

**Developments in the Netherlands and Western Europe in applying state of the art systems and organizations for Services to Stakeholders in the maritime transport chain leading to optimizing the Inland shipping fairways design and utilization.**

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**Summary**

Los desarrollos relativos al uso de ayudas de navegación, a posteriori de los medios electrónicos y hoy por hoy al uso integrado de los sistemas de "Vessel Traffic Services" (Servicio de Tráfico de Buques), sistemas hidro- meteorológicos, internet y comunicaciones en banda ancha, en el diseño y la explotación de los canales de acceso a los puertos en Holanda y en Europa son descriptos.

Asimismo, el cambio consistente en pasar de un sistema determinista de diseño de canales de acceso a los puertos a un diseño probabilístico basado en "RISK" (riesgos), se describe.

Ejemplos de la cuantificación de éstos basados en las experiencias desarrolladas desde la década del '60 hasta la fecha en el Puerto de Rotterdam Europort, se describen. Similares desarrollos en la Unión Europea en el desarrollo de los Servicios de Información Fluvial para optimizar el uso de las vías navegables fluviales europeas, se presentan.

Conclusiones y resúmenes, así como sugerencias para futuros enfoques de los mismos, son presentadas.

Finalmente, se expone la forma en que STC B.V. desde Holanda puede asistir en estos aspectos de diseño, de sistemas de apoyo y, especialmente, de factores de recursos humanos.

**Introduction**

The developments in Port and fairway design and efficient usage of the available infrastructure over the past decades has lead to an increased use of the available infrastructure and facilities. Whilst in the 50ties the port and fairway design was merely a civil engineering job and the navigation of ships in and out of the ports merely was up to the mariners, now-a-days the design and usage of ports and fairways is an integral process involving various stakeholders and services leading to a maximum use of infrastructure at minimal costs for realization and exploitation/maintenance of these.

The history of development of aids to navigation over the past from light house to lighted beacons and buoys , shore based radar (1948) up to full blown vessel traffic services (from 1976 shore base radar became part of VTS) are briefly described.



PHAROS ALEXANDRIA 270 – 290 BC

Did the oldest VTS only comprise static information to shipping in the form of Lighthouses and semaphores, present days Vessel Traffic Services comprise everything needed to come to optimal interactive information from and to shipping regarding traffic, dangers, hydrometric and meteorological conditions, bathymetry, environment, pollution etc and the measuring and forecast of these.

Whilst the designing of civil engineering projects in the past decades tended to migrate from deterministic to probabilistic, the need for more detail information, data, statistics and prognoses of these increased. Hence the integration of Vessel Traffic Services from the start of a port and fairway project in the design stage up to and including the operation stage seemed like a logical step. And lead to a further optimization of these and essential cost savings for both realization as well as operation and exploitation.

Now-a-days we cannot imagine ports and fairways anymore without Vessel Traffic Services varying from Information Services , through Traffic managements and Organization Services up to Navigation Assistance Services to individual ships.

After the introduction of Vessel Traffic Services (first mentioned at the first VTS conference in 1976) on Seaports and the entrances to these , Vessel Traffic Services were also introduced on Inland water ways, at the start especially on critical points at crossings of fairways( in the Netherlands at Dordrecht, Tiel and Nijmegen in Germany at the Lorelei).

As the rivers in Europe are considered to be the transport axes of the future the use of these should be optimized and harmonized. Several European projects were initiated and carried out leading to harmonization of the information and data flow needed to optimize the maritime transport both at sea as inland.

Some of these projects lead to the introduction of River Information Services (RIS) and recommendations on which were also adopted by PIANC the Permanent International Association of Navigation Committees<sup>1</sup>.

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<sup>1</sup> PIANC, the world Association for Waterborn Transport Infrastructure, published "Guidelines and Recommendations for River Information Services" already in 2002. In order to reflect the technological progress, a PIANC working group started to revise the guidelines in 2008. Based on this review a new version of these Guidelines is prepared. On 12 January 2012, PIANC released the PIANC RIS Guidelines Edition 3

### ***Historic developments of navigation aids in Europe***

#### **1. History shore based radar i.e. Vessel Traffic Services in the Netherlands**

For entering and leaving ports during several centuries use was made of conventional aids to navigation, like fixed beacons light houses (first one at Alexandria) and semaphores. Since it became possible by using gas lights also lighted buoys became possible since the 19<sup>th</sup> century.

The very first shore based radar was used in the Netherlands for entering the port of Amsterdam at IJmuiden. So over the centuries step by step more means became available to measure parameters important and transmit this information to the ships , for the ships to safely navigate in and out of ports.



**MOST SEAWARD LOCATED SHORE  
BASED RADAR STATION OF THE  
PORT OF ROTTERDAM RADAR CHAIN  
(1955 - 1970) PILOT MAAS**

It was not until in 1976 the very first VTS conference was held in The Hague the Netherlands that the terminology of Vessel Traffic Services was introduced encompassing all information that could serve the safe passage of ships in confined waterways.

#### **2. History VTS on the river (Rotterdam Waterweg, Dordrecht , Nijmegen, Lorelei)**

The first shore base radar systems along rivers and fairways were installed as part of the first radar chain in the World which was employed from 1955 for the entrance from the sea to the port basins of the port of Rotterdam.

These systems were set up specifically to improve safety and capacity of letting shipping enter and leave the ports basins during night time conditions and conditions of poor visibility.

At first these radar stations were only manned during the said conditions of visibility and hence were un manned outside these hours.



**RIVER RADARSTATION OF  
ROTTERDAM RADARCHAIN (FIRST  
RADAR CHAIN IN THE WORLD (1954))**

These systems were initially meant for entrances (sea and river) to ports but since the 1980s also the first river shore based radar/ VTS systems were realized (1983 Dordrecht, 1982 Tiel, 1986 Nijmegen, 1987 Easter Scheldt , Bremer Hafen River VTS, VTS Rhine at Lorelei )

### **Relation Civil works Vessel Traffic Services**

#### **1. Relation civil technical harbour Works and VTS**

Relation between the shore based systems and the civil technical design of a port or a fairway in the early days were limited. The civil technical design was based on the traffic density , the ship sizes and waves , tides and cross currents and winds mainly. Now-a-days designing shipping fairways and the associated infrastructure like locks, bridges and port facilities of inland and out on the sea for instance are based on PIANC recommendations. Though many recommendations exist worldwide in many regions, the most complete ones are the ones given by PIANC. Below a summary of PIANC conditions for determination of the required width of a fairway.

**TABLE 1**  
**SUMMARY PIANC RECOMMENDATIONS FOR FAIRWAYS DESIGN AS FUNCTION OF SHIPS(S) WIDTH**

| Parameter               | Factor with respect to design vessel Width (open water) |            | Remarks          |
|-------------------------|---------------------------------------------------------|------------|------------------|
|                         | Best case                                               | Worse Case |                  |
| Basic maneuvering space | 1.3                                                     | 1.8        |                  |
| additional              | 1                                                       | 2          | Fast > 12        |
| Encountering traffic    | 0                                                       | 0.5        | heavy            |
| Bank clearance          | 0.3                                                     | 1.3        | Fast/hard steep  |
| Speed                   | 0                                                       | 0.1        | fast             |
| Cross wind              | 0.3                                                     | 1          | Slow/severe wind |
| Cross current           | 0.1                                                     | 1.3        |                  |
| Longitudinal current    | 0.1                                                     | 0.4        |                  |
| Waves                   | 0.5                                                     | 2.2        |                  |
| Aids to navigation      | 0                                                       | 0.5        | With or without  |
| Bottom surface          | 0                                                       | 0.2        | Moderate         |
| Depth fairway           | 0                                                       | 0.2        |                  |
| Cargo hazard            | 0                                                       | 0.5        | hazardous        |
| <b>Total</b>            | <b>3.6</b>                                              | <b>12</b>  |                  |

Similar to the determination of fairway width parameters for determination of the required fairway depth parameters were defined

**TABLE 2**

**PIANC RECOMMENDATIONS FOR FAIRWAYS DESIGN AS FUNCTION OF SHIPS(S) DEPTH**

| Depth Parameter            | How determined                                      |
|----------------------------|-----------------------------------------------------|
| Ships Draft (Fore and Aft) | Based on defined design ship                        |
| Sea or Fresh water         | Statistics                                          |
| Squad (UKC dependent)      | Based on max speed design ship                      |
| Heave (UKC dependent)      | Based on max speed design ship                      |
| Pitch (UKC dependent)      | Based on max speed design ship                      |
| Roll (UKC dependent)       | Based on max speed design ship                      |
| Ships loading/trim         | Based on assumptions for design ship                |
| Measuring inaccuracies     | Calibration and Statistics of measuring             |
| Salinity                   | Statistics of measuring                             |
| Siltation                  | Surveys, contract depth and statistics of measuring |
| Required UKC               | 10%, 15%, 20% of draft minimum 1 meter              |
| Vertical tide              | Statistics of measuring                             |

Originally for the above dimensioning the design values ( maximum occurring in N years) of the various parameter were taken. This will for general conditions lead to serious over design and high costs for realization and maintenance and exploitation.

Optimization of the determination of the design parameters would there for lead to costs savings. In order to achieve this better definition of parameters lead to more measuring of the parameters and investigation into improves fore casting of the latter.

## 2. Vessel Traffic Services and fairway dimensions

As mentioned above Vessel Traffic Services systems over the years became an essential part of Port and fairway design. In the 70ties dimensions were determined based on empirical approaches. Later more and more the designs changed from empirical / deterministic to probabilistic. Now-a-days most designs are based on probabilistic Risk Assessment.

Hence the methods as applied in the past ( adding up all design factors with a safety margin) though still used as a first approach for design has been changed. More and more the design approach is by estimating of the probability of occurrence of the parameter(s) during the voyage of ships classes or individual ships, so as given in the following table.

**TABLE 3**

**DETERMINATION OF DESIGN PARAMETERS OF FAIRWAY WIDTH**

| Parameter            | Determination through                         |
|----------------------|-----------------------------------------------|
| Maneuvering space    | Vessel speed measuring and fore cast          |
| Encountering traffic | Actual and forecast through VTS including AIS |
| Bank clearance       | Actual and forecast through VTS including AIS |
| Speed                | Actual and forecast through VTS including AIS |
| Cross wind           | Actual and forecast through VTS including AIS |
| Cross current        | Actual and forecast through VTS including AIS |
| Longitudinal current | Actual and forecast through VTS including AIS |
| Waves                | Actual and forecast through VTS including AIS |
| ATON                 | Condition monitored                           |
| Bottom Surface       | Frequent Survey                               |
| Depth fairway        | Actual through Frequent Survey and forecast   |
| Cargo hazard         | Databases and AIS                             |

## Developments in Western Europe in RIS systems for optimizing the Inland shipping

The change in design methods has lead to optimization of fairway width and depth i.e. reduction of the required dimensions.

As an example of the reduction of the horizontal dimension of a fairway, we can look at the experience with the fairway to Rotterdam the "Eurogeul" , the entrance of the port of Rotterdam Europort . At the start of the design in mid 60s of the fairway the nautical experts required it to be 3 miles wide.(Trials in the area with using Hifix as positioning system on board VLCC's "showed" according to them 3 miles). In fact most of the pilots, during trials looked out the window to the buoyage all the time as they were not used to sail on electronic means for positioning.

The final design was agreed on 1800 meters width in 1970 for 62 ft VLCC with and Under Keel Clearance of 20% under controlled hydro and meteorological conditions. After first use and growing experience both on shore as well as on board the fairway width was decreased to 1200 meters for 68 ft draft VLCC's in 1980. After even longer experience it was reduced to 800 meters for 72 ft VLCC's in 1990 whilst nowadays it is 600 meters for 75 ft VLCC's since 2000.

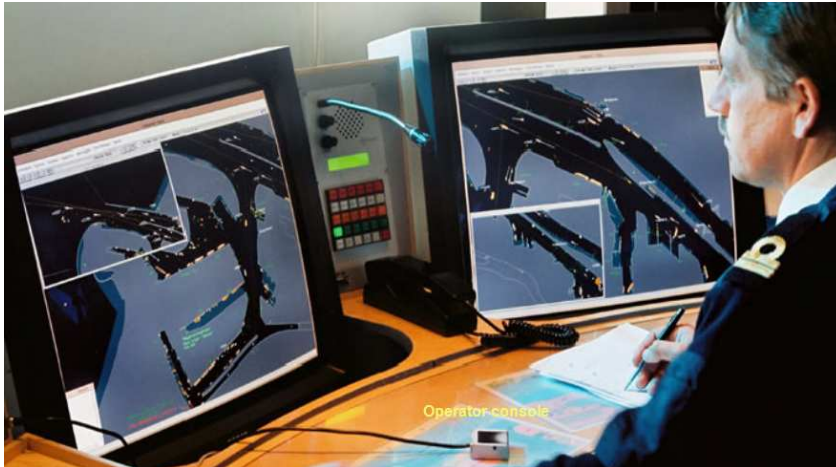
So similar to the developments that took place in the width development of the fairway , the depth development of the fairway to Rotterdam/Eurogeul was optimized.The initial design the maximum required value of the depth parameters were added in order to have 99% accessibility. Further research, better forecasting and measuring, experience and training led to reduction of the required depth in the fairway. Now-a-days by introducing a probabilistic approach to the access policy for classes of vessels and even for individual vessels has led to a reduction of the required depth for the deepest draft vessels of almost 2 meters.

**TABLE 4**  
**DETERMINATION OF DESIGN PARAMETERS OF FAIRWAY DEPTH**

| Depth Parameter            | How determined                                                    |
|----------------------------|-------------------------------------------------------------------|
| Ships Draft (Fore and Aft) | Based on each individual ship                                     |
| Sea or Fresh water         | Actual measurements and forecast                                  |
| Squad (UKC dependent)      | Based on max speed individual ship                                |
| Heave (UKC dependent)      | Based on max speed individual ship                                |
| Pitch (UKC dependent)      | Based on max speed individual ship                                |
| Roll (UKC dependent)       | Based on max speed individual ship                                |
| Ships loading/trim         | Based on measurements for each individual ship                    |
| Measuring inaccuracies     | Calibration and Statistics of measuring                           |
| Salinity                   | Actual measuring and forecast                                     |
| Siltation                  | Actual measuring and forecast                                     |
| Required UKC               | For each ship individually 10%, 15%, 20% of draft minimum 1 meter |
| Vertical tide              | Actual measuring and forecast                                     |

In the early days of shore based radar and VTS the motivation of a VTS was most of the time based on expected improvement of efficiency and safety. But in practice it was always difficult to motivate on base of safety as this was difficult to quantify. In practise the easiest motivation was to relate to reduction of fairways dimensions vertically and horizontally and the reduction in dredging works both initial as maintenance. Even now-a-days were Vessel Traffic Services is motivated based on a probabilistic approach and a Risk assessment approach (according to IALA), the above examples of dimension reductions show that motivation of a VTS based on reduction in initial dredging and maintenance dredging cost is still the easiest.

## Developments in Western Europe in RIS systems for optimizing the Inland shipping



ROTTERDAM VTS OPERATOR



ROTTERDAM VTS CENTER

### Development of River Vessel Traffic Services in Europe

The same tools, developed over decennia to improve fairway design of Sea Ports and to make use of them optimally, can also be used to make use of the inland fairways optimally (canals and rivers).

### Relation civil technical inland waterways improvement Works and VTS

One of the first times a direct relation was made between civil river works and river VTS was at the bend in the river Waal (main branch of the Rhine) at the City of Nijmegen.



## Developments in Western Europe in RIS systems for optimizing the Inland shipping

This was in 1986 when the river bend needed to be improved in order to allow push barges with four to six barges to pass this dangerous point in the river.

The Mayor of the city of Nijmegen would only consent in allowing these passages when there were adequate means in place to guarantee a safe passage. To this end besides river dredging works to widen the river bed and the bend, a Vessel Traffic Services station with radars, cameras and meteorological and hydrological stations was set up as well.



**RIVER WAAL (BRANCHE OF RHINE ) NEAR NIJMEGEN IN THE NETHERLANDS**



**VTS CENTER AT THE RIVER WAAL AT NIJMEGEN IN THE NETHERLANDS**





**INLAND VTS STATION OBERWESER (GERMANY)**



**INTERIOR INLAND VTS STATION OBERWESER (GERMANY)**

By also integrating other requirements of the fairway users needed for safe and efficient transport over the rivers, the River Vessel Traffic Services systems became more and more accepted in the Netherlands and Germany and later in Europe. As inland waterway transport goes cross borders this lead to the need for harmonization and to define the standards for these River Information Services.

#### **European developments**

In Europe in the 90ties and early 2000 we were facing the reality of EU economic development and growth. The EU enlargement opened new markets which lead to an Increase of traffic and transport volume. As the Road and Rail encountered limitations, the promotion of the use of the rivers became a spear point for policy makers.

Initiatives were set up with the Objective to realize sustainable mobility such as the Lisbon strategy, which was to make the trans European transport network the key network. Furthermore we needed to promote freight logistics as a key to sustainable mobility.

## Developments in Western Europe in RIS systems for optimizing the Inland shipping

Of all the transnational axes and projects, two were related to inland waterways:

- Rhine/Meuse-Main-Danube inland waterway axis
- Seine-Scheldt inland waterway

The Main requirements for these inland waterways to become an attractive transport alternative were:

- Safety of transport (low number of accidents)
- Short waiting periods at locks, ports and borders
- Available information (for resource planning)
- Sophisticated communication system (for efficient exchange of information)

In all the above River Information Services play a key role

### River Information Services (RIS)

RIS means River Information Services and stands for enhancement of swift electronic data transfer between water and shore for real time exchange of information. RIS makes use of modern Traffic Management systems. *RIS* is a concept for harmonised information services which are supporting *traffic and transport management* within inland navigation and providing interfaces to other modes of transport.

The RIS objectives are: Enhancement of the safety and efficiency of inland navigation, better use of the inland waterways and protection of the environment.

RIS services work on the basis of different information levels:

- Fairway information: Contains the data of the waterway only.
- Traffic information: It has the information on vessels in the RIS area.
- Traffic information (provided by traffic images) can be divided into tactical traffic information and strategic traffic information.

RIS can assist in providing information such as:

- Fairway information
- Traffic information
- Traffic management
- Calamity Abatement support
- Information for Transport Management
- Statistics
- Waterway charges and port dues

The realization of these services takes place through several RIS applications such as:

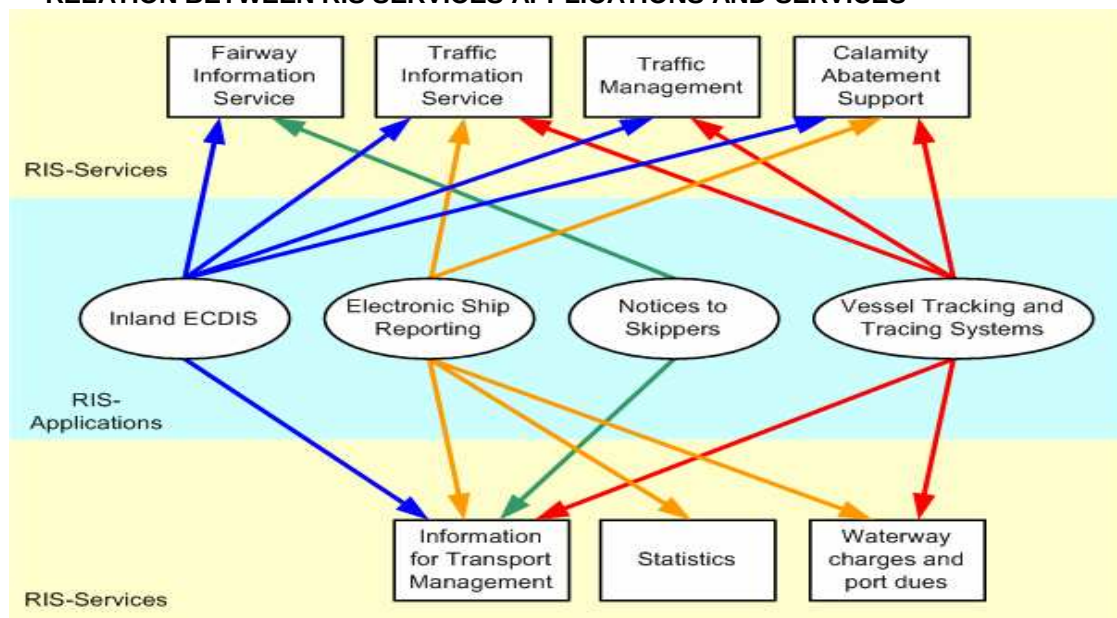
- Inland ECDIS
- Electronic Ship reporting
- Notices to Skippers
- Vessel tracking and tracing systems

### INLAND ECDIS ON BOARD AN IN LAND VESSEL



In the diagram below the relation between the services and the applications are depicted.

### RELATION BETWEEN RIS SERVICES APPLICATIONS AND SERVICES

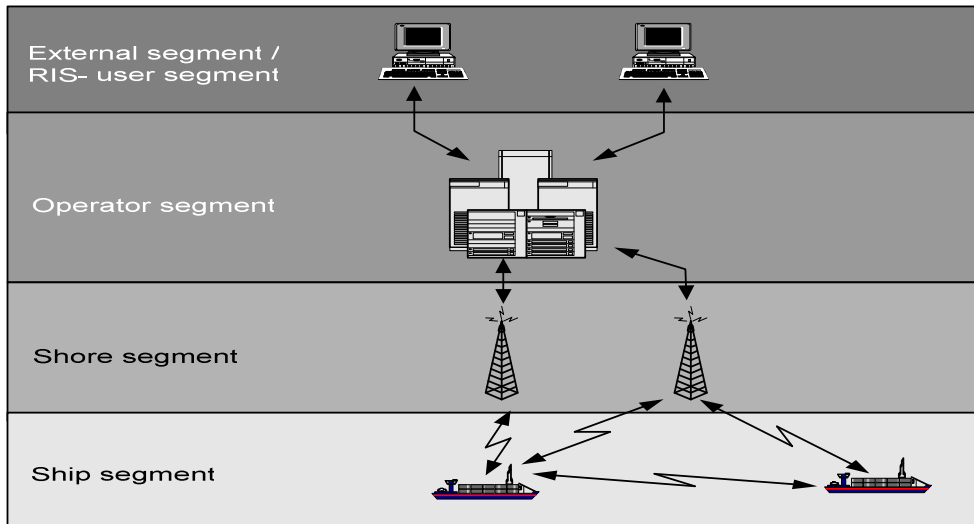


## Developments in Western Europe in RIS systems for optimizing the Inland shipping

In order to realize the RIS cross border networks are required consisting of four basic segments (see diagram on next page)

- External segment / RIS – user segment
- Operator segment
- Shore segment
- Ship Segment

### RIS SEGMENTS DIAGRAM

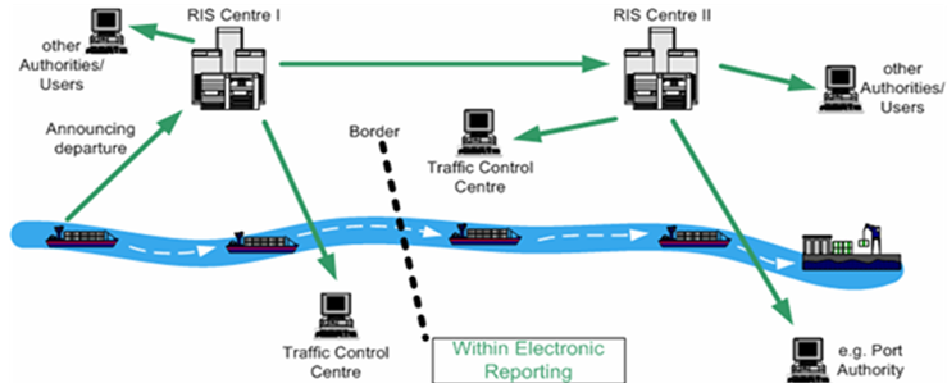


RIS can be designed, based on the development of each area and does not necessarily include elaborated Inland VTS stations. In case there are VTS stations, it is obvious that we will try to use these and integrate them to become RIS centers. RIS can be set up with or without electronic reporting for which purpose also partly Inland AIS can be used. The Electronic Ship Reporting Systems contribute to simplify the collection of statistic data, reduce errors compared to hand-collected statistics and reduce the costs of data gathering

### RIS SYSTEM SETUP WITHOUT ELECTRONIC REPORTING



### RIS SYSTEM SETUP WITH ELECTRONIC REPORTING



River Information services can be used for a great variety of purposes such as:

- Vessels and transport data Registration
- Authorities provides data immediately to the rescue and emergency teams
- Ship reporting systems have been introduced since the mid 90's in order to allow calamity abatement (IVS90, MOVES)
- Data is provided using VHF or using BICS reporting system (software tool provided by Dutch Waterways Authority)
- Voyage planning
- Port / terminal planning
- Cargo and fleet management

Also RIS can be used to collect relevant inland waterway freight statistics. These are mainly of interest to the waterway authorities for strategic planning and monitoring purposes.

Statistics can be made available in different formats:

- General traffic data;
- Cargo statistics;
- Vessel statistics;
- Lock statistics;
- Accident statistics;
- Port / transshipment statistics.

RIS can also assist in:

- Levying charges for the use of infrastructure;
- Sending of declaration notification;
- Sending of invoices;
- Providing :
  - fairway information
  - traffic information
  - voyage planning

Through RIS it will also be possible to apply automatic translation of the most important content of reports and documents into other languages and it allows easy integration with Inland ECDIS

### Summarizing,

River Information Service can play a key role in optimizing the use of Inland fairways and the maintenance and exploitation of these for all users.

- Traffic and transport services and systems for inland navigation should be harmonized
- Harmonized RIS should cover the rivers, canals, lakes and river ports
- RIS are not dealing with internal commercial activities between one or more companies involved.
- RIS are open for interfacing with commercial activities.
- RIS coverage areas, Vessel Traffic Services (VTS) may be established locally with the emphasis on traffic organization
- However, RIS does not necessarily include a VTS.
- RIS Guidelines describe the principles and general requirements for planning, implementing and operational use of River Information Services and related systems.

### The role of the STC group in RIS

By involvement in EU funded projects, STC plays an active role in developing the RIS concept and had a leading role in the Human Factors within RIS development. STC was involved in all mentioned European projects over the past decades (COST, BICS, RINAC, RIS, COMPRIS, INDRIS, MARNIS and EMBARC) and in the Guidelines for Man Machine Interface, development of an E-learning Tools for education of Inland Skippers, Providing an Operational Test-Platform, Demonstrators and Assessments using the extensive simulator park of the group. Furthermore STC has a long year experience in Simulator based design of Ports and Fairways

### STC VTS SIMULATOR





**Used abbreviations:**

|         |                                                                                              |
|---------|----------------------------------------------------------------------------------------------|
| AIS     | Automatic Identification System                                                              |
| BICS    | Binnenvaart Informatie en Communicatie Systeem (Inland Information and Communication System) |
| COMPRIS | Consortium Operational Management Platform River Information Services                        |
| COST    | Inventarisation of the various VTS systems in Europe                                         |
| ECDIS   | Electronic Chart and Data Information System                                                 |
| EMBARC  | European Maritime study for Baseline and Advanced Regional and Coastal traffic management    |
| EU      | European Union                                                                               |
| IALA    | International Association of Light house Authorities                                         |
| IMO     | International Maritime Organisation                                                          |
| INDRIS  | Inland Demonstrator of RIS                                                                   |
| IVS 90  | Informatie Verwerkend Systeem 1990 (Information ships database system )                      |
| MARNIS  | Maritime Navigation- and Information Services                                                |
| MOVES   |                                                                                              |
| PIANC   | Permanent International Association of Nautical Committees                                   |
| RINAC   | RIVER BASED INFORMATION, NAVIGATION, AND COMMUNICATION                                       |
| RIS     | River Information Services                                                                   |
| VHF     | Very High Frequency                                                                          |
| VTS     | Vessel Traffic Services                                                                      |