which can serve as a foundation for decision-making in the international arena (e.g. the IMO).

- HELCOM should be the hub for creating recommendations for the organization itself as well as for recommendations needed due to measures inflicted by other international organizations to the specific needs of the Baltic Sea.

- HELCOM should be a overseeing body committed to make sure that their environmental standards by all means are applied in all of the participating countries surrounding the Baltic Sea and also its catchments area

- Finally, HELCOM should also be co-coordinating body which shall make sure there is a multilateral reaction if a major maritime accident takes place (HELCOM 2006).

Figure 4: The HELCOM marine area and Baltic Sea



Source: HELCOM 2006

HELCOM´s vision for the future is "…a healthy Baltic Sea environment with diverse biological components functioning in balance, resulting in a good ecological status and supporting a wide range of sustainable economic and social activities" (HELCOM, 2006).

Traffic separation schemes

In addition to the work of SMA and HELCOM, traffic separation schemes have been established and adopted by the IMO in the following parts of the Baltic Sea area:

Figure 5: Traffic separation schemes in the Baltic Sea area

Area	**Number of schemes**
In Samsø Belt/Great Belt	2
In the Sound	2
Off Kiel lighthouse	1
South of Gedser	1
South of Öland Island	1
South of Gotland Island	1
Entrance to the Gulf of Finland	2
In the Gulf of Finland	5
The Bornholmsgat	1

Source: HELCOM 2006

These separation schemes are another important tool established to enhance safety and protect the environment in the Baltic Sea. Some of these schemes are already monitored via the AIS system (complemented by radar) and VTS centrals. The remaining part of them will also be so in the future (SMA, 2006).

Baltic Icebreaking Management

Apart from available ice breaking services in Sweden, there is also an organization called Baltic Icebreaking Management (BIM) where the ice breakers are equipped with and use AIS. This organization has members from all the Baltic Sea states. BIM’s existence is a direct consequence of annual meetings of the Baltic States ice breaking authorities, which have taken place for more than 20 years (BIM, 2006). In the winter 2002/2003 there were severe conditions in parts of the Baltic Sea due to heavy ice. A project was therefore initiated and then started in March 2004 under the auspices of HELCOM to upgrade the safety of winter navigation in the area. The Baltic Sea countries jointly initiated a group, who worked within the EU concept Motorways of the Sea, which led to the decision to let the BIM organization constitute a framework to create a more effective way of easing up the winter navigation for vessels in different parts of the Baltic Sea. In BIM, also non EU-members are participating. BIM is now an organization "…for the development of safe, reliable and efficient winter navigation between the Baltic Sea countries" (BIM, 2006). The objective of BIM is "…to ensure a well functioning, year-round maritime transport system in the Baltic Sea" (BIM, 2006). The member countries of BIM are Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia and Sweden. Information about ice conditions can be found on a website (www.bsis-ice.de) where information from all the countries are gathered in one place by an organization called Baltic Sea Ice Service, or BSIS (BSIS, 2006).

Safeseanet

Safeseanet is another project which makes the surveillance of the Baltic Sea more efficient. It is not a HELCOM project, but an initiative by the European Union with the objective of providing information about vessels traveling in waters of the European Union. The information system is computerized and fully implemented, using basic data from the AIS system about vessels trading in the area.

Most maritime authorities in different geographic locations of the European Union are being part of the Safeseanet projects according to IDABC (Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens). This organization makes sure that the computer system of Safeseanet is available around the clock everywhere, and that it is secure and that use of the system is restricted to member states only. The system serves as a resource of fast spread and useful information; however, the participating countries do not have the same computer systems and the authorities do not even always have the same objectives. In short, this means that data in different format are exchanged through different systems. For that reason

Safeseanet has implemented a Central Index System where only reference data is stored and provided to all parts. This means that the system does not hold the original information, but instead retrieves the information from one source to another upon request (IDABC, 2006).

The Safeseanet has been created in accordance with EU Directive 2002/59/EC to be the Union's vessel information system for monitoring traffic, but it is also a handy tool for control of vessels in ports (e.g. for Port State Control and reception facilities for ship generated waste). Another area where the system is considered helpful is to gather statistic for the European Maritime Safety Agency (EMSA) for future actions (IDABC, 2006). Finally, a possible use is to combine AIS information with the backtracking simulation which is done when an oil spill is detected in reality. According to HELCOM draft project description these two techniques today travel in different systems, so the task is to implement AIS information in Seatrack Web oil drift forecasting system. Then the AIS vessel information can be plotted jointly with the oil spill information to track ships illegally discharging oil into the sea. The benefits are obvious since few of the illegally discharging vessels are being identified today. The information can later on also be used as evidence in a trial (STW/AIS 2005). Apart from HELCOM and Safeseanet there is another project called Marnis (Maritime Navigation and Information Services). The main objective of this project relevant within European waters is to improve safety and protection of the environment, as well as the improvement of security and efficiency and reliability. These objectives are aimed to be achieved through some technical systems like Vessel Traffic Management (VTM) where VTS centrals and an all European network of AIS base and repeater stations will facilitate the possibility to monitor for instance sub-standard vessels or be able to provide "…sufficient salvage capabilities and the integration of VTM and SAR functions into a safety preventive and remedial network along the European coast". Important tools in this project are AIS, radar integration, ECDIS and VDR (Voyage Data Recorder), which may be implemented in a VTS or other central ashore somewhere in the EU (Marnis, 2006).

Chapter 4

The results

In this chapter the interviews are presented. These interviews are conducted with key persons in the SMA and the SCG and will together with other collected information of costs and benefits regarding the use of AIS be analysed in the following chapter. The interesting information from the interviews is of different quantity and will therefore vary in length. The results are presented within the following categories: AIS in the VTS, AIS and accident investigation, AIS in SAR operations, AIS and Safeseanet, AIS and ice breaking, AIS as a notice for mariners, AIS and hydrographical surveying, AIS and hydrographical information and AIS and the SCG. In this chapter the benefits from the AIS system in Sweden together with some risks will be explained by nine different persons from the SMA and one from the SCG.

AIS in the VTS

Rolf Zetterberg (Senior Technical Advisor, Swedish Maritime Safety Inspectorate, SMA)

The main advantage or benefit according to Mr. Zetterberg is the ability to identity the vessel with the AIS. This is a major benefit in the VTS centrals where the radar information and the AIS information is run together and then shown on a display for the VTS operator. But before the information is displayed the benefits from the two systems are weighted. Radar may be better in close range (at least to take a bearing) but at a distance the AIS with GPS technique provides a more accurate information which is ranked higher in the system, and in the displayed version of the information the AIS information contributes more than the radar.

Another benefit is that the AIS also gives size and course changes of a vessel. This is also done in the ARPA/RADAR anti-collision system but will there take a couple of minutes for the radar system to accurately detect and plot a change of course. This is also a problem since the main radar reflecting area on, for example a large tanker, is located in the aft of the vessel, the radar indicator will first show a course change to starboard if the vessel turns to port (since the aft part of the vessel first moves in the counter direction). While using AIS equipment the heading will be altered within a few seconds which means that in narrow situations the AIS provides information much faster than the radar.

The SMA will have enough information for surveillance and monitoring purposes. However, it is Mr. Zetterberg's opinion that SMA must put a lot of effort into traffic surveillance throughout the Swedish part of the Baltic Sea. The surveillance should give clear regulations for vessels in the area, especially in traffic separation areas, but also for speed limit surveillance and surveillance of draft of vessels.

Mr. Zetterberg is also involved with the work of providing a new function of the AIS system; a database with statistics of traffic movements in Swedish waters and also the other parts of the Baltic Sea. Hopefully this package (program package, database licenses, storing capacity of several 1000 Gigabytes, servers) will be ordered in August this year. The reason why it is urgent to get the system right now is because the Swedish Government has asked SMA to investigate the effects of the Baltic Sea recently approved as a PSSA by the IMO. One of the effects needed to be investigated is the dense traffic in the Baltic Sea area, e.g. the deep sea route outside Gotland made compulsory for some vessels after the approval of the Baltic Sea as a PSSA. The deep sea route among other things means that some traffic has to travel slightly longer distance on its way throughout the Baltic Sea and it is of particular interest to investigate how this affect the pollution to the environment from merchant ships. The costs for this new system is estimated to two million SEK (program package costs = SEK1, 5 million).

Also, an aspect of the costs of the AIS network in Sweden, Mr. Zetterberg means that if Sweden did not have the AIS system the SMA probably would have built more radar stations along the coastline, and radar facilities are more expensive (maybe up to 20 times, according to Mr. Zetterberg) compared to the present AIS technique.

Finally, there is also a need to describe why the Swedish Defense pays half the amount of the costs of the AIS system in Sweden. Being one of the experts of the AIS system in Sweden, Mr. Zetterberg can also contribute and give a satisfying explanation to this. The Swedish Defense benefit from the AIS technique since it provides information which is being used to identify the vessels movements along the Swedish coast. This is a useful complement to naval vessels and air crafts and make the surveillance work constantly performed by the Swedish Defense much easier. According to Mr. Zetterberg, an identification system (built on AIS technique, but before it was named AIS) appeared in the early 90s with the purpose of giving the command of the Swedish defense an overview of where all available units were located, for instance when they were searching for foreign submarines in Swedish waters.

Björn Lager (VTS Project Manager, SMA)

According to Mr. Lager, the major benefit of the AIS system for a VTS is to get control and knowledge of all vessels equipped with an AIS transponder in an area. Another crucial benefit is that only some few parts of the Swedish coastline are covered with radar surveillance.

In the future (at least one year from now) there will be a new VTS central established in Malmö, there will also be some surveillance equipment in the neighboring Öresund plus an approval by the IMO regarding reporting points within the VTS area. Also, the Baltic Sea will be silently monitored; especially all traffic separation schemes. Some areas in the southern Baltic – all sea traffic from Kullen to Falsterbo- will be actively monitored where vessels have to report before entering (Traffic Separation Schemes in that area are Helsingborg - Helsingör, and Falsterbo, see appendix). In such areas it is also possible for the VTS operator to place alarm zones and follow certain vessels (e.g. banned single hull tankers or deep draft vessels or vessels with particularly dangerous cargo). In this prediction of a pretty close future all Swedish waters including EEZ will be monitored and divided into traffic information service areas (actively monitored) and traffic information surveillance areas (silently monitored). Today these areas are only defined along the Swedish west coast. The only future problems with the AIS system according to Mr. Lager is that if too many pleasure craft install them there might be a risk that there will be too much information on the screens for the operators. A possible risk with the AIS system may occur if the Officer on Watch (OOW) focuses on the AIS on the bridge and forgets to also check the radar screen for other vessels.

AIS and accident investigations

Sten Andersson (Casualty Investigator, SMA: s Safety Inspectorate)

While conducting accident investigations, the AIS information of how vessels have been moving previous to an accident, is most helpful, according to Mr. Andersson. The descriptions of how the vessel has been moving previous to the accident – e.g. by the OOW, are sometimes not corresponding with the AIS information since no one wants to be blamed. In the collision between Finnsailor and General Grot-Rowecki (November 2005) AIS information was most helpful in determining what really happened previous to the collision. Another example he mentions, was the accident of the bulk carrier Polo M (November 2004) where the Inspectorate never would have known the reason for the grounding if there had not been any AIS information available. Fortunately, the AIS information in that case provided sufficient information to determine the reason for grounding. The AIS display also shows sometimes that vessels do not have the correct heading, something that may be commented later during a Port State Control (PSC). Other potential benefits are that since the system is cheap, more vessels are installing it, even vessels that are not required to carry the equipment.

AIS in SAR operations

Ulf Hallström (MRCC, SMA)

The AIS system gives information of the name of a vessel and information about where a vessel is located. MRCC uses AIS information during SAR operations, but if there is an issue of emergency towing of for example a drifting vessel (to prevent an oil spill), it is the SCG who is responsible for that and may work together with a VTS central. According to Mr. Hallström, AIS gives information about the vessel in distress and also about vessels in the surrounding area suitable for SAR operations, for example Coast Guard Vessels, Swedish Sea Rescue Society (SSRS) SAR vessels and merchant ships.

The old information (before AIS) showed where units available for SAR in a particular area were registered, and a Digital Selective or a VHF call was done to all vessels. Today if there is any kind of SAR units in the vicinity of the vessel in distress it can be seen immediately. The AIS information makes the procedure more rapid because this information immediately shows which units in the area are most suitable for the SAR operation and they can immediately be contacted. The AIS information is a great asset out of the perspective that you in every single moment receive a clear picture of the traffic situation in an area and how it changes. The fact that other AIS equipped vessels in the vicinity can be located immediately is also most helpful since then it is possible to decide if they are suitable as SAR assets. Before AIS, it was always necessary to do a general call.

In the coordination of a SAR operation Mr. Hallström does not see any obvious benefits from the AIS system. It is important to remember that in a SAR operation there might have been appointed an OSC (On Sea Commander) who are able to observe the units, or at least the OSC is communicating with them anyway which make the AIS information in terms of coordination less useful.

Future possible benefits with the AIS system according to Mr. Hallström are as follows. Since SMA is part of MARNIS, one aim for the SMA is planning to investigate is to implement MARNIS work package number 3, which means an integration of MRCC and VTS. A mission will be given to the working groups involved in the VTS and also in the SAR to investigate this possibility. The investigation will be completed on 29th December and delivered to Mr. Hallström (Head of MRCC) and Tage Edvardsson (Head of Unit for Infrastructure) this year. If this integration turns into reality, it also means that AIS information will be very important in this kind of new central. The concept exists today in Den Helder, The Netherlands, where a large screen shows the SAR operation instead of several small screens. This large screen is situated in a large room where it is eight meters up to the inner roof.

AIS as a notice for mariners

Svante Håkansson (notice to mariners, SMA)

According to Mr. Håkansson, the system can, in the future, be used for navigational warnings of floating containers from ships and buoys which are not in place and new wrecks. This kind of information may be sent from ashore via the AIS network. However, this is not the case today.

AIS and Safeseanet

Malin Dreijer (nautical administrator, SMA)

In an EU directive (2002-59-EC), regarding the establishment of surveillance and information systems, the AIS system is used as an important instrument within the system and is therefore really beneficial in this system. The overall objective of the directive is to increase safety at sea, and the method is surveillance for prevention of pollution and accidents.

Example: it is not any longer allowed to transport crude oil in single hull vessels, via the AIS system which vessels are passing can be seen and single hull vessels from those with a double hull can be distinguished. If there is a single hull vessel, they can be contacted and asked what kind of cargo they are carrying. If the cargo is crude oil; information about this specific vessel will be sent via the EMSA (European Maritime Safety Agency) Safeseanet system to all EU member states the vessel will pass on its way to the final destination. This procedure between member States is an example of a benefit the AIS system can contribute with to a coastal state, and this procedure is a pilot study initiated by EU member states. The EMSA Safeseanet system is connected to information within the Paris Memorandum, which means that all countries of the Memorandum will also receive information from the Paris Memorandum if, for example the vessel has been banned.

AIS and ice breaking

Johny Lindvall (Deputy Head of SMA: s Ship Management)

According to Mr. Lindvall, the icebreaking service uses the AIS information in assisting merchant vessels in two ways. Directly in their navigation systems for following vessels in reach of the icebreakers own VHF antennas. Also the AIS information is imported from the shore-based AIS, which covers almost all the relevant waters around Sweden, to the IBNet (IceBreakerNet, a common information system for the Swedish and Finnish icebreaking services) The information is then distributed in IBNet which for example means that the ship symbol will moved by dead reckoning even when the AIS information ceases to come. That happens for example when the vessel is out of range from the base station, for instance in the middle of the Sea of Bothnia. When the AIS information is presented in the IBNET system the information is complemented with data from IBNet: s ship register and traffic data (i.e. destination, estimated time of arrival, and estimated time of departure). Since it is not compulsory for the merchant vessels to write their destination in the AIS message, there can be a problem to correctly connect the information from AIS to the right vessel in IBNet. To do that automatically you must secure that several parameters correspond (name, IMO-number, MMSI-number, call sign). If some parameters differ or do not exist there will be no automatic match and the correction has to be made manually. Since the ice breaking units and their system need more information than the AIS system can provide, they also have their own system. Mr. Lindvall says that approximately two weeks before a vessel need assistance; the ships agent delivers necessary information to the ice breaking department. When the broker has engaged a vessel he informs the icebreaking service, usually that is done one to two weeks before the vessels ETA. It is essential for the icebreakers to have correct and accurate information of the ship movements so that they can plan their assistances effectively. Later, about two or three days before the requested assistance the ice breaking unit plans how to move in the Baltic Sea to assist the vessels in the most effective way. This includes decisions of how many ice breakers to use, where and when vessels will be assisted and if more than one vessel can be assisted at the same time.

When the vessel arrives it is of outmost importance that the AIS system provides correct information. For instance, one time there were three vessels in the vicinity with the same name (Kristina), the vessels were of different size and of different ice class. A situation like this creates a lot of manual work to make sure which vessel is in need of assistance. For that particular reason it is compulsory for all northbound vessels to report to the authorities while passing Svenska Björn (a Swedish lighthouse outside Åland). During severe winters, this point is moved further south depending on the ice conditions. If the provided information in the AIS is erroneous, it might also be a hazard for the icebreaker (or any other vessel), if for instance, they are in a narrow fairway and the expected fishing vessel turns out to be a passenger ferry. But Mr. Lindvall also says that when the AIS information is correctly entered into the system is it very helpful for the ice breaking units. Then the department can enter the information in their own system (IBNET).

The second benefit is while the ice breaking department has AIS information displayed on their screens and they can direct vessels navigating alone in icy areas by advising them to move from one specific position to another (in order to avoid ice). The units can then see how the vessels they direct are moving in the Baltic Sea. If they slow down, stop or just keep their speed, the units can follow that on their screens and from that information decide if they need to assist such a vessel or not. Before the AIS system, it was not possible to track ships movements and the units felt that they should move towards such a vessel to find out how it was progressing in the icy area. So, the ice breakers move less nowadays; instead they place themselves in strategic positions from where they are able to follow the traffic movements. The most important reason to this is the advanced radar and satellite information the units receive regularly, but the AIS technique is truly contributing and therefore also beneficial. Mr. Lindvall points out that less movement mean less consumption of fuel. The ice breakers have five engines in total, and while assisting vessels they usually have four engines running. The assistance speed is 8-10 knots and the consumption of fuel is 30- 50 tons per every 24 hours. Icebreakers use heavy fuel oil (HFO) where the current market prize is about SEK2600 per cubic meter. This makes a cost of SEK130 000 for 24 hours. In extremely severe conditions while using five engines, the consumption is 75 tons per 24 hours, which makes the cost for fuel SEK195 000. The speed and consumption for an ice breaker only moving (not assisting any vessel) is more or less the same as when they are assisting; therefore, the costs are also more or less the same (except for the extreme conditions). It is obvious, according to Mr. Lindvall, that the AIS system saves costs and also time for the ice breaking unit. But Mr. Lindvall thinks it is hard to quantify this benefit.

To conclude, there are three instruments which have influence on how the ice breakers work and move during winter time in the Baltic Sea. These instruments make sure that winter traffic in the Baltic Sea is safe and efficient. The instrument of outmost importance is the restrictions given by the ice breaking department of the SMA, since they decide what vessels may travel where and when. The other two are the ice breakers themselves and the information exchange (information to the merchant shipping but also the information received or collected about the sea traffic around the vessels). Information includes ice conditions (followed by radar and satellite system), and information about vessels position/destination/etc (followed by AIS). The AIS system is in other words not the most important factor, but still beneficial. Mr. Lindvall also says that in the last 10-15 years, the consumption of fuel has declined due to radar satellite images and AIS information. The fuel budget for the Ice breaking unit at the SMA during the last 10-15 years has been SEK25 million yearly, which is about three million SEK less than before this period. When asked to estimate the influence of the AIS system in monetary terms of fuel consumption, Mr. Lindvall says that it represents a decrease in monetary terms of at least SEK500 000 yearly. Finally, the possible future benefits from the system according to Mr. Lindvall is that he hopes that it will be mandatory for vessels who have to use AIS also must type in the destination of the vessel in the AIS system. This would be beneficial for the ice breaking service.

AIS and hydrographical surveying

Ulf Lejdebrink (Senior Advisor, Ship Traffic Division, SMA)

The Ship Traffic Division follows the sea traffic via AIS screens. Mr. Lejdebrink says that one thing they have noticed via the AIS technique is that more and larger vessels are passing between Gotska Sandön and Gotland. In this area, he thinks that the SMA should advise the vessels more specifically how to traffic this area or else in order to act more accurate depth surveys in the actual passage areas.

In the near future, a new system containing statistics about traffic movements along the coastline of Sweden (as mentioned in the interview with Mr. Zetterberg) will be used to analyze the traffic pattern in the Baltic Sea and compare it with how well these areas have been hydrographically surveyed. In a next step it is possible to make sure that areas where the traffic is located are being modern surveyed so that they can design fairways out of the information. This is of interest because the new system can provide exact statistic information about where certain vessels, e.g. oil tankers with a draft exceeding 15 meters, are moving in the Baltic Sea.

AIS and hydrological information

Kjell Johansson (AIS expert, Fairways, SMA)

Today, there is one weather information test station (at Bråviken, close to Norrköping on the Swedish East Coast) which transmits some meteorological data (direction of wind, average wind, and wind peaks) via the AIS network. There are many such weather stations along the Swedish coast and the plan is that they after the present trial period of this weather information will be permanent at several locations. This will be done during this year. Apart from wind information, the vessels will be able to receive information about the currents in certain areas, as well as water level. However, to take part of the information, the ship borne AIS system needs some additional requirements.

Another benefit is that this information is extremely up to date (only some seconds from real time) compared to the same information from the Swedish Meteorological and Hydrological Institute (SMHI) which is a normally a couple of hours old.

AIS and the SCG

Thomas Fagö, SCG

Mr. Fagö thinks that a major benefit from the AIS system for the SCG as an on board tool is to prevent collision and provide vessel information. For the land based Coast Guard centrals the AIS system gives a helpful overall view of, for instance, parts of or all of the Baltic Sea area or the Norwegian coastal waters. Still, the AIS is not satisfactory in terms of ships carrying hazardous cargo (e.g. dangerous goods) information; today for example the AIS cargo information often only says that the cargo consists of category A or category C without specifying what that is. But Mr. Fagö adds that according to the Safeseanet project, vessels should report about cargo carried on board when calling an EU port.

The SCG supervises Swedish waters (territorial and EEZ) and suspicious vessels might cause an action by the SCG. The AIS system has contributed significantly to the supervision work for the SCG. The system immediately provides vessel information, which means that the SCG does not have to use time and effort on identifying a suspicious vessel which – on the screens in the SCG surveillance center (this is not part of the VTS system provided by the SMA) ashore – gives the impression of being involved in illegal activities like smuggling or in any attempt to pollute the marine environment. For that reason, the AIS system is really a timesaver for the SCG. Also, when an oil spill has already taken place, AIS is used integrated with the Seatrack web. This is a program designed to make a prognosis for supposed oil spills and backtrack the chain of events – like how the oil spill moves in the water - when it has already occurred. The program can be used in the back tracking procedure to investigate which vessels were in the area where and when the oil spill took place. For instance, if an area has not been supervised for 24 hours, 150 vessels might have passed if it is, for example, outside the island Utklippan in the archipelago of Karlskrona. After tracking down some suspicious vessels (with the Seatrack web assisted by the AIS technique) the SCG in the next port of call for these vessels can be contacted and asked to take oil samples. Then the AIS system is helpful and time will be saved. The AIS system is also helpful at the very moment when an illegal discharge of oil is occurring since the SCG can focus on suspicious vessels. Mr. Fagö believes that the AIS contributes to less illegal discharging of oil since most vessels that carry AIS are aware of the fact that many other vessels also have the technique which makes it easier for a vessel which is next to an oil spill to have an idea of which vessel discharged the oil since all they have to do is to look on the AIS screen to get the name and call sign of the vessel they believe discharged the oil into the sea.

If there is a need for emergency towing, according to Mr. Fagö, the AIS technique does not contribute so much. A vessel in distress would be found quickly anyway. It might be helpful if the vessel in distress is situated in a very dense sea traffic area in South Eastern part of the Baltic Sea, like the Bornholsgat. All statistical material provided by the AIS system is also most helpful because it gives information on density of shipping, type of ships, routing, ports of call and sometimes also type of cargo; however, some progress could be made in that field (the SCG is the authority which collects all information about sea traffic along the Swedish coastline through their specific centrals surveillance). The SCG implements satellite images of the waters of Sweden and its EEZ and there are plans for integrating AIS information with satellite surveillance in order to catch polluters *red handed*.

Chapter 5

Analysis and discussion of costs and benefits

In this chapter the results from the interviews and the additional research will be analysed. Ten persons were interviewed; nine were from the SMA and one from the SCG. These ten interviews were completed to get a broad picture of costs and benefits in the areas where the AIS system was expected to be beneficial for the SMA and the SCG. In the analysis the identified costs and benefits will be discussed. Very few quantitative benefits were expressed by the respondents. For that reason, the author will in this chapter suggest recommendations for which benefits might be worth the effort to quantify in future studies.

Design of and focal points in the CBA of the AIS system

How do the people in the public maritime institutions as the SMA and SCG think the systems are beneficial to the public and what are these benefits and what are these costs? The answers will be thoroughly discussed and these ideas will be complemented with the author's own research. Malin Dreijer, Rolf Zetterberg, Thomas Fagö, Ulf Hallström, Johny Lindvall, Sten Andersson, Svante Håkansson, Björn Lager, Kjell Johansson and Ulf Lejdebring shared their knowledge of what benefits and what costs are associated with the AIS system given what they know about the technique today, approximately five years after implementation in the SMA and in the SCG. The result from the interviews are categorised and analysed in the same way as in the previous chapter (after area of interest of the interviewed persons). Due to the major problems of quantification of the results (read benefits of the AIS system) from the study, the analysis part of this study will to a very large extent consist only of qualitatively estimated benefits from the interviewed persons.

AIS in the VTS (ship to shore)

Safety

One way of trying to quantify the benefits for a coastal state like Sweden regarding the AIS system in the VTS is to express it in terms of safety in a ship to shore mode. This is done by the respondents and they expressed the identification of vessels and the opportunity to control traffic, and actively and silently monitor the Baltic Sea (e.g. in traffic separation schemes) as major benefits. A mentioned future risk is if many pleasure craft install the AIS there might be to much information on the screen for the operators.

Saved costs

To cover the same area with radar instead of AIS, the cost will increase with a factor of 20 according to Mr. Zetterberg. This means the lowered costs may be another benefit in the AIS system. Mr. Pettersson and Mr. Bäckström agree and writes that "…the cost of installing and maintaining an AIS network is minute compared to a VTS radar network" (Pettersson and Bäckström, Swedish Club Letter 1-2001). Anyhow, it is important to emphasize that the radar is, and will remain, one of the most important instruments on the bridge, also in the future.

Effect on marine pollution

The new statistical package will provide information of vessels transit passage in the deep sea route outside Gotland and this is beneficial since the SMA then can investigate how this route affects the level of marine pollution.

Recommended measures:

- **to quantify the number of avoided accidents or accidents which were less serious because the AIS were installed in the VTS.**
- **to quantify the saved amounts in monetary terms for use of AIS instead of radar to cover the same area.**
- **to quantify the effect on marine pollution with statistics in the new database.**

AIS and accident investigations (ship to ship)

Explaining the true chain of events

According to the interview with Mr. Andersson (The Safety Inspectorate) the registration of accidents in Sweden or with Swedish vessels involved do not tell us neither if an accident was avoided, nor does it tell us if an accident were made less serious thanks to the AIS system. But casualty investigations prove that the AIS system sometimes is a very important instrument when it comes to the delicate matter if the chain of events really is as the OOW explains them. Maybe the story is just slightly polished while told to the representative from the authorities after, for instance, grounding? In many cases, the answer of the question is yes, according to Mr. Andersson. The AIS information (stored in the Administrations database) is, as mentioned, already used by the inspectorate and has been useful in several cases. This makes it easier to determine what really has happened and means lesser discussions about what really happened. Another safety benefit is that since the system is not very expensive and vessels not required to carry AIS choose to install it.

Recommended measures:

- **to quantify safety benefits expressed in avoided accidents or accidents which were less serious because the AIS were installed on board**

AIS as a notice for mariners

This area remains unexplored but future benefits like navigational warnings should be implemented as soon as possible.

AIS and Safeseanet

The benefits from the AIS system in Safeseanet are the availability of information in the EU countries. For example, a single hull tanker leaving the Baltic Sea region can be tracked all the way through EU waters if needed. The AIS coverage in the Baltic Sea is very good thanks to the HELCOM cooperation. But it is hard to quantify these benefits though they should probably be expressed in terms of enhanced safety or avoided accidents.

AIS in SAR operations

Enhanced efficiency

The AIS and VTS system can definitely also be used when it comes to emergency towing of vessels. However, this is not an important benefit in the scope of the AIS. But truly the AIS system makes the SAR operations early part more efficient since the operator immediately observes where SAR units are located at the very moment when a vessel calls in distress and this also save some time so the SAR units may reach the vessel in distress sooner than if they did not have AIS transponders. It is also beneficial for SAR units to have a complete picture of the vessel in distress together with all AIS equipped vessels in the vicinity. A future suggestion is also to investigate if the saved amount of time in the start up process, and the fact that the AIS gives a picture of the traffic situation in every single moment of a SAR operation can save lives.

Recommended measures to quantify in SAR operations are as follows:

- **Saved time for the SAR co ordination centers because the start up process of a SAR operation will be more efficient and potential SAR assets can be identified within the AIS system**

AIS and ice breaking

Saved time and enhanced efficiency

The benefits of the AIS for ice breaking services is that the ice breaking units can locate the vessels in need of assistance, what course and speed they have and this helps them to determine and plan in advance where to break the ice for vessels in the fairways and where to meet the vessels before entering the icy areas. Also, an ice breaker can follow a vessels movement and decide if a vessel navigating in icy areas needs assistance immediately or if the vessel will manage on its own for a while. These benefits can be expressed as enhanced efficiency and saved time in operations for both the ice breakers and for the assisted vessels.

Fuel costs

Another benefit is that the units can see how vessels they advice from distance are moving through the ice and they can then determine if the vessels can continue on their own in an icy area or if the ice breaker have to steam towards the vessel and break ice in front of it. This benefit can be expressed in lowered fuel costs since the ice breaking units do not move that frequently anymore and the AIS system is one reason for that. The fuel costs saved per year are estimated to SEK500 000 in total.

Recommended measures:

- **To quantify the saved time in operations for both vessels and ice breaking units**

AIS and hydrographical surveying

Benefits are within the new system containing statistics of traffic movements which will help to know where to survey and design fairways. This benefit is difficult to quantify but it will probably help the SMA in what specific areas to survey and design fairways.

AIS and hydrological information

The future benefits are to provide hydrological information at several weather stations.

AIS and the SCG

The major benefits for the SCG are as an on board tool to prevent collision and for the land based stations to have an overall view of certain areas. The AIS is today not satisfactory since the cargo information often lacks of sufficient information. However, the AIS is a timesaver when it comes to identifying vessels in e.g. the Baltic Sea, for instance, when an oil spill has occurred it might be backtracked with AIS and Seatrack web or other vessels near the oil spill can help the SCG when trying to identify the polluter.

Recommended measures:

- **To quantify the saved time for SCG in terms of identification of suspicious vessels via the surveillance centrals**
- **To quantify the saved time of tracking down (via AIS and Seatrack web) a vessel suspected to illegally having discharged oil into the Baltic Sea**

How to determine the significance of AIS in accident prevention?

According to Mr. Eriksson (economist in the SMA), the benefit side in a CBA of the AIS system in Sweden deserves a broad description, without limitations to preventive benefits for “just an oil tanker accident”. However, when such an accident takes place, the media focus can be enormous. This puts a lot of pressure on the SMA to prevent an accident before it happens. Also, politicians, being representatives of the population, will be affected of the media pressure. It might be tempting to suggest that the costs and benefits of the AIS system could be expressed through presenting only costs associated with an accident involving a major oil spill. This scenario, as presented in the first chapter may occur. And maybe, the AIS system might be of such importance on the vessel or in the VTS central that an accident never will occur. However, this is unfortunately still unknown in Sweden. Obviously, the AIS system is helpful. It enhances the safety and, according to Mr. Lundkvist, some accidents have been prevented thanks to the AIS system, both ship-to-ship and ship-to-shore. There have been situations, where something is about to happen but information from the AIS system changes the chain of events and the accident has been prevented. According to Mr. Lundkvist, in some cases where there has been an accident, the consequences have been reduced because of the AIS system. In Mr. Lundkvist opinion, there is of course a possibility that there will be an oil spill in the Baltic Sea which may have severe consequences. However, being a risk analyst, he argues that the probability for the AIS and the VTS system to prevent or lower the risk of such an oil spill is very difficult to determine. “There might be a possibility that the AIS can lower the risk of such an accident but it might also be the case that the AIS do not have such an effect.”

To determine *how beneficial* the AIS system is, for instance in a VTS while monitoring the traffic flow in an area, is harder. To determine the significance of the impact of the AIS system in such a situation it is necessary to investigate accidents during a certain period of time via the database of accident statistics at the SMA where information about accidents on Swedish vessels in all waters, and on foreign vessels in Swedish waters (when this is possible) is stored. But, there is one problem. This database does not contain that kind of information, but it just might be stored in the Swedish Shipowners' Association where all information about accidents is confidential (unlike the database of the SMA).

An accident with pollution damage

One way might be to express benefits from the AIS in terms of enhanced safety meaning that at least one collision or grounding during, for instance a period of five years, (with resulting costs in terms of emergency towing or cleaning up costs from an oil spill). The problem is that it might not be realistic to claim that it is only the AIS system which prevents a particular grounding. To prevent vessels from grounding, a VTS central –with a fully implemented an efficiently working AIS system might clearly be one reason for avoiding grounding. But the issue is even more complex since there naturally also are officers on watch on the vessel who probably play a leading role when it comes to avoiding grounding with a particular vessel. If this approach is chosen, one type of incident can be chosen that has quite high probability to occur in the Baltic Sea area, and then the costs from emergency towing or cleaning up costs can be calculated. These costs are put in the CBA as benefits, because these costs do not occur since the accident was prevented. These benefits, in monetary terms, are then subtracted from the costs of the AIS system.

What are the difficulties and problems with the CBA?

The foundation of this study relies on the following expression: given what is known today in Sweden about the AIS system (and not what was known when it was implemented), was it worth to invest in the system? From this perspective, the costs and benefits with the system are analyzed in this chapter. It is hard to find quantitative benefits, since there are so many other factors which also must be considered while e.g. investigating an incident like a collision or grounding. On the other hand, the costs of the AIS system in Sweden are easier to present. Since the findings on the benefit side in this study are more or less only of quantitative nature, it is not possible to perform a quantitative CBA. The lack of figures makes it impossible to discount present and future benefits.

Chapter 6

Conclusion part

No politician wants to say that they are not providing funding for example an AIS system in the Baltic Sea if it is considered as a big risk for accidents like groundings with severe damage to the environment. The 11th of August this year, oil tanker Solar 1 sunk in the Philippines, leaving 2.1 million litres of oil in the archipelago resulting in a major impact on the local industry and the marine reserves (Göteborgs-Posten 2006-08-19). This could happen in the Baltic Sea, but as argued in this study the probability of occurrence of such an accident is uncertain and debated. The oil transports in the Baltic Sea will increase but even in this matter there are different opinions. Unfortunately, it is also still unknown to what extent the AIS system in Sweden can lower the risk of such an accident. AIS were introduced without a CBA in Sweden because the SMA in the early 90s thought it was worth the expenses and would be beneficial for the SMA. It was a policy decision and not an economical decision. Anyhow, this study proves that the AIS system is much more beneficial for the SMA and the SCG than "just" an oil tanker accident.

Present estimation of the AIS system in the SMA

Since yearly costs are 2.5 millions, the SMA has the opinion that the AIS system has an estimated value, a benefit, of at least this amount. Benefits and potential benefits not included in this study – are supposed to exceed 2.5 million SEK every year. This also means that the SMA thinks that the opportunity cost, or the alternative use of this amount cannot compete with the AIS system and the way the system contributes to safety in the different MTAs, MRCC or in the ice breaking service which today bear the costs of the system. It is hard to determine if the AIS system in Sweden is Pareto efficient or is a Pareto improvement without asking all stakeholders. But obviously the SMA and the SCG sees quite a few benefits with the AIS system. In monetary terms, to say that the system according to the quantifiable results in this study is a loss for the SMA and beneficial for the SCG since they are not paying for it is easy but not enough. Future studies where the benefits are quantified must be conducted to determine the total benefits and costs with the AIS system.

CBA in the SMA and the SCG

As presented in the analysing part of this study there are both some benefits (almost all of them not quantified in this study) and costs closely connected to the AIS system in Sweden. The most obvious ones are as follows:

- Enhanced efficiency in SAR operations and for the SCG surveillance work
- Lowered fuel costs and efficiency in operations for ice breakers in the Baltic Sea (most likely also for non-Swedish ice breakers)
- Assumed enhanced safety (both ship to ship and ship to shore).
- Assumed enhanced environmental protection

It is difficult to clarify the role of accident prevention in quantitative terms. This study only succeeded in a qualitative description of how safety and also environmental protection is enhanced thanks to the AIS. Doubtless the extensive statistical information from the AIS system is very welcome also for hydrographical surveys and for future fairway design purposes. The SCG does not pay for the use of the AIS system but really benefits from it in terms of efficiency in the surveillance centrals and while backtracking oil spills. And all the efforts of protecting the Baltic Sea within the scope of the AIS is also most beneficial on an international level where cooperation creates synergy effects all around the Baltic Sea.

The contribution of my study

Why is this dissertation of interest for the SMA and other stakeholder in the shipping industry in Sweden and perhaps also in other parts of the world? The knowledge presented from the interviewed persons and the analysis work done in this study is new in Sweden. No one has done a CBA of the AIS system in Sweden before and for that reason this study will contribute to further evaluation and estimations of the benefits achieved and from the costs associated with the AIS system in Sweden. Given what is known today about the AIS system, hopefully this study helps the SMA to make the right investments within the scope of AIS technology in the VTS centrals which may be the most important area in terms of safety and in other areas as well as for the SCG.

Suggestions to further studies

This CBA plots costs and benefits in the AIS system but could without doubt be complemented with a CBA of the AIS system in the eyes of Swedish and foreign ship owners to find out if they think that the system is beneficial for them (is it worth the investment in the system). Other studies could try to create quantitatively measurable benefits out of the qualitative benefits which have been identified in this study. Furthermore, the approach can be complemented with a risk analysis of potential accidents or oil spills avoided by using a system like the AIS. Also, when the results from the study of the MARNIS work package number 3 are finalised, the benefits within the scope of the AIS system in that study will be a good complement to this CBA.

Validity and reliability of the results from the study

The results from the interview are presented in the previous chapter and the interview person's names are also displayed. The reason is that since there are quite some key persons from various units with different areas of specialization and competencies regarding the AIS system, it would be difficult to present the results anonymously since it would be pretty obvious to many people which person said what. Furthermore, the author, as described in the methodology, has been very thorough in the collecting process of data in this study.

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INTERVIEWS

Markus Lundkvist (Risk analyser, SMA)

Gunnar Eriksson (Economist, SMA)

Ulf Hallström (MRCC, SMA)

Sten Andersson (Casualty Investigator, SMA)

Malin Dreijer (Nautical Administrator, SMA)

Rolf Zetterberg (Senior Technical Advisor, SMA)

Johny Lindvall (Deputy Head of SMAs Ship Management, SMA)

Kjell Johansson (AIS expert, Fairways, SMA)

Ulf Lejdebrink (Ship Traffic Division, SMA)

Svante Håkansson (Swedish Notices to Mariners, SMA)

Björn Lager (VTS, SMA)

Thomas Fagö (SAR service, SCG)

Kent Sylvén (Adveto)

APPENDICES

Appendix 1 Specification of costs for OP "Polo M"

Personnel

Ordinary working hours:	3699,50 hours at 515:-	=	1 905 242:-
Overtime:	438,75 hours at 630:-	=	276 412:-
Qualified overtime:	1197,50 hours at 745:-	=	892 137:-
	------------------		
			3 073 791:-

Additional personnel costs (travelling expenses, allowance for expenses etc.): = 51 718:12

Vessels and boats

Environmental protection vessel: ,	running time: 169,00	hours at 2 800:-	=	473 200:00
" ,	lay-days: 96,00	hours at 2 550:-	=	244 800:50
Surveillance vessel: ,	running time: 61,75	hours at 1 450:-	=	89 537:50
" ,	lay-days: 31,50	hours at 1 050:-	=	33 075:00
High sea surveillance vessel: ,	running time: 83,00	hours at 3 600:-	=	298 800:00
" ,	lay-days: 79,00	hours at 3 000:-	=	237 000:00
Combination vessel: ,	running time: 93,50	hours at 3 700:-	=	345 950:00
	-------------------			
				1 722 363:00

Aircraft: **time in air**: 8,00 hours at 8.400:- = 67 200:00

Additional equipment:

Off Shore Boom, variable fare:	roll at 200 m	6 units at 35 800	=	214 800:00
Sea sledge , fixed fare:	occasion	units at 97 800:-	=	97 800:00
Oil recovery and transfer system "FRAMO":	numb.of units x days	3 units at 26 100:-	=	78 300:00
Fender "Yokohama, small:	numb. of units x days	36 units at 360:-	=	12 960:00
Diving equipment, water:	pers./occasion	6 units at 580:-	=	3 480:00
Steam generator:	numb. of units x days	10 days at 2 000:-	=	20 000:00
Oil Container, 5 m3	occasion	16 units at 1 300:-	=	20 800:00
	-------------------			
				448 140:00

Costs for invoices acc. to specification: = 2 808 119:05
(VAT: 520 512:91)

SUM OF COSTS (SEK)**:** **8 171 331:17**

2006-04-28 SCG/Ek LH

Appendix 2 Costs for the VTS centrals in Sweden

Activity	Result Jan-Mars 2006	Budget Jan-Mars 2006	Result Jan-Mars 2005	Result Jan-Dec 2005	Budget Jan-Dec 2006
Marine Traffic Information (total cost)	11, 821, 000	12, 163, 000	8, 658, 000	37, 583, 000	46, 283, 000
Marine Traffic Information office	516, 000	333, 000	46, 000	215, 000	1, 335, 000
MTA Gulf of Bothnia	1, 099, 000	982, 000	769, 000	3, 688, 000	4, 017, 000
MTA Bothnian Sea	608, 000	621, 000	557, 000	2, 578, 000	2, 496, 000
VTS East Coast	4, 291, 000	4, 603, 000	2, 990, 000	11, 824, 000	18, 236, 000
VTS South Coast	673, 000	1, 091, 000	518, 000	2, 561, 000	4, 312, 000
VTS West Coast	3, 858, 000	3, 630, 000	3, 347, 000	13, 928, 000	12, 247, 000
MTA Vänern	321, 000	453, 000	262, 000	1, 526, 000	1, 840, 000
Other departments					

Appendix 3 Locations of the AIS sensors

Please provide the number and the locations of existing as well as planned AIS base stations.

AIS transceiver location identifier [1]	**MMSI**	**Operational status identifier** [2]	**Latitude**	**Longitude**	**Antenna height [m]** *(above sea level)*	**This station sends data to the following traffic service** [3]	**Free text description of the composition of the sensor location**
Seskarö	2655010	OPER	65.4394	23.4377	67		
Luleå	2655015	OPER	65.3228	21.5536	127		
Skellefteå	2655020	OPER	64.4630	20.5724	310		
Umeå	2655025	OPER	63.5024	19.4936	486		
Mjällom	2655030	OPER	62.5912	18.2342	316		
Sundsvall Alnön	2655035	OPER	62.2412	17.2824	211		
Hudiksvall	2655040	OPER	61.4224	16.5136	483		
Gävle	2655045	OPER	60.3754	16.5136	237		
Öregrund	2655050	OPER	60.2954	18.2400	98		
Väddö	2655055	OPER	59.5806	18.5036	162		
Nacka	2655065	OPER	59.1754	18.1036	324		
Nacka Strand	2655069	OPER	59.1700	18.1000	90		
Södertälje	2655084	OPER	59.1340	17,3724	135		
Västerås	2655075	OPER	59.3836	16.2412	263		
Torö	2655080	OPER	58.4918	17.5054	114		
Norrköping	2655085	OPER	58.4036	16.2812	298		
G Sandön	2655090	OPER	58.2230	19.1428	81		
Visby	2655100	OPER	57.3536	18.2236	243		
Hoburgen	2655105	OPER	56.5612	18.1330	116		
Västervik	2655110	OPER	57.4318	16.2548	325		
Borgholm	2655115	OPER	56.5140	16.4230	105		
Ölands sa udde	2655120	OPER	56.1354	16.2748	86		
Karlskrona	2655125	OPER	56.1351	15.3882	109		
Karlsh (Hörvik)	2655185	OPER	56.0194	14.4612	138		
Kivik	2655130	OPER	55.4006	14.0930	245		
Trelleborg	2655135	OPER	55.2867	13.1552	163		
Helsingborg	2655140	OPER	56.0248	12.4148	118		

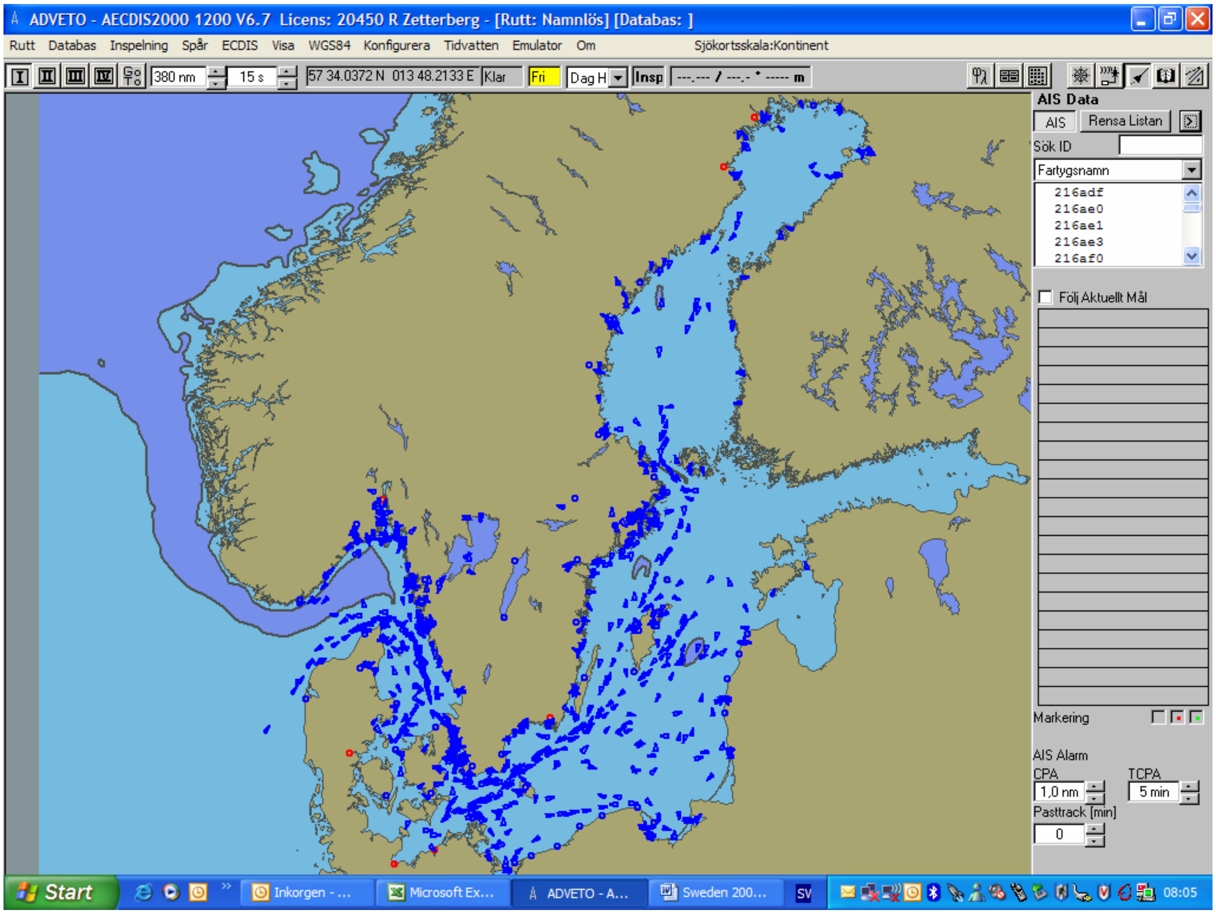
[1] *descriptive name, number, etc*

[2] ***OPER****- Operational,* ***PLAN****-planned*

[3] *leave empty if the station is not linked to any traffic service operating in your country*

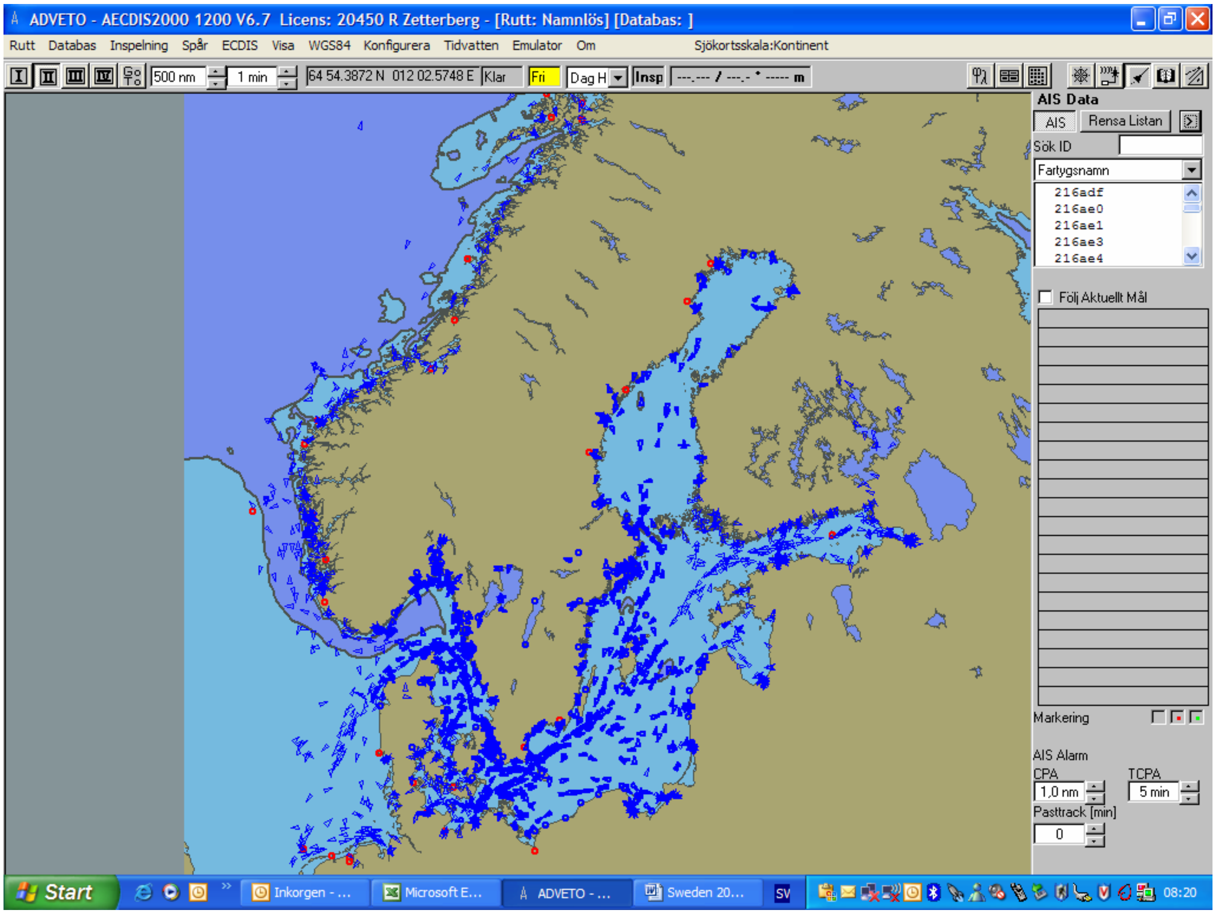
AIS transceiver location identifier [1]	**MMSI**	**Operational status identifier** [2]	**Latitude**	**Longitude**	**Antenna height [m]** *(above sea level)*	**This station sends data to the following traffic service** [3]	**Free text description of the composition of the sensor location**
Falkenberg(Slöi)	2655145	OPER	56.4974	12.416	180		
Gbg Brud	2655150	OPER	57.4141	12.034	326		
Hun.b.st Röd	2655155	OPER	58.2536	11.2500	140		
Strömstad	2655153	OPER	58.5542	11.1042	100		
Vänersborg	2655160	OPER	58.1918	12.1554	130		
Kinnekulle	2655165	OPER	58.3606	13.2442	346		m above lake level
Karlsborg	2655170	OPER	58.4024	14.3448	265		m above lake level
Jönköping	2655175	OPER	57.4688	14.1358	56		m above lake level
Uddevalla	2655180	OPER	58.2246	11.4947	387		
Öresund	?	PLAN	55.3446	12.4980	210		On pylon of bridge

Appendix 4 AIS information from Sweden



AIS information from Swedish base stations 2006-07-28 08:05

Appendix 5 AIS information from HELCOM



AIS information from the HELCOM network 2006-07-28 08:20

Appendix 6 Information about the status of the Swedish AIS network prior to a coming meeting relating to COMSAR.

BALTIC/BARENTS SEA REGIONAL CO-OPERATION ON MATTERS RELATING TO COMSAR — BBRC/COMSAR-16

Helsinki, Finland
18 – 20 September 2006

Doc. No.: BBRC-16/ /
Origin: Sweden

Agenda item: Status of the Swedish AIS network

The AIS network

The shore based Swedish AIS network has developed over a quite long period. In an ongoing process is the system improved and new applications for the use of AIS information are developed.

The present system consists of 36 base stations divided in 5 regions. Each region is independent and has its own server. The regional servers are connected via a high speed data network and exchange their information continuously. The users can connect to any of these regional servers and get their information according to their user profile. The data is available via the “normal” SMA data network.

In a 3-year programme are all base stations replaced with new stations with an improved radio, improved availability and better functions for remote service. This program is completed during 2007.

It has also been decided to move some of the stations to masts with a better back-up power supply. It is also studied to connect the base stations to a second, redundant, communication network. This is quite expensive and there is no decision yet.

A complete redundancy is created in some, important areas where additional base stations are installed on separate locations (Gothenburg, Stockholm, and Malmö). New base stations are also installed to improve local coverage in areas that has been shadowed due to the topography.

International co-operation

Sweden has actively participated in the AIS co-operation initiated by HELCOM, where 10 countries around the Baltic exchange AIS information. The HELCOM AIS system is in full operation since July 2005. The central part of the system is the so-called HELCOM AIS Information Centre, which is developed by the Royal Danish Administration of Navigation and Hydrography. This server connects to the different national servers and collects the national data. The data is processed, compiled and the data for the whole area made available to the national servers. The data is also stored for future processing and production of statistics, available to all participants.

A similar system for the countries around the North Sea is being established in the Safety at Sea project. Sweden is participating in this co-operation as well.

Applications

In the modernized Swedish VTS centrals the AIS information is fully integrated and data from radar and AIS integrated and presented to the operator on the same display.

In the support systems for MRCC is AIS information presented and rescue units, including helicopters are equipped with AIS (ongoing installation). AIS have proved to be a valuable tool in finding suitable resources and to manage Search and Rescue operations.

For the Ice Breaker service has AIS been integrated in the Command and control system. The icebreaker operations benefit from the accurate and timely information from ships in need of assistance and from the available resources. The information from the shore based network is transferred to the icebreakers via satellite communication.

In a system designed to identify polluters are the calculated tracks of a detected oil spill combined with historical AIS-track. Possible discharges may have occurred where the tracks coincide in time and position. The system is now evaluated.

It has been decided to procure a system capable of storing all Swedish AIS data for longer periods. The system will be used to produce statistics of the sea traffic and to assist in planning of fairways. It will also be a tool for risk analysis and for accident investigations.

Action requested of the BBRC/COMSAR-16: Take note.

(For further information please contact: Rolf Zetterberg, SMA, +46 11 191512)

Appendix 7 Interview guide for the key persons in the SMA and the SCG

Benefits

How is AIS a beneficial tool in your area of interest?

(Example: efficiency, coordination, surveillance, tracking, monitoring)

Any real cases you want to bring up where AIS were useful in any aspect?

Is it possible to quantify the benefits of the AIS as a tool in your area of interest?

Future benefits with AIS in your area of interest?

Costs

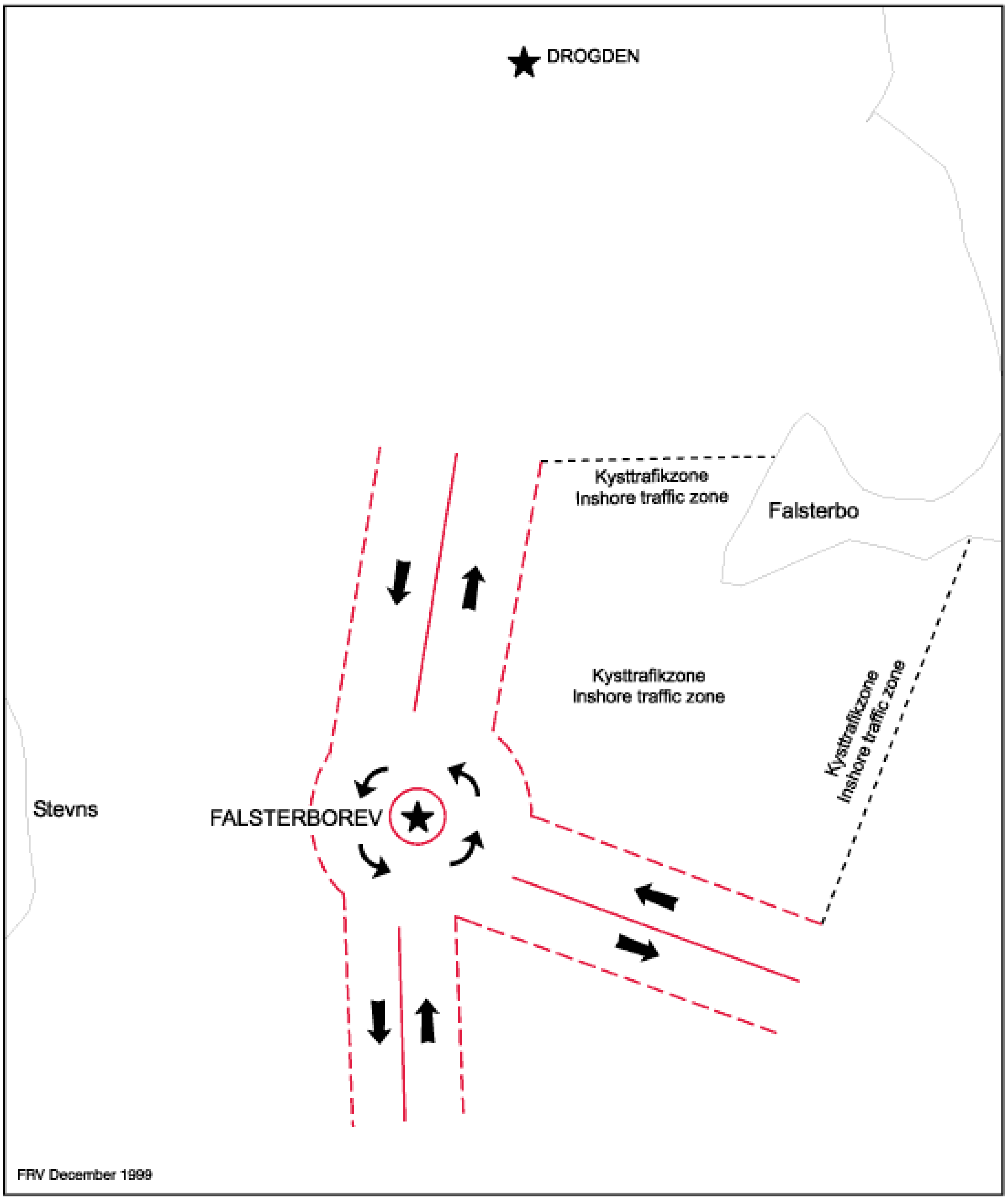
What costs/risks do you associate with the AIS in your area of interest?

Any real cases you want to bring up where AIS were troublesome or risky in any aspect?

Is it possible to quantify the costs/risks of the AIS as a tool in your area of interest?

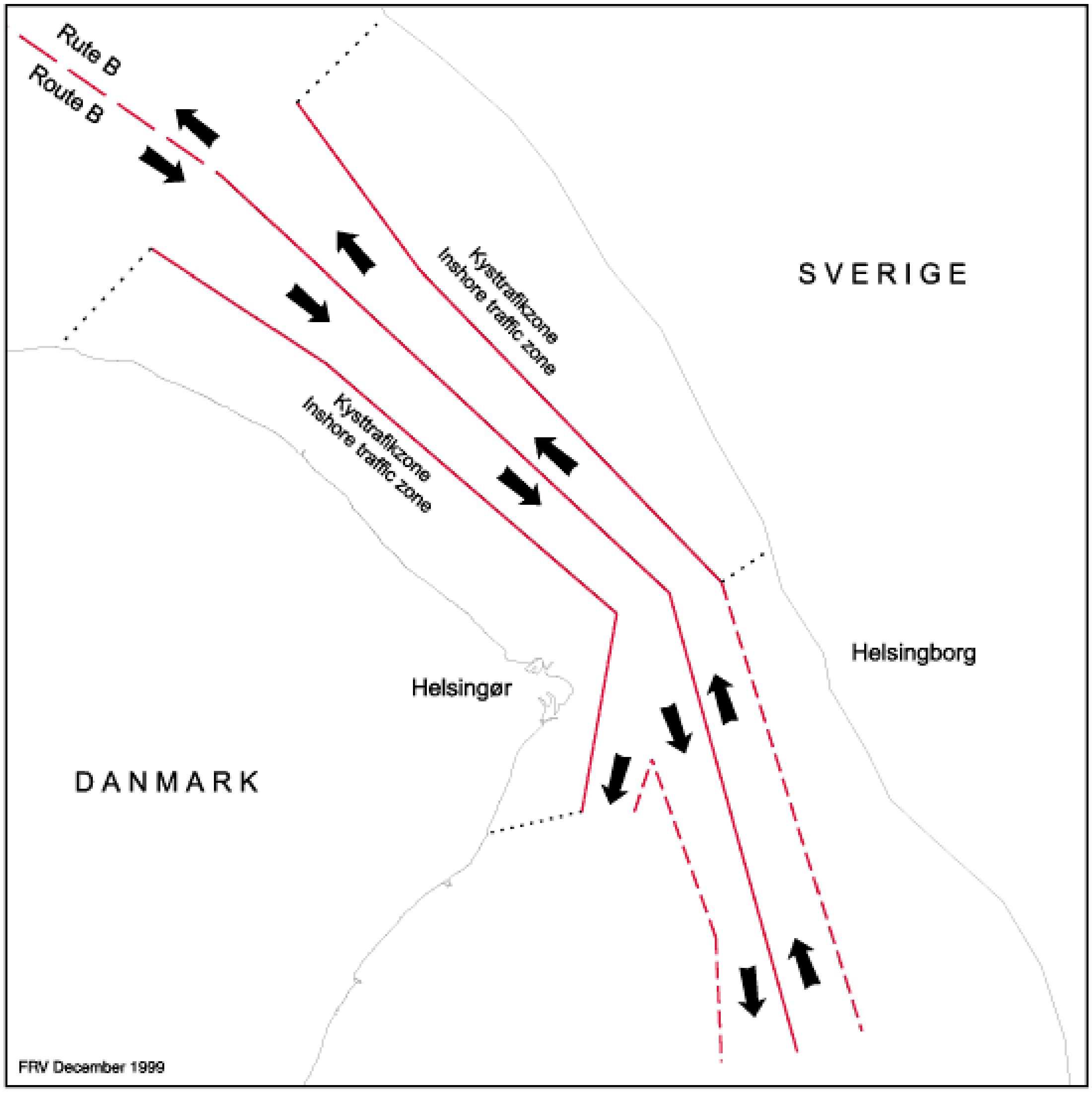
Future costs with AIS in your area of interest?

Appendix 8 Traffic Separation Scheme "Off Falsterbo Rev "



Source: Danish Maritime Administration (DMA)

Appendix 9 Traffic Separation Scheme "In the Sound"



Source: Danish Maritime Administration (DMA)