INFORMATION SYSTEMS IN SAIMAA

Adopting Best Practises to Finland

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EMMA – Report

Content

1 GENERAL

Inland navigation is popular means of transport in Europe. Its popularity is challenged by the following factors: busy traffic, narrow channels and several countries involved. International inland waterway transport in Finland is concentrated on Lake Saimaa and the canal connecting it to the Baltic Sea. The traffic frequency in Finland is much lower than in Central Europe and vessels are generally seafaring vessels visiting the lake and the canal. Therefore, vessels are following common seafaring practices even in inland waterways.

The purpose of this study is to evaluate if the current Vessel Traffic Service (VTS) is adequate for the purpose, and how experiences from River Information System (RIS) could be implemented in the Saimaa Lake and Saimaa Canal.

1.1 Description of Saimaa Canal and Lake Area

Vuoksi Waterways or Lake Saimaa consist of several lakes and waterways connected by natural or artificial canals and locks. There are several commercial ports in the Saimaa area. These are either public or industrial ports. Efficient waterway connection is essential for industry in Eastern Finland.

Major Ports in Saimaa lake area:

- Lappeenranta
- Imatra
- Savonlinna
- Kuopio
- Joensuu

Saimaa Canal is rented for 60 years from Russia from 2012 onwards. The Canal was built in phases between 1845 - 1856, and there have been several updates since then. The length of the canal is 42.5 km - half of which is in the rented area. The maximum size of the vessels in Saimaa Canal are as follows:

- Length: 82,50m
- Width: 12,60m
- Draft: 4,35m

The length of commercial fairways in Saimaa Canal and Saimaa Lake is 772 km. The Saimaa Canal, Lake Saimaa and locks are described in the Figure 1-1.

Lake Saimaa and Vuoksi waterway differs from typical Central European inland waterways. The waterway is mostly archipelago area. Additionally, most of the waterway traffic is between sea and lake with ordinary sea vessels. Internal traffic within the waterway area is minimal. In fact, there are only two vessels doing regular cargo transportation within the waterway. This traffic is mostly raw wood transport to pulp mills. There are, however, also several pusher barge combinations in the area as well as one operator still conducting log floating.

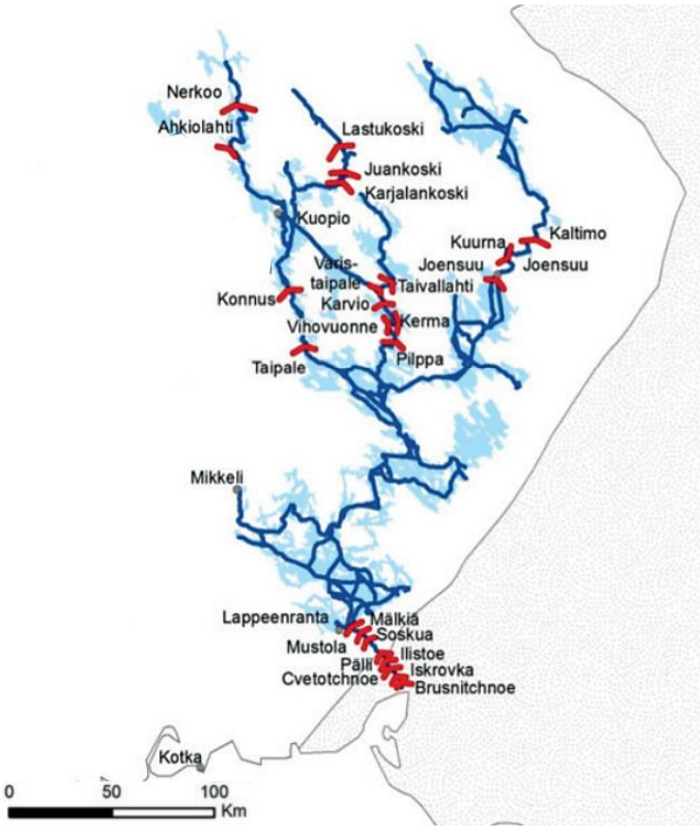

Figure 1-1 - State-owned lock canals (Liikenneviraston tilastoja 1/2017)

1.2 Traffic Volumes in the Saimaa Canal and Lake Saimaa

The highest transport volumes were reached between 2000 and 2005. Statistics illustrate that cargo traffic in Saimaa is decreasing. However, current industry and industrial development possibilities require sea transport option to and from Saimaa. The development of traffic is shown in Figure 1-2, Figure 1-3, Figure 1-4. Increased measures to control traffic should be planned according to traffic and technological development. Technological development includes autonomous vessels, which are already in development.

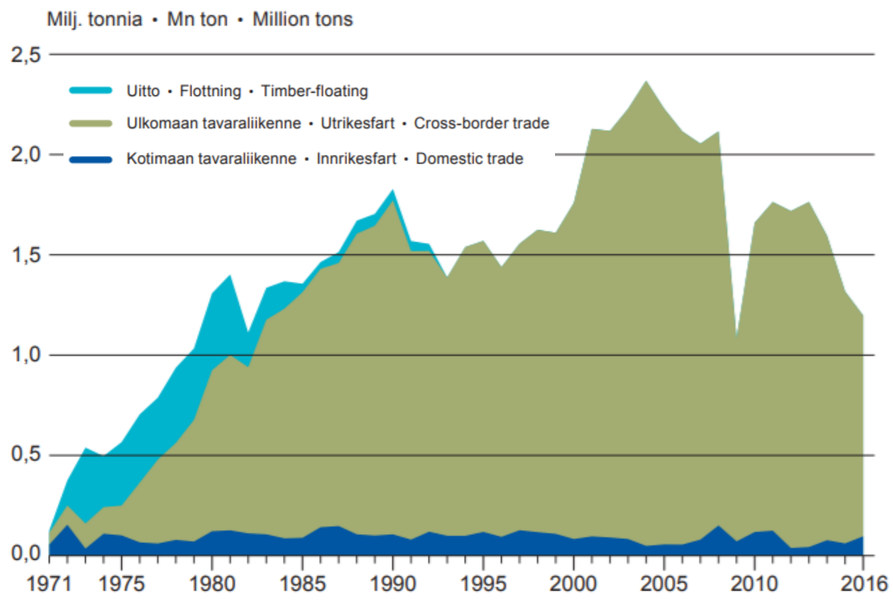

Figure 1-2 - Goods traffic through the Saimaa Canal, 1971–2016

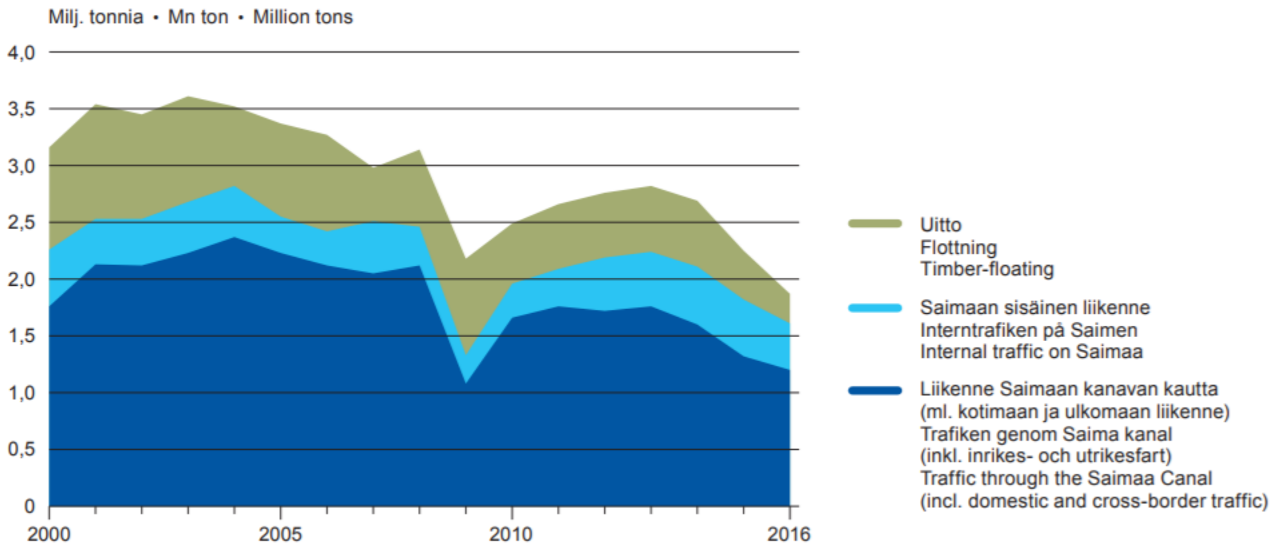

Figure 1-3 - Total maritime transport of goods in the Vuoksi watercourse (Saimaa), 2000–2016

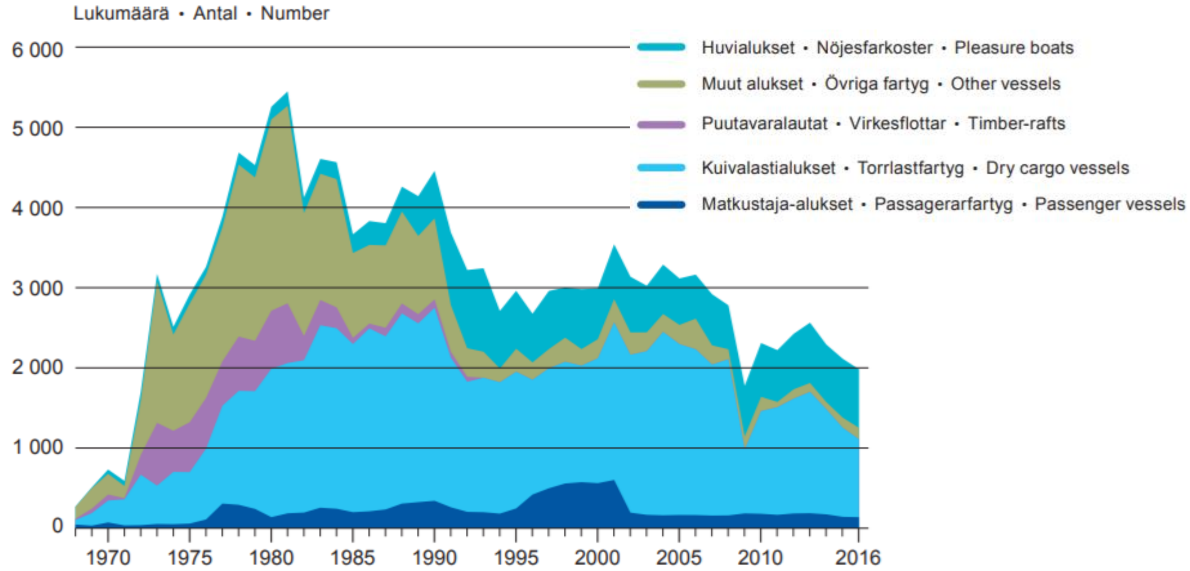

Figure 1-4 - Number of vessels in Pälli lock of the Saimaa Canal, 1968–2016

The average traffic season in Saimaa Canal is 293 days per year. In 2016 in total 971 cargo ship navigated through the Saimaa Canal (one way), which results on average 3.3 ships per day (Figure 1-5).

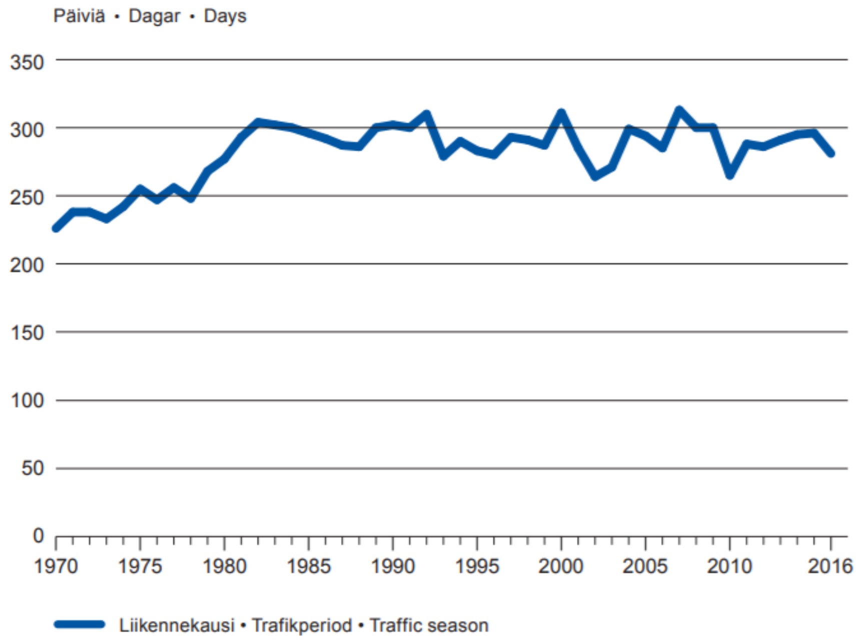

Figure 1-5 - Length of the traffic season of the Saimaa Canal, 1970–2016

2 CURRENT INFORMATION AND TRAFFIC CONTROL SYSTEMS IN THE SAIMAA AREA

2.1 VTS Service in the Saimaa Area

Vessel Traffic Service (VTS) allows monitoring of vessels, in real time, to enable safe and efficient traffic management in a specified maritime area, including the position of vessels in order to immediately identify incidents that may generate risks for the crew and the environment.

SOLAS Chapter V (Safety of Navigation) states that governments may establish VTS when, in their opinion, the volume of traffic or the degree of risk justifies such services. In Finland the vessel traffic services (VTS services) are operated by the Finnish Transport Agency. The provisions on vessel traffic services are laid down in the Vessel Traffic Service Act 623/2005 and in the Government Decree on Vessel Traffic Service 763/2005.

VTS areas along the coast provide all three service levels as described below. However, Saimaa VTS provides only information, because of there are no radars in the lake area. The need of radars has been considered obsolete due to low traffic frequency.

All VTS services:

- **Information (currently only information in the Saimaa lake area)**
- Navigational assistance
- Vessel traffic is organized in order to improve traffic flow and safety.

Technical solution used in Saimaa Lake and Saimaa Canal (Author and the Finnish Transport Agency 56/2016):

- Tactical traffic view:
  - AIS –system and Electronic chart system (ECDIS)
  - Video cameras located in the most critical passing locations
  - Communication by Marine VHF system
- Controlling of the locks:
  - Video cameras with the locks
  - Inhaler system on bridges and locks
  - Traffic lights
  - Distance control of the locks and the bridges
  - Communication by Marine VHF system

2.2 Vessel Traffic Management Information System (VTMIS)

The Vessel Traffic Management Information System (VTMIS) is an extension of the Vessel Traffic Service (VTS), in the form of an Integrated Maritime Surveillance, which incorporates other telematics resources to allow allied services and other interested agencies in the direct sharing of VTS data or access to certain subsystems in order to increase the effectiveness of port or maritime activity operations as a whole, but that do not relate to the purpose of the VTS itself (http://www.sheltermar.com.br/en/vts/).

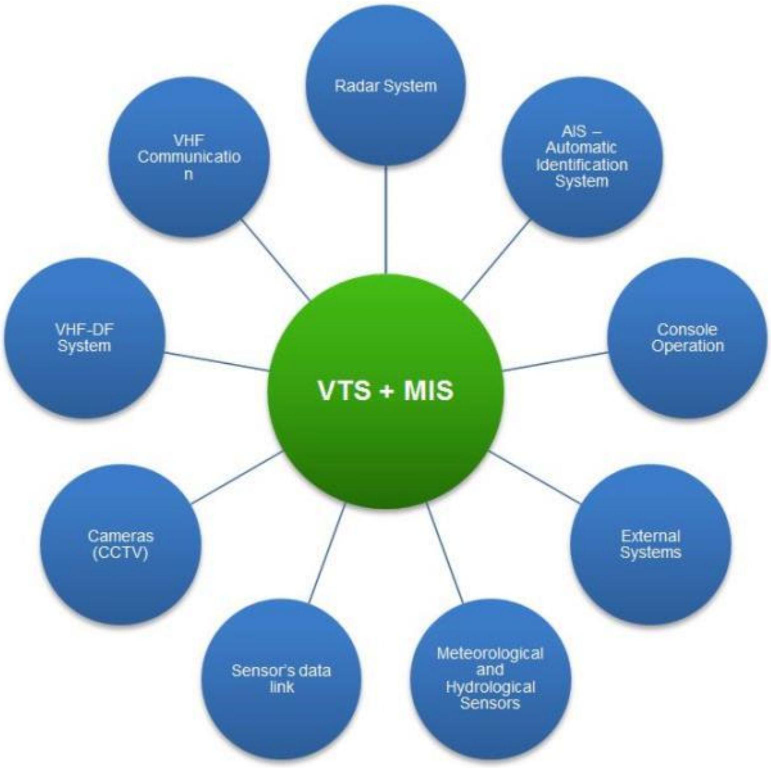

Figure 2-1 – Example of VTS and MIS information (http://www.sheltermar.com.br/en/vts/)

2.3 Automatic Identification System AIS

Automatic Identification System AIS is compulsory to all vessels larger than 300GRT according to SOLAS regulations. Practically this means that all commercial vessels should have AIS equipment. AIS is used for

- Collision avoidance
- Fishing fleet monitoring and control
- Vessel traffic services
- Maritime security
- Aids to navigation
- Search and rescue
- Accident investigation
- Ocean currents estimates
- Infrastructure Protection
- Fleet and cargo tracking
- Statistical analyses of traffic

All commercial vessels in Saimaa Lake and Saimaa Canal apply with SOLAS regulations and therefore have AIS equipment onboard. Example of AIS map with vessels is shown in Figure 2-2.

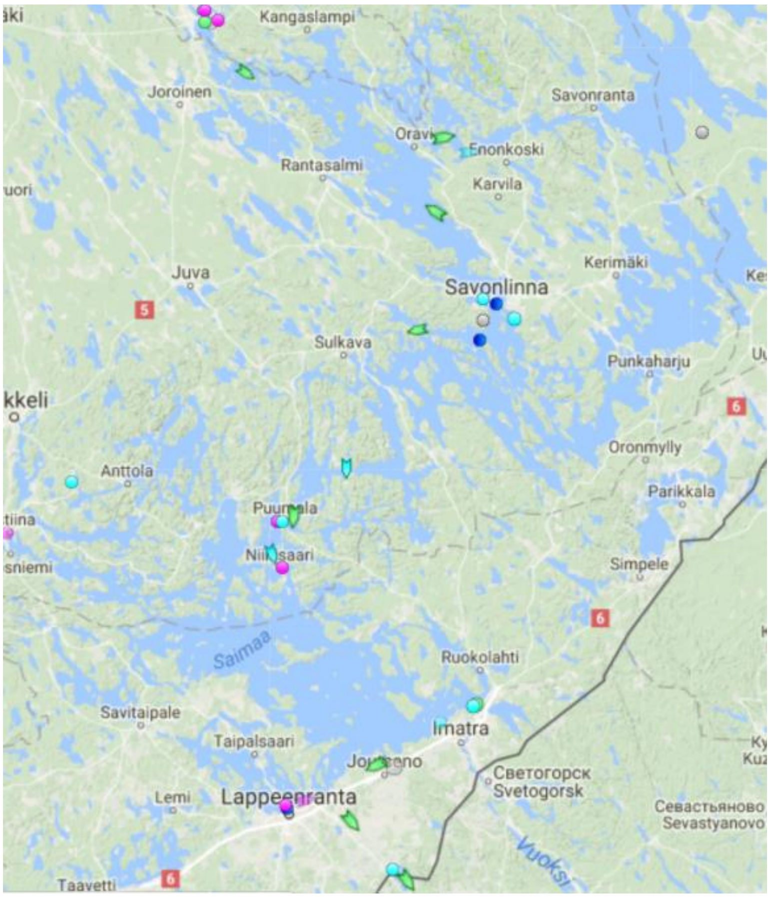

Figure 2-2: Example of an AIS map

2.4 Piloting in the Saimaa area

It is compulsory to use a pilot in the Saimaa Canal and Lake Saimaa. Ships officer can apply for a pilot exemption certificate after sailing certain number of voyages on the concerned route, prove familiarisation of the route and language skills. Only official languages in Finland, Finnish and Swedish are accepted. There has been discussion if English should be approved, but for now communication skills in domestic language are considered essential by law.

English can be used only in VTS areas, which provide navigational assistance and organize vessel traffic.

The Finnish Transport Agency has searched for solution to improve VTS services to allow English language to be used as a piloting language for regular pilots and pilots with exemption certificate. (The Finnish Transport Agency 56/2016). As a result, three different models were introduced. All of these require changes in current legislation and investments to e.g. radar systems. These three models are:

1. the current model is modified by introducing English as a third language of communication alongside Finnish and Swedish
2. vessel traffic organisation services are provided in the Saimaa Canal in English by an independent service provider selected through competitive tendering
3. information services and vessel traffic organisation services, as defined in the Vessel Traffic Service Act, are provided on the Saimaa Canal in English by Saimaa VTS.

The first model does not require considerable investments. It does not provide accurate positions with radar system but relays on the AIS system. Legislation needs to be changed and language requirements for the lock master have to be updated after 2019 when the current service contract will be renewed.

Another view for the pilotage is to utilise pilots as resource. Typical small SOLAS vessels rely on mere two navigating personnel. The voyage from the sea for instance to Kuopio takes 12 hours. Pilotage is heavily subsidised and provides professional help on the ship´s bridge. Officially, a pilot is just a guide, but in practise some vessels rely on pilot on navigation. It is possible that all vessel will not use exceptions if made available.

2.5 PortNet -Single Window Data Management System

PortNet is a data management system maintained by the Finnish Transport Agency. Whenever a vessel visits one of Finland's ports, following information is inserted in the system:

- Vessel (24 hours before arriving in the Finnish port)
- Cargo (within one hour from docking)
- Dangerous cargo (24 hours before arriving in the Finnish port)
- Vessel waste information

According to the Finnish Transport Agency PortNet serves approximately 1000 users on a daily basis. There are 1500 user names saved in the system. The main actors of PortNet include brokers (save all data), customs (check all data), ports (use data in invoicing and statistics as well as in monitoring of traffic of dangerous goods), maritime authorities (traffic monitoring), coast guard (vessel traffic monitoring), chartering companies and port operators (check vessel related schedules).

Chapters 2.1.-2.5 illustrate that wealth of information from several systems is available for vessels operating in Saimaa. These systems have much in common with River Information System (RIS) used in Central Europe. However, vessels in Saimaa area are SOLAS vessels. The use of RIS is not compulsory in Saimaa as it is not connected to other European inland waterway systems. Thus, there is no justification for implementing RIS in Saimaa.

3 RIVER INFORMATION SYSTEM (RIS)

3.1 General

River Information Services (RIS) are information services designed to enhance safety and efficiency of inland waterway transport (IWT) by optimising traffic and transport processes. Focal aspect is a swift demand oriented electronic data transfer between water and shore through real-time exchange of information. RIS therefore aim to streamline the exchange of information between all IWT stakeholders. Since 2005, an EU framework directive provides minimum requirements for RIS implementation and agreed RIS standards to enable cross-border compatibility of national systems. The European waterways affected by the RIS Directive are illustrated in the following picture.

*Source: http://www.ris.eu/general/what_is_ris_*

An EU framework directive (EC/2005/44) provides minimum requirements to enable cross-border compatibility of national systems. Comprehensive and international guidelines for RIS are continuously developed to harmonise the existing standards for particular river information systems and services within a common framework.

Many institutions and RIS experts are involved to optimize and harmonize various information services. Numerous services relevant to RIS are already sustained, particularly the use of Notices to Skippers, the Electronic Reporting of voyage-, cargo- and persons on board related information, Inland Electronic Navigational Charts (IENCs) on board and the Automatic Identification System (AIS) for vessel tracking and tracing.

On October 20th 2005, the EU RIS Framework Directive of the European Union (2005/44/EC - OJ L 255,30.09.2005) entered into force. The Directive is applicable to all interconnected waterways of class IV or higher across the European Union and provides binding rules for the authorities on the implementation of RIS services according to agreed regulations.

The European Commission has published the RIS Guidelines, but also Commission Regulations regarding all RIS key technologies (Vessel Tracking and Tracing (VTT), Notices to Skippers (NtS), Electronic Reporting International (ERI) and Inland Electronic Chart Display and Information System (Inland ECDIS))

Two main CEF/TEN-T projects developed RIS further and push the topic further (CoRISma project ended 2016 and follow-up project RIS COMEX, started 2017). Ministries of transport from different EU Member States are the main drivers in the projects. This is the reason the influence is big and results high on the EU agenda.

The following section will provide some information regarding RIS objectives and RIS levels as defined in the CoRISma project, being used in the European Union.

3.2 RIS Objectives and RIS Service Levels

3.2.1 Objectives

According to www.ris.eu the objectives are:

- Enhancement of safety in inland ports and rivers.
- Enhance the efficiency of inland navigation - optimise the resource management of the waterborne transport chain by enabling information exchange between vessels, lock and bridges, terminals and ports.
- Better and more effective use of the inland waterway infrastructure - providing information on the status of fairways.
- Environmental protection - providing traffic and transport information for an efficient calamity abatement process.
- Better integration of IWT into multimodal supply chains trough accurate and timely information to support transport management.

3.2.2 Service levels

Level 1

Corridor Management is a service to enable reliable route planning by supplying dynamic and static infrastructural information (Fairway Information)

- This is the basic level. It deals with the hard infrastructure information and provides the fundamental fairway information required for route planning. On this level, questions such as these are answered: How many locks are on the way? Are they open? How high / low are the actual water levels? Where can that information be obtained?
- The main task here is to provide fairway information from the point of origin to the final point of destination.

Level 2

Corridor Management is a service to enable reliable travelling times for voyage planning and for traffic management, by providing traffic information.

This level builds on the previous one, adding traffic information to Corridor Management. It's logical: Once you have the infrastructure information you need the actual traffic image. You are looking for information such as: How many vessels are on the fairway? What is my estimated time of arrival?

To know the traffic situation on a Corridor allows the stakeholders to plan their voyage better, or to know the position of specific vessels on the waterway network

Level 2 is further sub-divided into

- Level 2a: Taking in account the actual traffic situation (e.g. actual traffic density, actual waiting times)
- Level 2b: Also taking in account predictions during a voyage (e.g. predicted traffic density, predicted waiting times) where considered reasonable

Level 3

Corridor Management is a service to support transport management of the logistic partners (e.g. deviation management)

- This is the last level, which therefore builds on Levels 1 and 2, and introduces a new dimension: Third party information for logistics and transport management purposes
- Private stakeholders within the logistics chain can benefit from customised services providing specific relevant information (e.g. vessel position information or estimated times of arrival of specific vessels for authorised logistics users, voyage and cargo reports), enabling increased efficiency within the logistics processes

4 SMART BUOYS

4.1 General

Smart Buoy is a combination of robust polyethylene spar buoy and versatile selection of monitoring sensors.

The use of "normal" navigation buoy as a sensor platform saves costs both in investment and maintenance. Extra costs are only about 30% more compared to buoys without intelligence.

With Smart Buoy it is possible to:

1) Monitor the location of the buoy and battery charge, adjust the lantern remotely, and

2) Detect oil in the water, algae and oxygen in the water, measure turbidity, salinity and conductivity and

3) Measure tide, wave height, current and temperature. From web-applications you can read the values and also adjust both the intensity and flasher sequence of the lantern.

Finland has tested, with good results, the performance of Smart Buoys in the Gulf of Finland. Smart Buoy data from the sea was compared against the data collected by traditional manual methods.

Several data can be collected from the Smart Buoy. Available sensors are listed in Figure 4-2. Examples of data are shown in figures below.

Water level and currents are important for pilot and navigators. This information should be integrated to the Saimaa Portal or LiviApp as explained in chapter 5. According to the pilots, five to ten such buoys should be installed to Saimaa (Vuoksi) waterway. Adjustable illumination would be beneficial in all buoys.

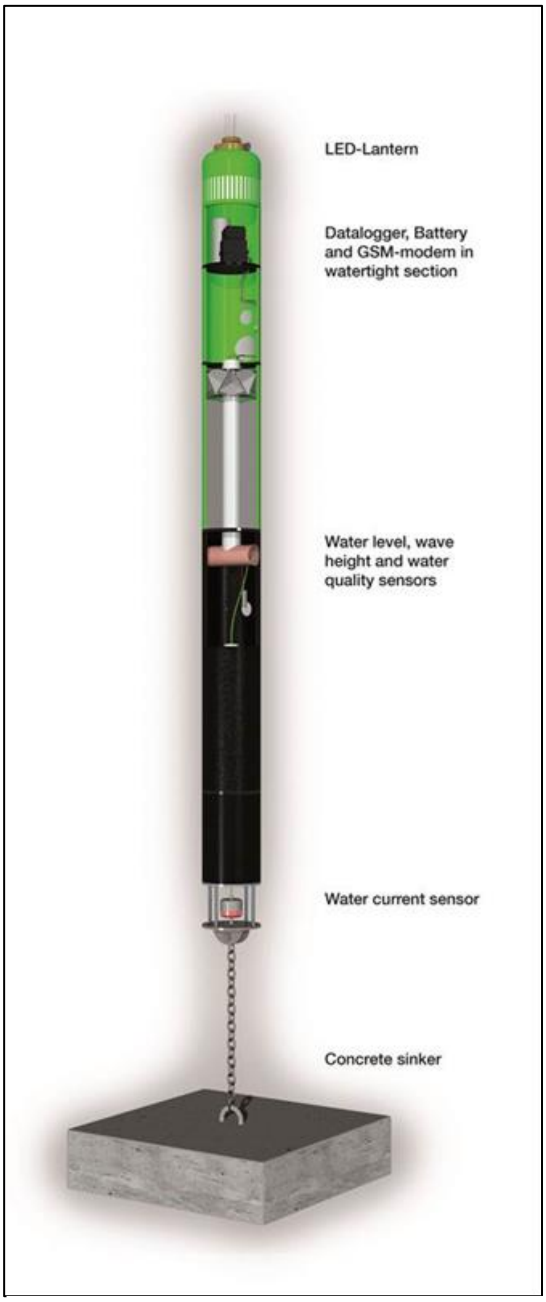

Figure 4-1: Smart Buoy (Meritaito Ltd.)

Parameter	Sensor	Range	Accuracy	Maintenance interval
Temperature I	YSI	-5 .. +50°C	+-0.15°C	Annually
Dissolved HC (Oil)	Trios EnviroFlu	0 .. 500 µg/l	0,3 µg/l	Once a Month
Temperature II	Aandera	-10 .. 43°C	+-0.1°C	Annually
Conductivity	YSI	0 .. 100 mS/cm	+-0,5%	Twice a year
Salinity	YSI	0 .. 70 ppt	+-1% or 0.1 ppt	Twice a year
Dissolved Oxygen	YSI	0 .. 50 mg/l	+-2%	Twice a year
Turbidity	YSI	0 .. 1000 NTU	+-2% or 0.3 NTU	Twice a year
Algae chl-a	YSI	0 .. 400 µg/l	-	Twice a year
Algae Cyanobacteria	YSI	0 .. 280 000 cells /ml	-	Twice a year
Water level	Aandera	0 .. 30 m	+-0.02%	Periodic calibration
Wave height	Aandera	0 .. 30 m	+-0.02%	Periodic calibration
Current speed	Aandera	0 .. 300 cm/s	1% or +- 0.15 cm/s	Periodic calibration
Current magnitude	Aandera	0 .. 360°	+-5°	Periodic calibration

Figure 4-2: Proven sensors available for Smart Buoys

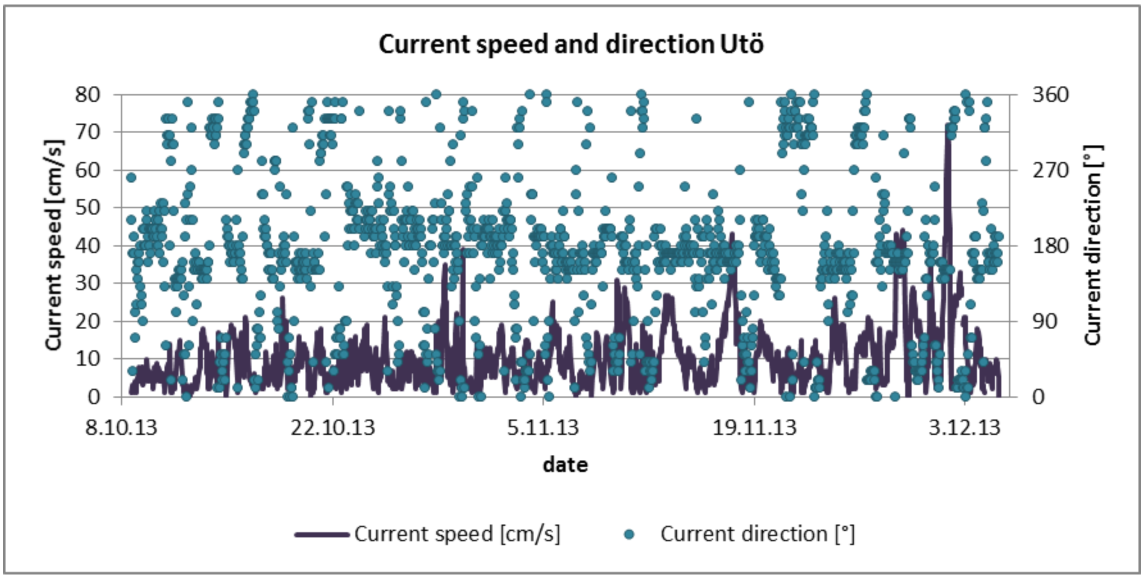

Figure 4-3: Smart Buoy current speed and direction measurements

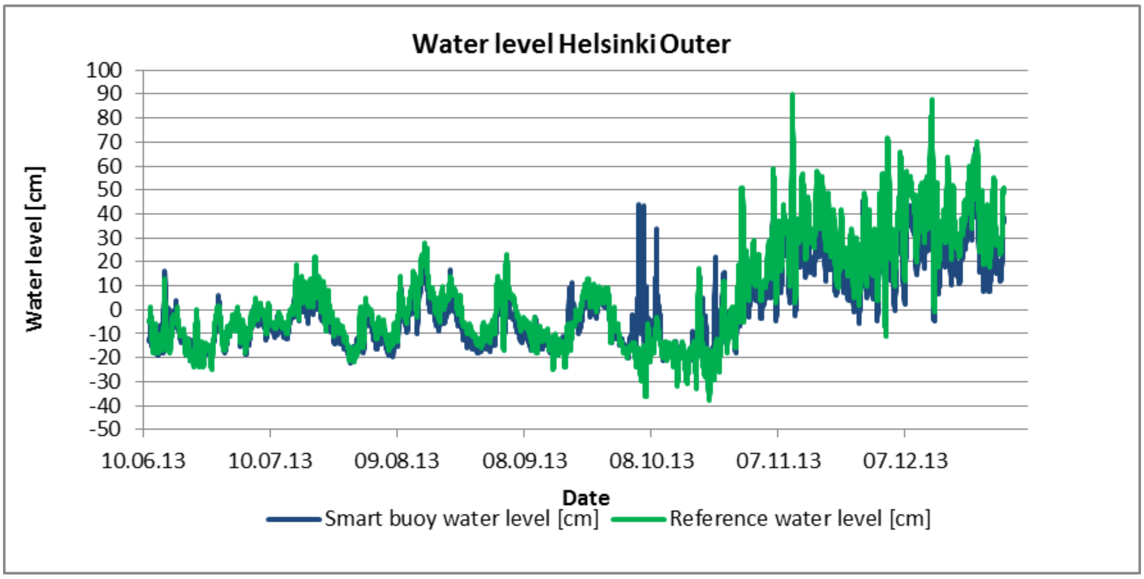

Figure 4-4: Smart Buoy water level vs. Reference water level

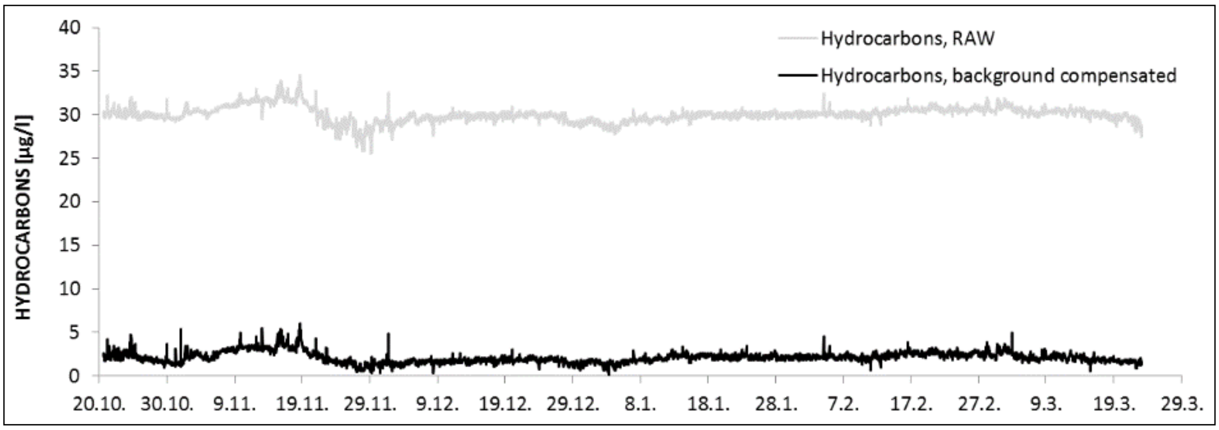

Figure 4-5 Hydrocarbon (oil) values from Smart Buoy

4.2 Remote Aton management

SeaHow has developed SeaDatics software for the remote management of the AtoNs. At the moment there are more than 600 AtoNs monitored by Finnish Traffic Agency in the system. The amount is constantly increasing trough the upgrading of the old AtoNs annually.

SeaDatics system also has mobile version which enables the change of light intensity on-the-need basis. By having the minimum default intensity and having the possibility to increase it when needed saves battery energy in fairways with little or irregular traffic. This feature has been tested with Pilots in Sea areas for two years now and the feedback has only been positive.

In smart fairways development pilots can (with smart phones) either turn on or increase the light intensity of the buoy lanterns as they arrive on the fairway. The idea is to save maintenance costs especially in the fairways with little traffic.

The system includes many useful options for Aton management like:

- Components and maintenance history
- Real-time location tracking
- Battery charge monitoring

Data transmission uses GSM-network and text message format, which has found to be more reliable than GPRS. The datalogger inside the buoy can be adjusted to burst the data in desired intervals to the web-server from where it can be forwarded. The data can be delivered directly to server of the responsible administration of fairway monitoring and maintenance as well. Then SeaHow can provide you with the interphase to the Smart Buoy datalogger.

4.3 Lantern light management

Lantern light management as a feature in smart buoys has several benefits for navigation purposes but also for the fairways situated close to population. This can be more relevant topic in inland waterways than it would be in Sea areas. Example setting on/off the lantern is a very good solution when fairways are located near populated areas to avoid light pollution caused by the signal lights.

Another great solution from light management feature in smart buoys is the possibility to adjust the flasher sequence. When all fairway lights are synchronized to the same sequence it helps the captain or the pilot in night time to navigate more accurate, because fairway can be seen with one simultaneous signal blink. It also eases navigation and avoids the eye fatigue when navigating in night time. Third and the most important feature in light management feature is the possibility to adjust the light intensity. This feature reduces the risk for accidents caused by rough weather or sudden fog in the fairways. When this kind of operational situation arises can the signal lights in fairway turn into full power to create better support for the navigation purposes.

5 SAIMAA PORTAL

To improve usability of the Saimaa Canal there are plans to create a “one stop shop” for those using the Canal. This stands for an information platform also known as the Saimaa portal. As part of this activity, several stakeholders were asked to take a questionnaire. The objective of the questionnaire was to identify the information needs of the Canal’s users. 35 respondents were reached through the questionnaire. The respondents represented industry, port operators, cargo transport, authorities as well as passenger traffic. The respondents were well informed of inland waterways in Finland.

One of the key questions in the questionnaire was the kind of information the stakeholders need. According to the responses information needs can be divided into the following categories: traffic information, weather information, service information and other. Other includes additional information for instance in delays and changes in traffic, pricing as well as schedules of canal renovation.

The findings of the questionnaire were discussed and prioritised on a workshop hosted by the Finnish Transport Agency on 10.1.2018. The workshop was attended by 11 persons representing chartering, the Finnish Transport Agency, industry, Ministry of Transport and Communication, piloting and the Regional Council of North Karelia. The range of needs arising from the questionnaire surprised the participants of the workshop. Yet furthers needs were identified in joint discussion: the documents that are needed on a vessel travelling through the Canal and customs related, country specific information. This kind of data is currently not easily found / available from public sources.

Overall significant amount of information concerning the Canal is available (cf. chapters 2.1-2.5). The challenge is that information is scattered in number of sources. Therefore, there is need for a joint platform which would make use of already existing information. In the workshop the platform was labelled as “the Saimaa portal”.

As part of the workshop the participants agreed on the kind of information the Saimaa portal “must” contain. The first category contains information on traffic. Such information exists for instance in PortNet and AIS, and it should be made use of. It still needs to be decided how traffic related information is presented / visualised in the portal. The second category deals with weather information. There is specific interest in water levels in parts of the Canal as well as in specific weather conditions such as fog and ice on vessels.

The third category concerns exceptional situations, e.g. traffic breaks especially on the Russian side of the Canal. Information on breaks is usually sent by e-mail. In the future such information could be presented with certain symbols on the portal. This would allow the users of the Canal notice quickly if there is a change in operating conditions that can have influence on traffic.

The fourth category contains information of services in ports on Lake Saimaa. This stands for instance for technical (basic) information such as number of docks, storage space, public or private port and some contact information. All this data could be shown on the map in the portal, and there could also be a link to the port’s website for more detailed information. In the end it would be the port’s responsibility to make sure information is up-to-date.

The Finnish Transport Agency utilises information gathered from the workshop in the development of the Saimaa Portal. Currently the Agency is developing a mobile application based on the traffic situation tool (see the figure below). The so called LiviApp has been designed for mobile devices. The app is currently being tested. The app will contain information of interruptions and delays in inland waterway traffic. During fall / winter 2018 more features will be added. The app will be available by the beginning of 2019 inland waterway season.

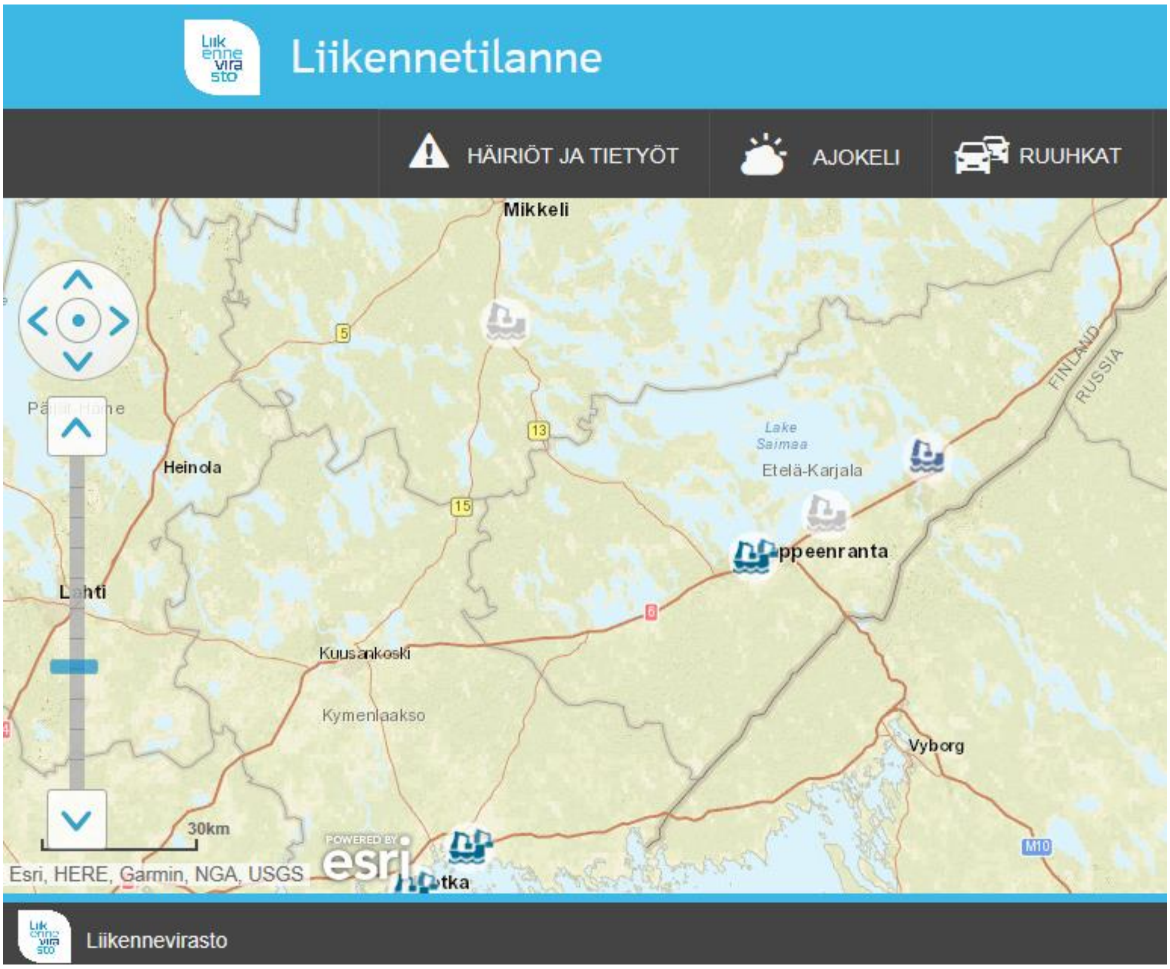

Figure 5-1. The traffic situation tool (source: the Finnish Transport Agency)

6 AUTOMATION OF CANAL AND BRIDGES

There are eight locks in the Saimaa canal. These are controlled from Mälkiä and Brusnitchnoe locks. Additionally, there are several locks and opening bridges in the Saimaa waterway area. Other locks and bridges in Saimaa could be automated with distant control functionality.

In Göta canal in Sweden, all locks and bridged are controlled from a single traffic control office. This includes Falsterbo canal some 400 km from the control tower shown Figure 6-1 in Trollhättan.

Figure 6-1: Control center in Trollhättan for all locks and bridges (Google Maps)

7 CONCLUSIONS AND RECOMMENDATIONS

It's a fact that in transport, digitalisation can significantly improve traffic and transport management through more accurate information on traffic and infrastructure conditions and on the location of vehicles and goods. Better access to and sharing of digital transport data for both public and private stakeholders along the supply chain can foster seamless information flows and open up a wide range of new business opportunities.

River Information Services (RIS), Sea Traffic Management (STM), Smart Fairway and RIS Corridor Management concepts as well as corresponding infrastructure are being developed further by the CEF projects CoRISMa, RIS Comex, RPIS, MONALISA, MONALISA 2.0 and STM Validation[1]. Especially corridor management aims to realize support for route and voyage planning as well as transport and traffic management.

This report illustrates the range of information sources available for vessels operating in the Saimaa Canal and Lake Saimaa (Vuoksi waterway). Finnish authorities testing new solutions such as smart buoys and pilotage to improve safety and efficiency of inland navigation. These solutions add up to existing information.

7.1 Comparison of RIS with Current Systems in Saimaa Area

In Central Europe implementation of interoperable RIS will provide information for navigation and operations. However, one must consider that e.g. in Finland no RIS services neither infrastructure exist but similar Vessel Traffic Services (VTS) systems, Automatic Ship Identification (AIS) and single window data sharing systems are in operation. These systems are used in marine traffic. In some BSR countries, such as the Nordics, inland waterways are connected to sea rather than other inland waterways. Seagoing vessels like river-sea ships are used in addition to inland barges. A separate RIS system for inland navigation is probably not being installed, especially as river-sea shipping plays a more dominant role in these waterways and duplication of similar systems is not productive. Therefore, regulations and operational practices should take interoperability of both sea and inland waterway systems (RIS/VTS) into account.

Anyhow the developments in central European RIS systems and corridor management applications is interesting to follow and a harmonisation of VTS system might be beneficiary.

[1] CEF funding Project cofinanced by the EU, Project Numbers: 2012-EU-21007-S, 2010-EU-21109-S, 2014-EU-TM-0206-S, 2015-EU-TM-0036-W, 2015-EU-TM-0038-W.

7.2 Recommendations

7.2.1 Feasible Development Actions

VTS system could be further developed to provide more benefit for resources used. The current system is not efficient, because its traffic control features are limited. It could also be further investigated if the service could be incorporated to other VTS centres. Also, distant control of bridges and locks could be an added value function. Radar coverage is too expensive for the very large area when considering the low traffic volumes. Using AIS and other means for traffic control could be studied further.

The development in pilotage and technology should be followed intensively. The impacts of using English language as working language requires further studies. Allowing the use of English language in VTS would set the same requirement for other users as well; bridge control and road ferries should be able to communicate in English or VTS should be used as a middle man.

Locks and bridges in the Saimaa canal are automated and remotely controlled. However, automation of other bridges and locks should be studied.

The development of the Saimaa Portal application should be continued. The developed smartphone application is in demo phase and should be in test phase in 2019. Experiences from these tests should be used to develop this application together with all relevant stakeholders. Using collected information related to weather and navigation and to provide this information as integrated part of the developed application platform enhances operations efficiency and safety.

7.2.2 Smart fairway pilot in IWT

A substantially step forward will be to extend the smart fairway towards inland waterways. Smart fairway applications (such as the smart buoys) will bring additional information services towards IWT stakeholders and at the same time can increase safety and ease of shipping on respective waterways. Especially navigation and pilotage will benefit from using smart buoys. Remotely controlled lights in buoys can increase the safety of navigation in many ways. It is strongly recommended to install such buoys in the Saimaa (Vuoksi) waterway and have strong development process trough test pilot. Results from the smart fairway pilot in IWT area can then to be copied elsewhere in Scandinavia and Europe where VTS is the system used.

Especially the Saimaa Lake area could act as pilot environment and can produce very good results due to the highly developed data transferring infrastructure. The test filed is also interesting because of the very rough weather conditions in four different type of weather seasons and highly narrow routes and harsh environment. Any aids to navigation will increase safety in sensitive environmental area where no room for accidents caused by human error should exist.

Reducing the life-cycle cost of fairway maintenance is possible with more accurate information collected from the fairways. This could result less signals, markings and batteries to go faulty condition with anticipatory maintenance operations. Investment to smart fairway can be then compared to traditional version by comparing costs for responsible administrations for future fairway investments.
As such the further implementation of smart fairway and smart buoy applications should be aimed.

8 LIST OF TABLES AND FIGURES

9 ABBREVIATION LIST

AIS	Automatic Identification System
CEF	Connecting Europe Facility
ECDIS	Electronic Chart Display and Information System
GRT	Gross Register Tons (ship volume measurement)
MIS	Management Information System
RIS	River Information System
SOLAS	Safety of Lives at Sea
TEN-T	Trans-European transport networks
VTMIS	Vessel Traffic Management System
VTS	Vessel Traffic Service

10 THE LIST OF LITERATURE AND SOURCES

Seppo Virtanen (2018) Smart Buoy – A Platform for Versatile Remote Offshore Applications to Support Maritime, eaHow

Seppo Virtanen & Antti Lindfors (2014) e-Navigation testbed, Smart Buoy’s monitoring performance and data validation, Meritaito Ltd.

Vesa Lasaroff (2018), Statistics on traffic through the Saimaa canal and other canals in Finland, Finnish Transport Agency

Information concerning RIS, retrieved 1.6.2018 from http://www.riscomex.eu/service-levels/