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Project 6.2.2, Task 16

RINAC

(River based Information, Navigation and Communication)

RINAC final report

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RINAC

(River based Information, Navigation and Communication)

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1. Executive Summary

1.1. Background

Considering the growing interest in a more efficient use of the inland rivers and vessels for transportation, the project 'RINAC' aims at improving the safety on these inland rivers, at increasing the commercial benefits of the skipper in an environmental friendly way and at reducing his workload. Furthermore, the standardisation of the functionalities of RINAC might be beneficial for the international development of tools and applications that are compatible in a competitive market.

RINAC stands for River Information, Navigation And Communication. During the project this acronym has become the representation of the integrated information architecture aboard the vessel itself.

As a consequence of the new functionalities that RINAC incorporates, attention must be paid to the requirements on the training and certification of the user of RINAC: the skipper.

1.2. Primary objective

The main purpose of this project is twofold. The first objective is to define the functional description of an architecture that manages the information flows aboard a vessel and provides the skipper with the appropriate applications to operate in a RIS environment.

Secondly, RINAC attempts to indicate an appropriate strategy regarding the certification and training issues as recommendation for future policies of responsible organisations.

1.3. Conclusion

The RINAC architecture

The implementation of the integrated architecture aboard a vessel, RINAC, seems feasible. Technically and financially there are no obstacles that prevent major parts of the implementation of RINAC from being realised. Based on the first 8 work-packages it can be concluded that the integration of information flows enable in principle an improvement regarding the safety conditions, the commercial benefits and the workload of the skipper.

The proposed RINAC architecture is conform with the RIS (River Information Services) concept, emphasising the distinction between tactical and strategic information. It may therefore be expected that RINAC would perfectly fit in the inland river situation of the near future and that it will be the tool to operate in a RIS environment.

Training and certification

A shift must be expected from traditional techniques of navigation like 'the outside window' to new ones, like inland ECDIS[1]. Furthermore, communication handling is becoming an additional task for the skipper. The training and the certification processes are subject to changes due to these shifts. Several conclusions and recommendations have been made.

One should bare in mind however that a further investigation is necessary to determine the effects of combining radar and ECDIS on workload and navigator performances as a basis for one-man operations.

Furthermore it can be said that the importance of the inclusion in this scrutiny of 'rare case situations', like calamities, is increasing.

[1] Electronic Chart Display Information System.

2. The work-packages

In this chapter the work done in the different work-packages is summarised. In order to make them introduce better the conclusions, they have been rearranged and sometimes combined in separate paragraphs.

2.1. Wp 1: input from the INCARNATION project; background

The INCARNATION Project was concerned with the provision of vessel traffic information services for inland waterways. It examined the feasibility of supplying river navigators directly, onboard their vessels, with operational traffic images from the shore-based radar and other information sources.

During this project the concept of RIS was discussed and defined. RIS stands for River Information Services and it attempts to specify the management of the information flows between a vessel and the shore or another vessel.

Mainly based on the safety aspect, these information flows can be divided in two.

1. Tactical Information

   This is information that is directly related to the position, speed and orientation of the ship. This information is required for short-term decision making regarding collision avoidance and anti-grounding control. Consequently, the validity of tactical information is limited. In general, a time-window smaller than 10 minutes and a distance not greater than some kilometres are applicable for tactical information.

2. Strategic Information

   This type of information is needed for longer-term decision making regarding planning, logistics and transport management (including incident abatement). In contradiction to the tactical information, a time-window of 10 minutes and longer or an area of many kilometres may be applicable in this case.

RIS is about the functional definition of these information flows, emphasising the distinction between tactical and strategic traffic images (during the RINAC project this last concept is renamed into Strategic Information Display) at the user-control level but ensuring integration of all functions at the information control level.

2.2. Wp 2: communication

Work-package 2 deals with communication on-board, both internal (the communication between the different on-board systems) and external (communication between ship and shore or between ships).

In this work-package, an overview is given of the current communication situation aboard the average vessel, describing the communication needs for tactical, strategic and fairway information. Since the communication need is growing, existing communication systems may no longer suffice in the future. Therefore, the developments in terrestrial and satellite communication systems are reviewed. Another way of dealing efficiently with large amounts of data, is the use of standardised messages. For this type of data communication, transponders form the obvious means. Transponders and the use of transponders are also investigated in this work-package.

When investigating the communication media and techniques on suitability for integration in the RINAC architecture, it has been taken into account that the operational environment will be according to the RIS concept. To complete this communication overview, the internal communication systems, their advantages and disadvantages for certain tasks and the communication protocols are described.

Based on this report it may be concluded that the physical implementation of the external communication layer consists of the VHF AIS transponder, the GSM and the radio. This work-package therefore significantly contributed to the definition of the communication layer of the RINAC architecture.

2.3. Wp 3 and 4: sensor management and traffic image sensoring

For inland waterways with their constraints of narrow fairways, near passages, etc. a reliable traffic image on-board of the vessels is of vital interest. Shore-based radar on-board, additional to the sensor systems that are now available can be one of the solutions. Work-package 3 investigates the sensor requirements and the type of information used for inland navigation of vessels. In this work-package also an indication is given on the possibilities of integration of the different sensor information.

Work-package 4 discusses the instruments that provide the information as identified in work-package 3. In this work-package both currently widely used technologies and recent state-of-the-art technologies are covered. In the corresponding report it is concluded that for the next coming years the common pulse radar can not be replaced by new techniques without paying a price; technically or financially.

Based on these reports it may be concluded that the physical implementation of the sensor/measurement part of the communication layer consists of Differential GPS, Radar and the heading and platform sensor instruments. The actuator part comprises control mechanics for the rudder, throttle and optionally for an ETA pilot.

These two work-packages therefore, are the basis of the definition of the internal communication layer of the RINAC architecture.

2.4. Wp 6: data management

This work-package investigates the critical inland river-related information in relation to safe navigation of the vessel. The inventory shows that at a number of places in Europe the development of Inland ECDIS is now being considered although at present there are no S-57 compliant data for inland waterways issued by official authorities available.

In Austria several demonstrations for an ‘inland waterway traffic management system’ for the ‘Bundesministerium für Wissenschaft und Verkehr’ (BMWV) approved the need and applicability of ECDIS data. The evaluation of the supplied dxf-data and additionally available data in Austria to produce ECDIS data for these demonstrations led to first results how to proceed in the development of Inland ECDIS compatible data of the Danube.

In Germany, the ARGO project supported by the Federal Waterway Administration (WSD-SW, WSD-S and WSD-W) focuses on the production of an Inland ECDIS database, covering parts of the Rhine.

In The Netherlands, the discussion about implementation of "River Information Services" (RIS) with components such as a "Fairway Information System" (FIS) in the framework of the INDRIS project led to decisions concerning S-57 compliant data.

On the other hand France - given the inland navigation system and the traffic densities - is interested in Inland ECDIS but does neither have the time nor the resources to actively promote ECDIS on inland waterways.

The WP proposes an Inland ECDIS harmonisation Committee, in order to derive one European S57 and S52 standard for future use. An initial and informal working group on Inland ECDIS has been established during the project’s lifetime under the auspices of the DG VII Concerted Action on Inland Navigation.

Figure 1: ECDIS with radar overlay[2]

In summary, the mentioned projects and activities indicate a picture for the future availability of S-57 data sets of European inland waterways. Important aspects like constant maintenance for new editions and update data, distribution, prices and commercial services have often been touched yet for a first time. RINAC made DG VII at different occasions aware of the present state of the art and the identified need to start harmonised action at once.

So far the step to standardise in such way that it can be used as input for voyage planning and monitoring software has not been made. Standardisation incorporates two main problems: the availability and the update rate. Also some requirements on the inland ECDIS system itself should be made. These requirements are covered in this work-package, defining the concept of the distribution layer of the RINAC architecture.

[2] Source: WSD Südwest, University of Stuttgart, 7C's

2.5. Wp 5: human-machine interface

This work-package discusses the requirements that are related to the user interface. It first defines a decomposition of the HMI into two levels. Then it describes the standards and guidelines that have impact on these two levels.

Furthermore it is shown that the HMI must comprise a tactical traffic image a strategic information display (These elements are discussed in more detail in the next paragraph).

The results of this work package completely cover the human-machine-interface of the RINAC architecture.

2.6. Wp 7: information needs for the inland navigation and communication applications

The primary objective of WP 7 of RINAC is to define the different information flows on traffic and additionally on transport for tactical and strategic functions on inland navigation. The River Information Service (RIS) concept of INCARNATION will be taken as the basis in this workpackage; starting with the general outline and benefits of the RIS-concept for the RIS user on-board of an inland vessel.

The report gives an overview of the present situation on traffic and transport information (and information need of users) for processes like navigation, cargo management, lock management and reporting.

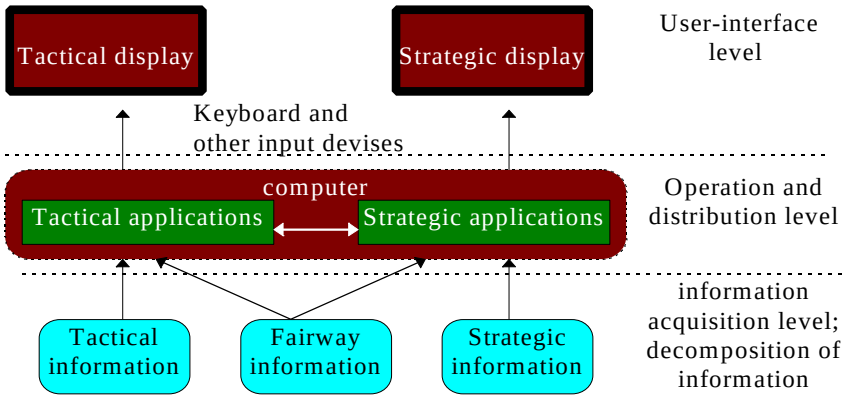

Figure 2: Decomposition of information conform to the RIS concept

Then the result of a decomposition of information processes within a RIS that is related to traffic and transport information is specified. Based on the first and

second level decomposition of these information processes in the tables, the information needed for the different functions are described and specified. This decomposition of processes and the information-requirements provide essential information for the definition of the application and user-interface layers of the RINAC architecture.

2.7. Wp 8: the architecture of RINAC; 4 layer model

In this work-package, the proposed functional description of the RINAC architecture is presented. RINAC is the integrated information, communication and navigation architecture aboard a vessel. It attempts to improve the safety on these inland rivers, to increase the commercial benefits of the skipper and to reduce his workload. These improvements must be realised by the implementation of RINAC. The concept of RINAC can be simplified by defining 4 layers and the corresponding effects of RINAC on these layers[3]:

1. RINAC describes what information is acquired aboard the vessel and how (sources of the information and the implemented communication techniques).

2. It proposes a database system, making all information that is once received available for multiple applications (distribution of the information).

3. RINAC aims at standardising these applications and what information they use (processing of the information).

4. And it tries to specify the user-interface (presentation of this processed information to the skipper).

The elaboration of these 4 points results in a scheme: the architecture of RINAC, which is the major result and last part of this work-package. In this architecture, the distinction between the tactical and strategic information at the level of the human interface is emphasised as is required by the definition of the RIS environment (as discussed in Wp 1).

[3] These layers are covered by and can be recognised in the different workpackages.

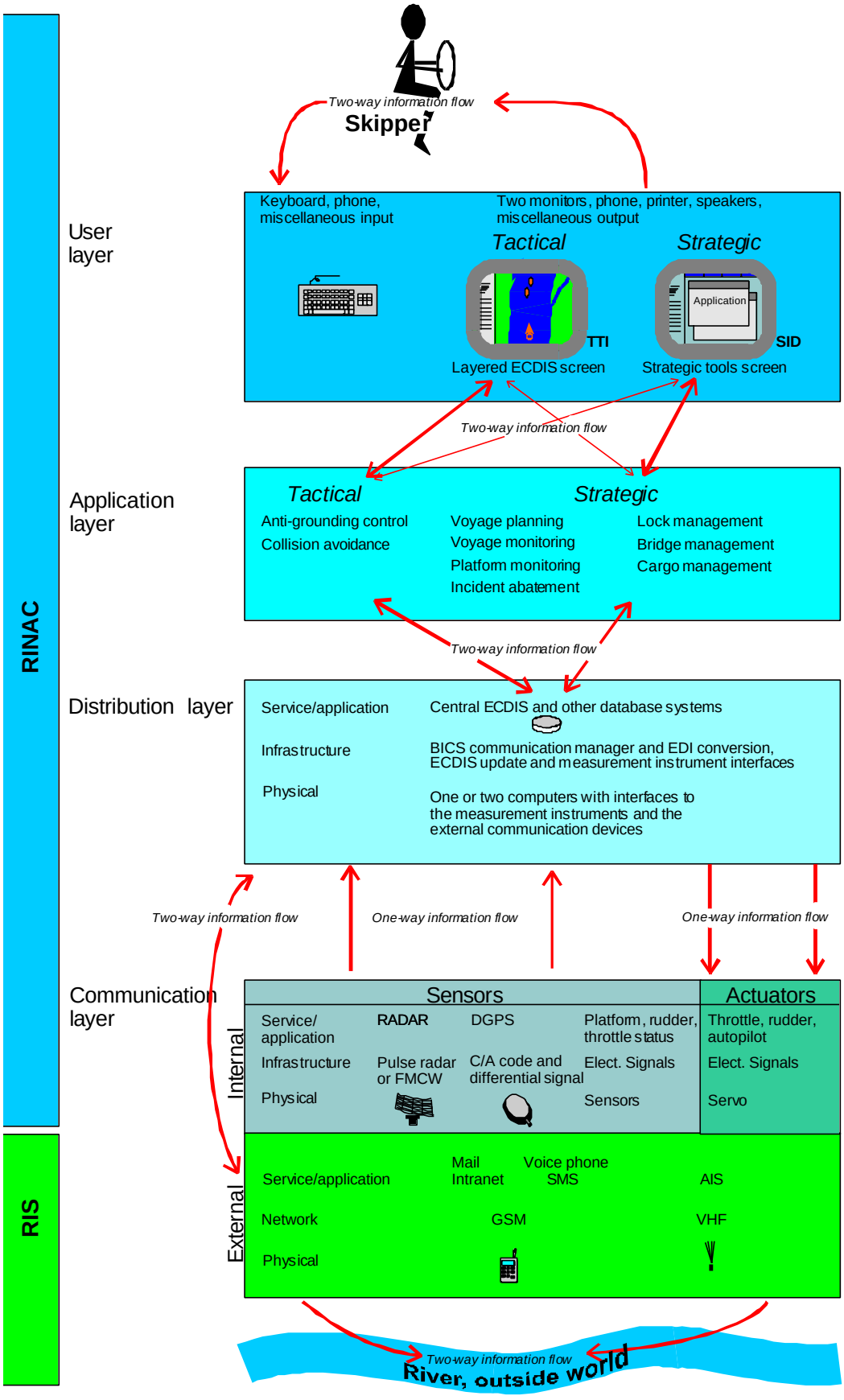

Figure 3: The RINAC architecture

Ad 1: communication layer

This layer is covered by several work-packages 2, 3 and 4 and by the INDRIS project. The sources of the information must be separated in an external communication part (Wp 2 and the INDRIS project), an internal sensor part (Wp 3 and 4) and an internal actuator part (Wp 3 and Wp 4).

Ad 2: distribution layer

The information that is acquired must be stored, sent to some devise in particular or further processed. In order to guarantee availability of the information, it is managed in databases in a central computer. This subject is discussed in Wp 6.

Physically it is one or two computers with CD-ROM and the right interface towards all the equipment. Its infrastructure consists of some applications and database control software. The distribution layer services RINAC by allowing read, write and edit operations on the databases that contain all information that the sources have made available. Among these databases, at least the following can be distinguished:

- inland ECDIS database for all geographic information
- cargo and logistics database
- ship's characteristics and actual status database

Ad 3: application layer

As mentioned before, it is this layer that requires separation of the tactical activities from the strategic ones. The tactical applications at least include anti-grounding control and collision avoidance tools. Strategic applications should include voyage monitoring, voyage planning and other tools. These topics are discussed in Wp 7.

Ad 4: user-interface layer

This layer realises the visualisation and presentation of the tactical information and the strategic information to the skipper (see also Wp 5). To emphasis the distinction between two types of information, it is proposed to use two separate screens.

2.8. Wp 9 and 11: present training and certification requirements

Work-package 9 discusses the present training courses. It was found out that all the courses covered by the investigation belong to the SEDOC category 2 or 3. Duration varies between 2 and 3 years with the exception of Belgium (4-6 years, depending on the grade of occupation).

Considerable differences were observed in the ratio between the theoretical and practical part (share of hours spent in service on-board the ship) of the courses in particular programmes. They vary from 15-20% in Austria and practically oriented programme ("Beroepsbegeleidende Leerweg") in the Netherlands to as much as 60-75% in Belgium and theoretically oriented programme in the Netherlands. In principle, the conclusion of this education level does not offer a possibility for applicants to proceed with the high education level (University) but enables professionals to apply for some further courses in the specific field of inland navigation.

Work-package 11 deals with skipper's licences and other certificates enabling their bearers to act in carriage of goods and passengers in European inland navigation.

Three different kinds of skipper's licences allowing them to navigate inland navigation vessels in the EU member states are issued at the moment as the result of the unification of provisions for the application and issuance of national licences governed by the directive 91/672/EEC. That are master's licences of group A and group B whose issuance belong under the jurisdiction of national authorities, as well as patents on Rhine going vessels exclusively under the liability of the Central Commission for Navigation on the Rhine (CCNR).

Licences of group A are of a higher grade than those of B and allow their bearers to steer the ship also on inland waterways of maritime character except on the Rhine. All those who want to guide a ship on the Rhine are obliged to possess an additional certificate which corresponds to the Rhine Boatmaster's Patent Regulation issued by the CCNR as a competent authority for the regime on navigation on the Rhine.

For each type of master's licence there are given the definition and area of validity, requirements for the acquisition, necessary professional skills as well as additional skills required for passenger transports.

In accordance with the Rhine Skipper's Patent Regulation different kind of licences are assigned to the types of vessels that shall be operated. The following kind of patents are valid on the Rhine:

- "great patent" for all types of ships valid on the whole Rhine

- "small patent" for vessels having a length of less than 35 m and not intended to push or tow and for vessels intended to transport not more than 12 persons

- patent for leisure boats having a length of less than 25 m

- peniche patent allowing their bearers to steer a peniche on the section between Basle and the lock of Iffezheim

- authority patent allowing their bearers to navigate police, customs or fire-fighting launches.

A detailed list of various basic and specific knowledge required to be shown by applicants during examination for different kinds of patents is also given.

Other certificates comprise licences for handling radar devices on the EU waterways and on the Rhine, hazardous (ADNR certificate) and VHF ship radiotelephone as general communication means. The contents of examination of the applicant for each of the above mentioned certificates including theoretical and practical part as well as the basic and specific knowledge requirements are given in detail.

2.9. Wp 10 and 12: future training and certification requirements

An analysis of training needs for work-package 10 should be made using the results of work-package 8 seen in the light of work-package 9. This confrontation will result in (new) requirements for education, training and certification.

The amount of information, the intensity of vessel encounters in some areas and the physical restrictions of the waterways require well-trained personnel, capable of dealing with the systems that supply the relevant information. Increasing professionalism coming along with the diminishing number of people onboard, which hampers the traditional onboard education, and the increasing complexity of the traffic image requires abilities already mirrored in the present equipment on-board of inland vessels.

Within this work-package the approach aims at a set of STCW-type (Standards of Training, Certification and Watchkeeping of IMO) of definitions for the identified required competencies for inland navigation. The identified competencies will differ from sea navigation due to the large ressential differences between areas, vessel sizes and available (and hence required) existing and new technology in different areas, either on-board or on-shore.

Within the different areas and on-board different vessels it will be the level of competence and the extensiveness of 'knowledge, understanding and proficiency (STCW)' that differs and hence the education requirements and the contents of the training programmes. The result of this work-package should be a description of the (level of) competencies required for the navigation on different waterways. Following from this a description should be given of the required education and the contents of the training programmes on suitable tools. Certification is treated as a description of the criteria for evaluation.

Work-package 12 addresses the future certification of the on-board equipment of inland waterway vessels enabling the skipper to benefit from enhanced information services aiming at improving the safety and efficiency of inland waterway transport.

The report of this package:

a) analyses the principles of a possible methodology from the design of future certification procedures,

b) shows how such a methodology could actually be implemented

With respect to point a) a comparison of the certification processes within various modes of transport, and more precisely a review of the methods the efficiency of which has been demonstrated in the aviation sector, lead to think that there could be serious advantages paying attention to procedures based on the consideration of a target safety level.

With respect to point b) the report concludes in identifying a number of specific issues (such as the standardisation of DGPS systems, the identification of the proper competent authorities) that should be tackled at institutional level to facilitate the development of RINAC services at European scale.

3. Conclusion

Since the principal objective of this project is twofold, the conclusion has two parts. First the RINAC architecture is focused at, followed by the evaluation of the training and certification needs.

The RINAC architecture

It has been shown that the skipper's tasks require the availability of specific information. RINAC therefore attempts to improve the management of such information. The concept of RINAC can be simplified by the definition of 4 layers of information management:

1. RINAC describes what information is acquired aboard the vessel and how (communication layer including the AIS, GSM, GPS and other data).

2. It proposes a database system, making all information that is once received available for multiple applications (distribution layer including the Inland ECDIS and other databases).

3. RINAC aims at standardising these applications and the information that they use (application layer including collision avoidance, voyage monitoring and other tools).

4. And it tries to specify the way of presentation (user-interface layer specifying the SID and the TTI and other input/output devises).

Based on the first 8 work-packages, it can be concluded that the integration of information flows enable in principle an improvement regarding the safety conditions, the commercial benefits and the workload of the skipper. This conclusion includes the following items:

safety improvement
- positioning is based on inland ECDIS, radar, inland AIS and DGPS, one technology compensating for the imperfection of the other
- the tactical display presents only real-time and important information; the platform and calamity status is only shown if it are warnings
- more information can be handled, resulting in a better knowledge of the environment

commercial and logistics improvement

- integration of information enables optimisation of the costs, time and profits balance
- more information can be handled, enabling a more sophisticated logistic management

decreasing the skipper's workload

- the integration of information enables the automation of several tasks
- information requirements that some tasks have in common has to be provided only once

stimulating the development of competitive applications and technologies

- the standardisation of the RINAC concept realises a stimulating environment for international manufacturers to develop tools and applications that improve the situation on the inland rivers
- new technologies can easily be implemented
- new communication technologies can increase the functionality of RINAC, independently of the current hardware aboard the vessel

The training and certification requirements

A shift must be expected from traditional techniques of navigation like 'the outside window' to new ones, like inland ECDIS. Furthermore, communication handling is becoming an additional task for the skipper. The training and the certification processes might be subject to changes due to these shifts.

In the future, a complete training course should therefore consist of a course of candidates to a skipper's certificate and refreshment courses by means of which the skipper becomes familiar with changes in technology. Such a course must train the understanding and handling of radar systems, the electronic chart and the other information systems that RINAC incorporates.

The modifications in the certification process require further efforts towards standardisation of equipment and operational procedures. A European competent authority should be identified and set up which would be entitled to edict a common set of rules applicable to vessels of any nationality navigating European inland waters.

It is necessary to implement quality control procedures to ensure the quality of both design and production of equipment.

4. Recommendations

The RINAC architecture

For this project, the RINAC architecture has been discussed on a theoretical level rather than a practical one. In order to realise an improvement in the collaboration between the vessel and the RIS environment, the skippers must be motivated to buy and use RINAC compatible equipment. Instead of a theoretical discussion of the RIS concept and the distinction between the tactical and strategic information flows, a concrete demonstration of what RINAC would look like on his vessel might be more to his advantage.

The training and certification requirements

It is concluded that a further investigation is necessary to determine the effects of combining radar and ECDIS on workload and navigator performances as a basis for one-man operations. The importance of the inclusion in this scrutiny of 'rare case' situations, like calamities, is increasing.

The target safety level of the future certification procedure should be derived from data already collected at the occasion of the INCARNATION project. The RINAC project and other projects such as COST326 and MASSTER provide recommended input for the HMI requirements.

Furthermore it must be noted that simulation facilities could significantly contribute to the assessment and validation of and on-board equipment.

5. Dissemination Activities

Presentation / paper / article	place	event/date
RINAC home page; TNO-FEL	http://www.tno.nl/instit/fel/rinac	internet
Schip & Werf de Zee; article: Europese maritieme research (in Dutch); C.C. Glansdorp		magazine Jan 1997
11th Ship Control Systems Symposium; paper/presentation: 'Bridge 2000', the Real Integrated Bridge; W. F. M. van der Heijden	University of Southampton, Southampton, UK	conference 14/18-04-1997
Incarnation newsletter no. 3; article: RINAC; W. F. M. van der Heijden		magazine May 1997
Concerted Action on Inland Navigation; presentation W. F. M. van der Heijden	Seezeichenversuchsfeld, Koblenz, DE	meeting 26-06-1997
Europäische Binnenschiffahrt; presentation Telematics and Information Systems; C.C. Glansdorp	Wiener Rathaus, Vienna, AT	conference 04-07-1997
9th International Congress of the International Association of Institutes of Navigation, paper: Added Value for Integrated Bridge Systems for Shore Applications; R. Hol and W. F. M. van der Heijden	RAI Conference Centre, Amsterdam, NL	conference 18/21-11-1997
'Bridge 2000'; 1 day symposium on integrated bridge systems; R. Hol and W. F. M. van der Heijden	TNO-FEL, the Hague, NL	symposium 03-12-1997
Meeting ASTM F-25 'Ships and Maritime Technology', Task Group F-25.05.05 'Shipboard Data Management and Communications Systems; Presentation EC projects on Inland Navigation; van der Heijden	San Diego, CA, USA	meeting 09-12-1997
Presentation on the RINAC project at Austrian Research Centre Seibersdorf	Seibersdorf, AU	meeting 29-04-1998
Concerted Action on Inland Navigation; presentation W. F. M. van der Heijden	World Expo, Lisboa, PT	meeting 08-06-1998
Poster presentation RINAC at PIANCC congress	the Hague,NL	conference September 1998
RINAC presentation at EC DG VII exhibition stand at the 5th World Congress on Intelligent Transport Systems	Seoul, Korea	conference 12/16-10-1998
Article on the RINAC and INDRIS project in 'Toegepaste Wetenschap' (in Dutch)		magazine December 98
European Inland Waterway Navigation (EIWN) ; 'RINAC, the Future ridge to Operate with RIS'	Hungary	conference 9/11-06-1999
Description of the RINAC project for a booklet on EU projects (in Dutch) for the Dutch Ministry of Economic Affairs (Senter)		brochure
Article on the RINAC and INDRIS project in 'de Scheepvaartkrant' (in Dutch)		magazine December 98
Workshop on telematics of the Central Commision for the Navigation on the Rhine; presentation W.F.M. van der Heijden	Strasbourg, FR	conference 29-01-1999
Waterborne conference	Rotterdam, NL	conference 29/31-03-99
Article on the RINAC and INDRIS project in 'TNO Magazine'		magazine March 98
Transport Research Conference	Lille, FR	Conf. Nov.99