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Section II

Maritime ports and seaways

(for commercial, fishery and pleasure navigation)

SUBJECT 4

New trends in port planning and development

Ports et accès maritimes

(pour la navigation commerciale, de pêche et de plaisance)

SUJET 4

Nouvelles tendances de la planification et du développement portuaires

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En collaboration avec les Autorités portuaires de Zeebruges et avec le soutien de la CE, une méthode de couplage de ports (dite "méthodologie de la chaîne des valeurs") a été développée et testée sur trois études de cas.

Le concept de ports couplés et la méthodologie des chaînes de valeurs ouvre de nouvelles perspectives non explorées, même s'ils vont à l'encontre des vues traditionnelles de beaucoup de groupes d'intérêt du secteur du transport. Il faut une évolution stratégique de l'approche du "transport de port à port" vers une optique de "porte-à-porte intermodal" dans le transport maritime pour convaincre un nombre suffisant de parties intéressées dans les deux ports des avantages de l'établissement d'un couple de ports durable. Il faut que les usagers potentiels (les demandeurs) aient assez de valeur ajoutée pour accepter des modifications à leurs voies de transport existantes ou considérer la création de voies totalement neuves.

En l'absence d'un potentiel accru de flux de trafic de marchandises de port à port clairement évident, d'une part, et de bénéfices financiers facilement réalisables à court terme et à bas risque, d'autre part, on ne peut s'attendre à ce que les partenaires potentiels s'engagent dans le développement d'un couple de ports s'il n'y a de changements sérieux dans l'environnement externe. Ce type de changements se produisent actuellement dans le contexte européen, notamment suite à la résistance croissante à l'extension continue du transport routier sur les axes principaux et la demande pour des services logistiques intégrés pour les usagers.

PART 3

New integrated tools to improve the traffic and the port planning

by

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Summary

The circumstances arising in the European internal transport system have imposed an urgent need of improvements. Considerable improvements could obviously be achieved through a better utilization of the existing free capacity offered by the inland and short sea shipping. In order to make this mode of transport more competitive and to promote her integration in the multi-modal transport chains (i.e. to enable the fluvial mode to become more attractive for the customers on the transport market) both technical and organizational components have to be considered.

It seems that the introduction of an efficient management of the information exchange systems of the inland and short sea shipping (as a part of multi-modal chains) will significantly help to meet the envisaged objective.

1. General considerations

As port planning and port development, promotions of intermodal systems are closely connected with the management of maritime traffic and inland and short-sea shipping. In this report, we will focus our interest on the management of the information required by inland and short-sea shipping in order to:

- satisfy the "Almost Just In Time" concept (AJIT),
- become a reliable and economic transport mode that should be part of most of the multi-modal transport chains.

2. Inland and short sea shipping: the present situation

Nowadays it is still very difficult to localize accurately a ship between its departure and arrival points (tracking system) and to exchange information with it (information transfer system). Then, it is quite difficult to treat, in real time, the existing information to obtain an efficient management of fluvial traffic (including short sea shipping). The ship location techniques (radars and photo-electric cells) used at present are insufficient, not reliable and only applicable in some selective cases.

A better technique has been developed to manage the road network in Holland, Belgium, France and Germany. It consists of the utilization of the mobile communication systems Prodat, Euteltracs by satellite. These systems could also constitute for ships an efficient solution of communication associated with a quick treatment of information. Such an information transfer system can contribute more efficiently to safety and traffic rationalization, permitting at the same time to increase the infrastructure capacity by a better exploitation of the navigable waterway network.

The development of a tracking system, a traffic control and a communication system between ships and dispatching centers can lead to a more efficient utilization of waterways and to increase the global speed of fluvial transport.

The communication technique to contact a ship through a satellite will also permit the development of an inter-modal transport system. It will contribute to a better scheduling, regularity and service quality to reach the "Almost just in time" industrial strategy of production/storage (AJIT).

3. Targets of the telematic system

The purpose of a telematic system is to improve the performance of the fluvial/coastal transportation using a better data transmission and a rapid and efficient communication system. This system should be used by the different actors involved in the transport chains (traffic management centers, shippers, ships, managers of waterways and ports, local authorities,...). The communication systems used at present seem not to be efficient enough to improve the fluvial transport and to give transporters a possibility to compete with the other transportation modes or to be integrated in intermodal chains.

The main objectives of the telematic system for inland and short sea shipping are:

- rationalization of the traffic (traffic control, safety, better exploitation of the waterway network);
- making the fluvial mode more attractive;
- including fluvial transport in the intermodal systems;
- reducing the specific transport cost.

This research can be defined in 4 stages:

- analysis of the present situation;
- definition of the telematic chain;
- choice of communication and tracking system of the ship;
- feasibility and assessment tests.

4. Analysis of the present situation

4.1 POSITION OF THE FLUVIAL TRANSPORT AMONG THE OTHER TRANSPORT MODES

The European integrated market, the development of a free economy with the Eastern European countries and the incessant economic growth in Europe will continue to generate an increase of the total cargo flow.

Due to its low cost, its weak impact on the environment, the small consumption of energy and the reserve of capacity both in infrastructure and in material, the development of the fluvial transport can be considered as unavoidable.

During a long period (more exactly up to 1986), inland navigation was the first transport mode between countries of the Common Market. Following the expansion of the Community to countries having no fluvial vocation, this domination disappears. The fluvial mode stays now at the second place (with 38%) after road transport (49%) and before the railway (13%).

4.2 ANALYSIS OF TRANSPORT BY WATERWAY: ADVANTAGES AND WEAKNESSES

Advantages

- Inland navigation is a transport mode which doesn't induce any threat to the environment. This is not the case for the other transport modes with air pollution and acoustic harm.
- The fluvial mode offers a great degree of security, accidents of ships accompanied by death and injury occur only to an insignificant degree. Moreover, one of the interesting performances of the inland mode is the level of security for the transportation of dangerous cargo.
- The transport cost based on fluvial transportation is the most economic, as the salary and the energy costs are relatively low.
- Waterway transport is also the only transport mode to move huge pieces that have extra dimensions or are very heavy.

Weaknesses

We shall distinguish the intrinsic weaknesses of the sector and these induced by too strict or misfitted regulations. The most important weakness is the lack of flexibility with regard to the road. A "door to door" transport is obviously impossible unless both the shipper and the consignee are located on the edge of the waterways. This shortcoming will be greatly softened if the general requirements for an intermodal system can be reached. For instance, improvement on the breaking load based on technical and logistic considerations should be provided.

Some other negative effects of the present regulation also reduce the chances of fluvial transport to succeed in the following challenges:

- integration of fluvial transport in global logistic chains;
- updating the fluvial mode with the new transportation and handling techniques already used in maritime ports;
- improvement of the capability of the fluvial mode to maintain and obtain new markets when facing competition with the other transport modes.

4.3 DEVELOPMENT PERSPECTIVES

Road and railway transportation modes are threatened by congestion on a lot of European ways. Their increase in the future will lead to large inconveniences on the environmental plane and will affect the cost of transport. Waterways constitute the best alternative solution. With the aim to ease the transfer of traffic towards waterways, it is necessary to realize a more homogeneous navigable network, a more modern fleet and a well performing system of information management. A high level of performance in data transmission must be reached to assure the best economic efficiency.

The combined transport techniques for goods dispatching, associated with an optimal development of the inland ports as intermodal platforms, can also promote the complementarity of the fluvial mode with the other transport systems.

In order to realize the transport of containers, which has been increasing greatly, the modernization of the present fleet with largest and reinforced hatches will permit the transfer of a great quantity of containers towards the fluvial mode.

It is true that the flexibility of the road allows the road mode to be better integrated into the logistic chain of firms and companies. But the example of container transport on the Rhine river shows that the lack of flexibility of waterways is not an incurable disease, and reminds us that the choice of a transport mode is submitted to a lot of constraints. Among them, the category and the volume of cargo, the position of goods in the global logistic chain, the cost of transport,..., are talking in favour of the inland and short sea navigation.

The logistic approach of Almost Just In Time (AJIT) implies that the goods have to be located in a suitable place, in good condition and at the right moment. For a lot of transports, the regularity prevails over the speed. If navigation keeps some advantages, it is obvious that its integration in the global logistic chain should be improved in lots of domains in order to keep or enlarge its part of the market.

4.4 THE USERS OF THE TELEMATIC CHAIN

The analysis of the present situation enables to identify the potential users and the necessary information flow between the different users. It is necessary to establish a global telematic chain, to classify the databases, and to choose the equipment for communication and tracking. The possible users of such telematic chain are:

- the manager of the waterway (locks,...);
- port authorities;
- shippers;
- shipping companies;
- forwarding agents;
- ship owners;
- bank;
- river police;
- customs
- administration;
- civilian rescue organizations;
- other transport modes.

5. Definition of the telematic chain

After recognizing the potential users and their needs, the establishment of the telematic chain is discussed (namely at the level of conception). Below, we present:

- the components of the telematic chain;
- the different managers of the telematic chain (definition of the database);
- scheme of the information flow.

5.1 THE COMPONENTS OF THE TELEMATIC CHAIN

To define the telematic chain, the information concerning waterways, ships and commercial activities and the location of the ship are necessary. Figure 1 shows the different components of the telematic chain. All this information must be coupled with an efficient communication system.

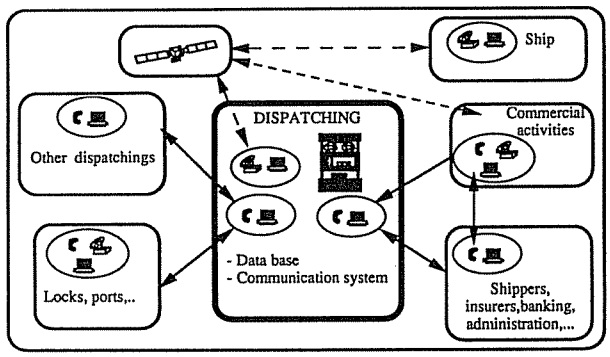

Figure 1 – The different components of the telematic chain

The dispatching is the heart of the system. It is composed of different data bases such as the waterway, the ships and the commercial activities D.B. In addition to DBs, some programs are necessary, like a statistics program, a traffic control and a forecasting model. At the same time the dispatching manages the communications between users, operators and the DB. Two kinds of communication system are needed:

- An on-shore based communication system between users, operators, and other dispatchings. Communication is based on modems (terrestrial mode).
- A ship-shore communication system. In this case satellite communication is used.

All the information coming and leaving the dispatching passes through one of the two communication systems, terrestrial or satellite.

5.2 THE DIFFERENT MANAGERS OF THE TELEMATIC CHAIN (DEFINITION OF THE DATA BASE)

Nowadays, an information system between fluvial transport and other transport modes does not exist even if it would be very helpful for shippers, shipowners, ports and local authorities to share their resources.

At the first stage, a users list and a flowchart of the required information are fully established. Then, the second step concerns the database generation which is very important for the system. The DB should be established in such a way as to facilitate the information transfer between the different users and to do so as fast as possible. The level of access of each user should be defined to guarantee a high security of the information. The choice of the type of DB is made to ease the integration of the fluvial mode with other systems (other transport modes) at the country level and at the international level (EC). The use of "Distributed DB" or "Neutral DB" may be a suitable solution. The selected DBs are:

- a Commercial activities D.B
- a Ships D.B.
- an Inland waterways D.B.

The ***"Commercial Activities D.B."*** contains the information concerning the quantity of goods transported or to be transported, the origin, the destination, the owner,... From this database the relevant authorities can obtain the information concerning the dangerous, the domestic and the international goods. The users mainly concerned by the "Commercial Activities" are the shipowners and the shippers. For dangerous goods, the more concerned users are the authorities and civilian rescue organizations. Figure 2 shows the general components of the "Commercial activities".

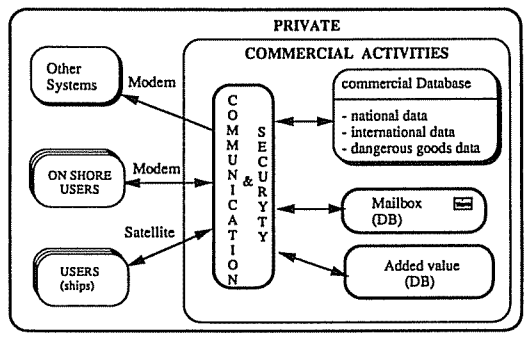

Figure 2 – The general components of the "Commercial activities"

The additional functions of the commercial activities are the "Mailbox" and the "Added value". The "Mailbox" has several functions:

- the information transfer between users through their computer without retyping;
- when receiving or sending a message, a signal appears on the computer screen. The message will be stored if the correspondent is absent.

The "Added value" is a DB from which the users can find, for example, models of contracts or usual documents concerning banks, insurances,...

The management of this DB can be entrusted to a private company and checked by the authorities. The users (shippers, shipowners,...) must take out a subscription to use this information. Each user has a password that permits him to add or to discard information.

"Ships D.B.": The data needed for building up the traffic model may be classified into two categories:

- variable data;
- permanent data.

The so-called "variable data" contain:

- the position of the ships;
- their status in terms of: passengers and/or cargo;
- the mission requirements of each vessel and its intentions:
  * origin-destination,
  * navigation plan including time of departure and estimated time of arrival (ETA).

These informations are checked by the captain.

The so-called "permanent data" contain:

- name of the ship, flag;
- type of the ship (push boat, self propelled vessel,...);
- name of the shipowner, address, tel, fax;
- main dimensions of the ship.

These informations are checked by the authorities.

The ***"Inland waterways D.B."*** contains the information concerning the characteristics and the status of the waterway:

- characteristics of each section;
- characteristics of the locks, dams, bridges;
- flow and velocity in each section, water depth,...
- accidents, works and reparations, breakdown of construction works;
- characteristics of the port facilities.

The authorities are responsible of the waterway information.

Communication (authorities and operators): The authorities and the operators of the national dispatching have the responsibility of communications.

5.3 SCHEME OF THE INFORMATION FLOW

The informations reach the dispatching through the communication and the positioning (tracking) systems. The information will be stored into the "Ships D.B." or the "Waterway D.B.". From these two DBs some information will be transferred to the computation modules (statistics, traffic forecasting and management). After treatment of these informations by the different modules the results are transmitted to users by terrestrial or satellite communication systems.

The "Commercial Activities D.B." is located separately from the system and works independently. The information of this DB can be used by the shipowners to select the cargo and by the public authorities for statistics and security purposes (for instance to provide information to civilian rescue organizations). Figure 3 shows the flow of information in the proposed telematic chain.

Below is presented a list of the standard information transmitted or received by each user.

Individual shipowners and navigation companies

The individual shipowners and the navigation companies are susceptible to ask information related to:

- commercial activities,
- waterway conditions (hydraulic and geometric characteristics,..),
- the actual traffic situation of the waterway network.

Information received:

- queuing up at a lock,
- queuing up at a port or a quay,
- information in case of accident, breakdown of locks and information related to any unexpected problem.

Information transmitted:

- information concerning the type of cargo and the "Origin and Destination" of cargo (O/D),
- communication with the dispatching and/or the base in case of a navigation company.

Public administrations, port authorities and waterway authorities (local)

Information received:

- from the "Commercial Activities D.B.", concerning the cargo (terrestrial),
- from a ship, concerning the cargo and the O/D (satellite),
- from a ship, concerning "fixed data" (satellite),
- from a ship, concerning its position (satellite),
- from a measuring device on the waterway (terrestrial),
- from operators, concerning the problems on the waterway network (terrestrial),
- from an operator or boatsman, concerning accidents (satellite or terrestrial),
- from an other dispatching center (terrestrial),
- from lock operators, concerning operations at the locks (terrestrial),
- from ports, concerning loading or unloading activities or status (terrestrial).

Information transmitted:

- waiting queue at the locks to transmit to the operators (terrestrial),
- waiting queue at the locks to transmit to the boatsmen (satellite),
- information to ports concerning ships, type of cargo, and estimated time of arrival (ETA) (terrestrial),
- in case of accident, information to civilian rescue organizations (type of cargo and location) (terrestrial),
- information to transmit to the other dispatchings concerning the cargo and ship (terrestrial),
- information to the customs concerning the cargo and the ship (terrestrial),
- information to the banks concerning invoices, payments,... (terrestrial).

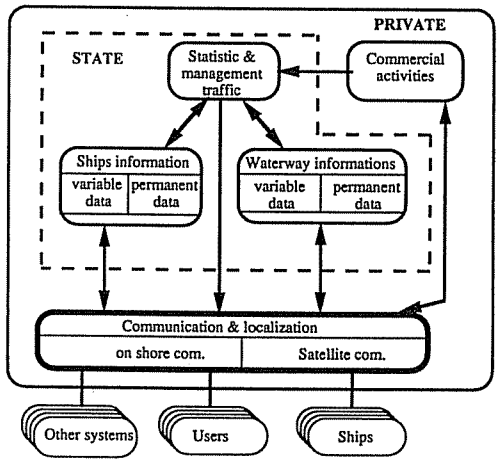

Figure 3 – Flow of the information in the telematic chain

Shippers and forwarding agents

Information requested:

- from the dispatching centers, information concerning the "Ship DB" to know if a ship is free or occupied (terrestrial),
- exchange of messages with boatsmen through their mailbox to establish a contract or to get information (satellite).

Information transmitted:

- to update the "Commercial DB" with the present transported cargo and the remaining cargo to be transported (terrestrial).

Maritime and inland ports

Information received:

- from the dispatching centers: ETA of ships and the type of cargo transported (terrestrial).

Information transmitted:

- to the ships: waiting queue at the port and the berthing place at the quay (satellite),
- to the dispatching centers: end of loading or unloading (terrestrial).

Locks

Information received:

- from the dispatching: ETA at the lock and their passing turn (terrestrial).

Information transmitted:

- to the dispatching: confirmation at the end of the operations at the lock (terrestrial),
- to the dispatching: payment of the navigation fees (terrestrial).

Banks

Information received:

- from the dispatching: invoice resulting from the use of the waterway (terrestrial).

Maritime agencies

Information requested:

- from the dispatching: list of the available ships ("Ship D.B.") (terrestrial).

Information received:

- from the dispatching: ships ETA at their arrival point (terrestrial).

Information transmitted:

- to the boastmen or the shippers (contracts, documents or other information) (terrestrial).

Customs

Information received:

- from the dispatching: name and cargo of ships at entering a country (terrestrial).

Civilian rescue organizations

Information received:

- from the dispatching: list of dangerous cargoes and ship localization (terrestrial).

Other carriers (road and railway)

Information received:

- from the "Commercial D.B.": list of cargoes arriving at the port and some logistic information useful to organize the intermodal chain.

6. Choice of communications and tracking system of ships

The use of the AJIT concept needs a double flow of cargo and information. The integration of the inland and short-sea shipping navigation in the global logistic chain can only be planned with a well performed and efficient communication system.

Today it is still very difficult to locate and exchange in real time any information with a sailing ship. Then, it is also difficult to exchange the relevant information and to efficiently manage the fluvial traffic. At present the ship positioning techniques used are insufficient and are only available for very punctual applications.

In the proposed telematic system, the selection of the communication and tracking systems is realized with a multicriteria analysis. The selected criteria are: cost, capacity, mobility, accessibility to data, facility of use, range of action,....

The use of a satellite communication system provides an efficient solution to communicate with and to localize ships (tracking). The system used during the feasibility tests is the Alcatel Mobicom system. The main function of this system is to establish an efficient continuous connection between the mobile units and the dispatching center.

To use this system, some tools or modules have to be developed to allow the transfer of the following information:

- Retrieval of the requested information from a data base. For example, the shipowner needs to retrieve the information concerning available cargo to transport. We can imagine to generate a macro command

to be transmitted to the relevant DB by satellite. When the message is received, the information is retrieved, the results are transferred to a file and finally transmitted to the ship. Such macro command reduces the communication time, eases the procedure and gives to the shipowner a possibility to select cargo to transport and to contact the shippers.

- The captain can obtain the relevant information about the waterway network. We can imagine a videotext system giving the information concerned.
- Visualization of the network with the traffic on each axis, as well as the waiting list in front of the locks. Such information is very useful to the captain to select the route and an economic speed.

Using the ship tracking system, public administrations and local authorities would be able:

- to manage in real time the traffic;
- to make statistics;
- to define the waiting list in front of the locks;
- to track the ships with dangerous goods, and to inform the civilian protection of the exact position and the transported goods in case of accident.

This system can also be used for other purposes, for instance, the navigation companies can track their fleet to plan the ship's arrival time and to transmit messages to the captain for the next shipment.

6.1 MODULES TO DEVELOP

The different modules to develop are:

- digitization of the European network, definition of nodes;
- a traffic control system;
- a module for the statistics and traffic forecasting;
- a module for ship-shore communication (i.e. communication between the "Ship DB", the operators and other users). The module will be used to define the optimal route/schedule for the ship;
- a communication module between onshore users and dispatching centers.

6.2 USER INTERFACE

In general, the user of this tool does not have any education in computer science nor any experience in using computers. Thus, as far as the development of the user interface is concerned, it is reasonable to generate screen pictures as simple as possible, convivial and all of them with the same structure. The convenience and the quality of interactions between the software and the user are the main criteria to obtain a high utilization efficiency.

All these elements contribute to some improvements related to security, economy, environment, traffic management and planning,....

7. Feasibility and assessment tests

After a comparison with some other different communication systems, telecommunication through satellite remains the best solution. The system that was selected is the Alcatel Mobicom system.

To execute the tests a special authorization was received from to the "Office of Navigation", which gave us the opportunity to use one of their boats. The Alcatel Mobicom company provided a portable unit composed of an antenna, a screen and a keyboard. The dispatching center was simulated in our office.

The target of the feasibility test was to show the system's efficiency. This test has been realized on one reach of the Meuse river including locks, ports,....

The main objectives were:

- to assess in the field with a special attention to the problems of shadowed zones, transmission and tracking quality, etc.;
- to obtain the crew's opinion on the system.

Results from the field test

Firstly the material was tested from the point of view of localization (tracking) and shadowed zones. Then, the test concerned the communication between the ship and the DB. The objective of that test was to show that it is possible to be connected to a DB located on shore. The test has simulated the following cases:

- a connection between the DB and a shipper (terrestrial communication);
- a message sent from the ship to the DB (satellite communication);
- the DB reply to the ship (satellite communication).

During the tests, it was noticed that the satellite signal has been interrupted when the ship passed through the lock in the final phase of locking (at the lower position). Otherwise, the satellite received continuously and normally the signal sent by the ship when the ship passed across the town and the port of Liège. The tracking test was also successful.

In conclusion the test results were conclusive.

Acknowledgment

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RESUME

3e Partie
Un outil intégré pour la gestion et la planification du trafic fluvial, côtier et portuaire (Fluviatique)

L'état actuel du transport intérieur européen révèle un besoin urgent de changements et d'améliorations. Des améliorations considérables devraient être bien sûr réalisées à travers une meilleure exploitation de la capacité offerte par la navigation intérieure ainsi que le cabotage. Afin de rendre ces modes de transport plus compétitifs et de les intégrer dans la chaîne de transport multi-modal, par exemple leur permettre de devenir plus attractifs pour les clients du marché de transport, deux aspects doivent être considérés: la technique et l'organisation.

L'introduction d'un système de gestion et d'échange d'informations pour la navigation intérieure et le cabotage comme une partie de la chaîne multi-modale aidera d'une manière significative à atteindre notre objectif.

La navigation intérieure dispose de suffisamment d'avantages intrinsèques pour que son existence ne soit pas mise en danger. Pourtant elle souffre de toute une série de maux qui risquent de la paralyser au moment où notre économie a le plus besoin d'elle.

Si les artères infrastructurelles sont bonnes ou en passe de le devenir, il n'en va pas de même du système nerveux. Une réglementation trop contraignante empêche un dynamisme pourtant nécessaire. Le handicap le plus grave est la paralysie provoquée par le manque de communication qui:

- empêche la navigation intérieure de s'intégrer dans la chaîne logistique globale;
- gêne l'organisation des ruptures de charge;
- ne permet pas une utilisation efficace de la voie d'eau.

La mise en place d'un système de communication est donc primordiale. Grâce à l'utilisation adéquate des moyens de communication, il est possible de mettre en place un réseau de flux d'informations entre les nœuds constitués par diverses bases de données. Ces bases de données sont au nombre de trois:

- base de données «bateaux»;
- base de données «voies navigables»;
- base de données «activités commerciales».

Les deux premières bases de données seront gérées par les organismes publics, tandis que la base de données commerciales sera gérée par un organisme privé. Ce système de communication comportera deux éléments nouveaux: la localisation permanente du bateau et l'échange de données entre points fixes et mobiles. Seul le satellite peut assurer la localisation du mobile sur tout le réseau européen. Par contre les communications entre postes fixes par lignes téléphoniques ou câbles est la solution qui s'avère la plus intéressante.

Les essais réels effectués ont montré une fois de plus que le choix du système de communication par satellite est le plus adapté.

La présente analyse reproduit sous forme condensée les premiers résultats d'une recherche financée respectivement par les Ministères des Technologies Nouvelles et des Travaux Publics (Service des Voies Hydrauliques) de la Région Wallonne.