

Geographic Information System (GIS) tools for aiding development of inland waterways fleet

Cezary Zrodowski, D.Sc., Eng.
Aleksander Kniat, D.Sc., Eng.
Ryszard Pyszko, D.Sc., Eng.
Gdańsk University of Technology

ABSTRACT

The information aiding of planning and operation of inland waterways fleet covers many items among which problems associated with analysis of existing waterways are especially important. Such analyses concern mainly their navigability features (from the point of view of elaboration of design assumptions for floating units) as well as planning land-waterborne transport links. Range of input data for the analyses is very broad hence they can be next used for managing the waterways. This paper presents a concept of forming the GIS data model for the purposes of INCOWATRANS project with taking into consideration the existing data and their possible usage by the administration of waterways and their other users.

Keywords : polish waterways, inland shipping, proposal of navigating system

INTRODUCTION

Data bases elaborated for the purposes of INCOWATRANS project are mainly aimed at providing tools and data for spatial analyses covering course and bathymetry of waterways, leading to generation of correct design assumptions for inland waterways fleet. However a preliminary analysis already shows that the structure and content of such data base is so broad that its limitation solely to that aim would be a loss of time and money. The data necessary for realization of the main aim can be successfully applied also to other tasks provided they could fulfill certain requirements. To this end were defined potential additional tasks of such base, its users and resulting requirements first of all concerning its structure which should be made ready for additional data input in the future without their modification and excessive increase of labour outlay for elaboration of the data model itself.

To comply with existing standards is also important in order to make it possible to integrate the data base in question with already existing systems.

DESIGN ASSUMPTIONS FOR THE DATA BASE

The expanded GIS data base can contain many additional functions going beyond analysis of navigability features of waterways shared and maintained by many users simultaneously. The most potentially interested in using such tool can be the following :

- ship owners (operators) – (their land staff and ship crews)
- producers (constructors) – (building and repair companies engaged in building waterway infrastructure)
- supervisors (state and local administration, ship classification institutions, insurance companies, engineering supervision)
- scientific research and didactic institutions
- other commercial and non-commercial users (tourist agencies, forwarding agents etc).

The most important functions of the base desirable from the point of view of the potential users cover the following :

- ❖ Inventory control functions
 - ◆ Inventory control and aiding the management of waterways infrastructure resources

- ◆ Inventory control of waterways land-surroundings
- ◆ Aiding the financial analyses and rationalization of infrastructure maintenance costs
- ❖ Analytical functions
 - ◆ Running the spatial analyses associated with ship traffic – – mainly concerning navigability of waterways and resulting requirements for floating units
 - ◆ Running the spatial analyses aimed at planning the inland navigation maintenance and development as well as its infrastructure (e.g. disclosing “bottlenecks” and planning modernization)
 - ◆ Running the network analyses aimed at optimization of land-waterborne transport.
- ❖ Interface functions
 - ◆ Integration of existing distributed data
 - ◆ Accessing the existing data in internet in a coherent way, with taking into account priorities and access rights of particular users
 - ◆ Ensuring a uniform mechanism of access to all necessary data for all interested in waterways usage (including non-GIS data, e.g. technical documentation of hydro-engineering facilities or floating units)
- ❖ Navigation functions
 - ◆ Improving safety of navigation on waterways by real – time monitoring current navigation situation to avoid collisions and to support environment protection and emergency management
 - ◆ Tracking positions of ships and planning their navigation
 - ◆ Accessing information on navigability state resulting from water level state.

From the so defined functions of the base technical requirements also result for the entire system which should definitely ensure :

- ◆ Effective data collecting which guarantees access to coherent and updated information.
- ◆ Comprehensive analysis of collected data on the basis of which it would be possible to generate knowledge useful for their users.
- ◆ Information turn automation which covers a.o. :

- ♦ Control of access of particular users to information and permissions to put the data into the base
- ♦ Control of data modification and validation level of modification (what to modify itself a user is authorized, about what he is to inform other users, for what and from whom he is to get acceptance)
- ♦ Control of propagation of messages on modifications (who should be informed about modification and in which way)
- ◆ Processing the data of different kinds, covering :
 - ♦ CAD technical documentation (technical drawings and 3D models)
 - ♦ GIS documentation (of waterways infrastructure)
 - ♦ Text documentation (procedures, protocols etc)
 - ♦ Multi-medial documentation (graphic, audio, film, measurement data files etc)
 - ♦ Database files (catalogues of products, material properties etc)

ARCHITECTURE OF THE DATA BASE

Two kinds of problems associated with fleet and waterways management, which require different informatics tools to be used, can be distinguished as follows :

- ☆ Problems associated with object's structure – the domain of Product Lifetime Management (PLM) data bases
- ☆ Problems associated with dispersion of geographic objects – the domain of Geographic Information Systems (GIS).

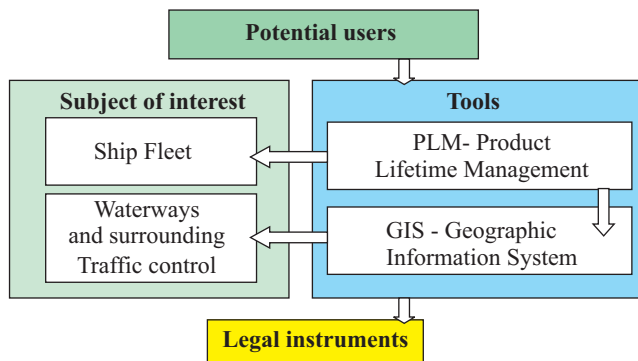


Fig. 1. Structure of issues covered by data base .

The data base for INCOWATRANS project connects both approaches by means of integration of GIS and PLM tools into one coherent system ensuring user access to all data in a way which best corresponds with their character.

The next important issue, the first element of data base structure is a mode of access to data. In order to ensure up-to-date information the distributed structure was chosen. It is characterized by uniform access to data on logic level though their physical location may be different, and by avoiding redundancy of data.

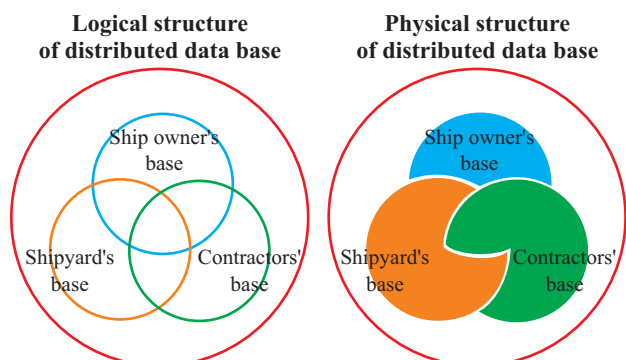


Fig. 2. Structure of distributed data base .

GIS DATA

From the very beginning it was assumed that the base in question will be built on the official data accessible in official data bases and enabled for research purposes at no charge or preferential conditions. Hence selection of data is crucial for GIS model structure. Models and data quality of a few bases were preliminarily analyzed and as a result the base of Map of Hydrographic Division of Poland (MPHP) and the base of General Geographic Data (BDO) were selected as those potentially most useful.

MODEL ANALYSIS

Model analysis of the selected data bases is aimed at answering the question whether they are conceptually coherent and may be used to build an integrated GIS covering shipping problems and which elements of both the bases may and should be used to this end.

The MPHP base contains the data on surface waters in Poland, having the accuracy equivalent to a map in 1 : 50 000 scale. Such accuracy of data makes their using for navigation purposes possible. Next, their structure enables to conduct network analyses (all water-courses have defined axes and nodes in junctions). A drawback of the MPHP data is the lack of attributes determining navigability of water-courses.

The BDO base was elaborated with the accuracy corresponding with a map in 1:250 000 scale. Hence it is less precise, however apart from layers describing waters it contains several layers of the so called “background” which describes land surrounding waterways. Additionally, the water-courses have defined attributes describing their navigability however in the way not complying with the Act on Inland Navigation. In Tab.1. the most important criteria of the model in question and BDO and MPHP bases are compared.

Tab. 1. Comparison of content of BDO and MPHP base .

Content	INCOWATRANS base	MPHP base	BDO base
Waterways	Yes	Yes	Yes
Water-course network	Yes	Yes	Yes
Land - water - course network	Yes	No	Yes
Navigability	Yes	No	Yes
Compatibility with UZS	Yes	No	Yes
Roads	Yes	No	Yes
Railways	Yes	No	Yes
Ports	Yes	No	Yes
Hydro-engineering objects	Yes	No	Partial
Navigation obstacles	Yes	No	Partial
Compatibility with TBD	Partial	No	Partial
Compatibility with RDW	Partial	No	No
Scale	1 : 50 000	1 : 50 000	1 : 250 000
Coordinate frame	WGS84	WGS84	WGS84

The optimum solution seems to be connection of the MPHP layers describing water-courses and reservoirs and the BDO “background” layers. For such data integration speaks the fact that both the bases were elaborated with the use of the same frame of geographic coordinates, namely WGS84.

ANALYSIS OF DATA QUALITY

Assessment of data quality is usually very important for estimation of labour consumption for their implementation, and it covers several aspects :

- ✳ Correctness of geometrical and attribute data
- ✳ Completeness of geometrical and attribute data
- ✳ Topological coherence of water network and land-water network within a given data base as well as at the points of contact of the bases to be integrated.

To ensure an efficient and reliable assessment a few procedures and techniques of quality control were applied. Some of them were of organizational character, another were based on available informatics tools. The most important are the following :

- ⇒ Automated control realized by means of the tools available within GIS software (e.g. coherence control of topological network)
- ⇒ Automated analysis of data base content (e.g. searching for nonsense quantities : odd values, exceeding limits, control whether all attributes are determined, whether appropriate error codes are introduced for those not determined etc)
- ⇒ Manual control of the GIS on the basis of spot check of well documented areas (e.g. basins of ports of Gdańsk and Szczecin)
- ⇒ A part of metadata attributes was shifted from the level of class description to that of records (e.g. date of input, date of approval, putting-in person). Due to this a better control over quality of input/ modified data was achieved.

Correctness assessment of geometrical data was performed only for water-courses and reservoirs. It consisted in simultaneous displaying the hydrological layers of BDO and MPHP bases and their visual comparison. The observed differences resulted from the different scales of the bases and consisted in simplification of shoreline on BDO layers against that on MPHP layers, which seem unimportant however. The maximum shifts of characteristics points did not exceed 10 m. As in both the cases the data were introduced independently the mutual coherence of water-courses and shorelines demonstrate that the data stored in both bases are correct.

Assessment of completeness of the data covers only those connected with water-course navigability. The assessment was performed by means of :

- Comparison of content of the data bases with maps of Gdańsk area (the lack of about 20 landing stages and 10 other hydro-engineering objects was stated)
- Analysis of data base content as regards filling base records with all attributes (the common lack of many important attributes, e.g. name of port/landing stage is observed only for a few biggest port facilities, also an error code description is lacking in the case of a lacking value of attribute)
- Analysis of base structure completeness and possibility of its supplementing by means of existing data. The lack of objects of the type "MOST" in the BDO base may be given as an example. Such objects can be indicated by pointing out sections of roads and railways having the attribute "PRZEBIEG" of the value "PO MOŚCIE".
- Analysis of completeness of definitions of particular classes of objects against demands of the elaborated model and possibility of their extending. As an example the height above water level for bridges and electric transmission lines crossing water-courses, and current speed for selected river sections can be given. Many lacks were here revealed and their detail description is contained in the report on the modified data model.

In the case of the topological coherence control the following was assessed :

- ✳ Topological coherence of water-course networks within MPHP and BDO bases.
- ✳ Topological coherence of water-course network and land-water-course nodes and land junction network within BDO base (in MPHP base there is no land objects).
- ✳ Topological coherence of water-course network of MPHP base as well as land- water-course nodes and land junction network within BDO base.

The topological coherence was investigated by means of relevant tools contained in GIS GeoMedia system. Sporadic lacks were revealed in junctions between water-courses covered by MPHP base (Fig.3) as well as lacks of junctions of the type of water-course/port, port/road as well as port/railway, which can be deemed typical for BDO base (Fig.4). Therefore without any further control was assumed the lack of coherence between the water-course network of MPHP base and the land network of BDO base. Additionally, to include sea ports into network analyses some artificial sections of sea waterways to connect the ports with inland waterways network, should be added.

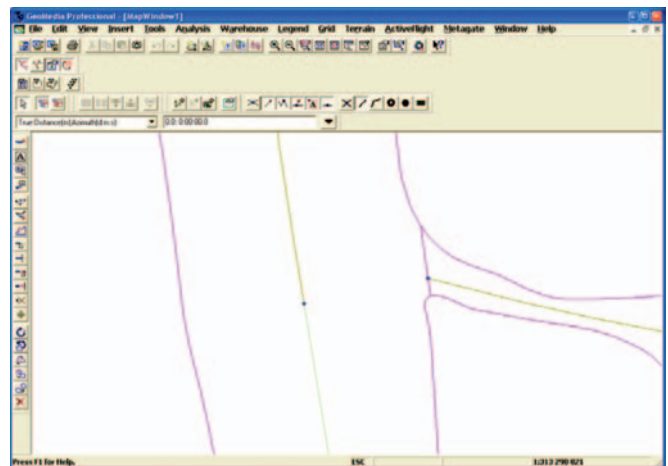


Fig. 3. An example of lack of junction between water-courses represented in MPHP base .

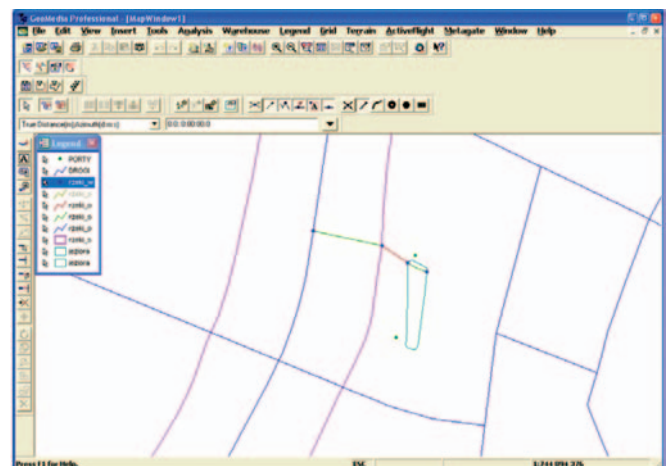


Fig. 4. An example of lack of coherence between water-course network and road network represented in BDO base .

DESCRIPTION OF GIS MODEL

For elaborating the GIS data model were established several principles and guidelines resulting from provisions of Polish legal acts {Act on Inland Navigation (UŻŚ), Topographic Data Base (TBD)} and European ones {General Outline Water

Directive (RDW)} as well as from structures of the existing data bases whose data have to be used in building INCOWA-TRANS data base.

The most important are the following :

- ★ All types of objects of the same functional features (i.e. those described by the same attributes) are located in one class but other layers. For instance the class "Pipeline" covers the layers : "Water pipeline", "Gas pipeline", "Oil pipeline".
- ★ A part of attributes resulting from location of an object on a map is duplicated within the base structure. It results from possible inaccuracies or ambiguities e.g. in which way should be territorial membership of an object located on the border of two administrative regions qualified ?
- ★ Water-courses are divided into sections of constant features. Additional division points are assumed in the points where nodes are located even if the water-courses in question do not there change their properties.
- ★ As use is mainly made of existing data (MPHP, BDO) and easy integration of the elaborated base is aimed at, only new classes of objects are defined (not included in MPHP and BDO) or the definitions of existing classes are extended by navigability features (without any changes of the existing ones even at the expense of redundancy of some attributes).

Model class hierarchy can be defined on the basis of a kind of geometrical representation of objects (Fig.5) or their functions. The presented scheme of the model contains only the classes introduced to be used solely in shipping model, and not defined in the MPHP.

DESCRIPTION OF PLM MODEL

PLM base serves for effective collection of data on infrastructure objects of waterways (and ships) in the way which is not possible in GI- systems which impose some limitations on the depth of hierarchy of classes and types of objects (limited to simple 2D geometrical objects). In PLM system an arbitrary object structure of an arbitrary depth of class nesting in model hierarchy can be modeled. In the current stage of implementation of the system the PLM structure limited only to floating units was elaborated. It results from the classification of ships adopted by most ship classification institutions, shipyards and authors of CAD software for shipbuilding industry.

Important is that in the same way the data base for ships and that for hydro-engineering objects can be built.

In Fig. 6. the hierarchy of PLM model classes is presented. It can contain an arbitrary number of nested levels of subsystem and subpart classes. The main ship systems cover the following :

- ◆ Hull ◆ Piping ◆ Cabling
- ◆ HVAC ◆ Machinery ◆ Equipment.

The example structure of one of the systems (Hull) shown in Fig.4, contains several subsystems :

- ▲ Geometry ▲ Structure ▲ Material.

SUMMARY

- The structure of GIS model coherent with description of features of navigable inland waterways was presented together with the premises laid down during its elaboration. All efforts were made to achieve the elaborated structure complying with formal and practical standards being in force in the domain of GIS modelling, especially in water economy.
- The range of elaborations which have been so far worked out within the frame of building the GIS base intended for INCOWATRANS project, contains main conceptual investigations associated with the elaboration of the data model and its implementation. They contain the following items :
 - ✦ Control of inventory and analysis of legal acts with a view to building GIS model.
 - ✦ Elaboration of the preliminary GIS data model covering various functions of the model such as :
 - ▲ analytical
 - ▲ inventory
 - ▲ interface
 - ▲ navigation.
 - ✦ Acquisition of the existing data (BDO, MPHP).
 - ✦ Conversion of the data into an editable form which makes their extension by means the available GIS tools (GeoMedia 5.1) possible, as well as split of the data which makes their handling easier and processing within the network also possible.
 - ✦ Consultations of the data base design assumptions with its potential users (Water Economy Office in Warszawa, RZGW in Gdańsk, Institute of Meteorology and Water Economy (IMGW), CODGiK, Port of Szczecin).
 - ✦ Test implementation of the model and conformity tests of software, data and the assumed model of usage of the data base (the distributed data base model).

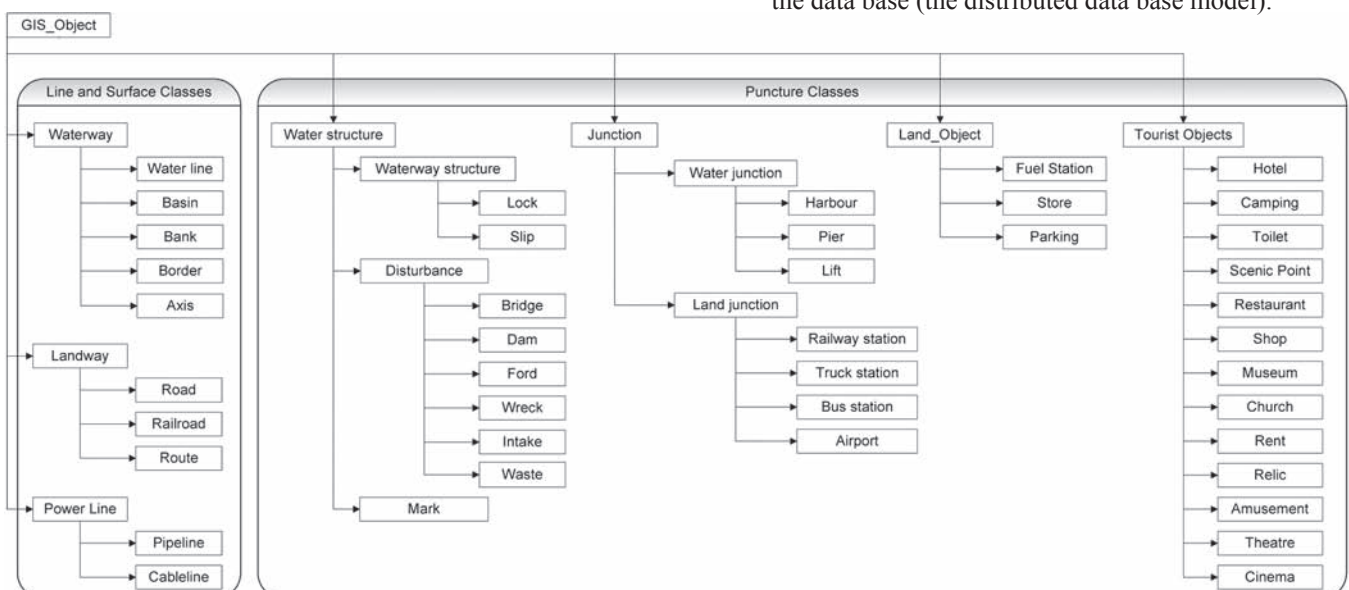


Fig. 5. Hierarchy of classes of the assumed GIS model .

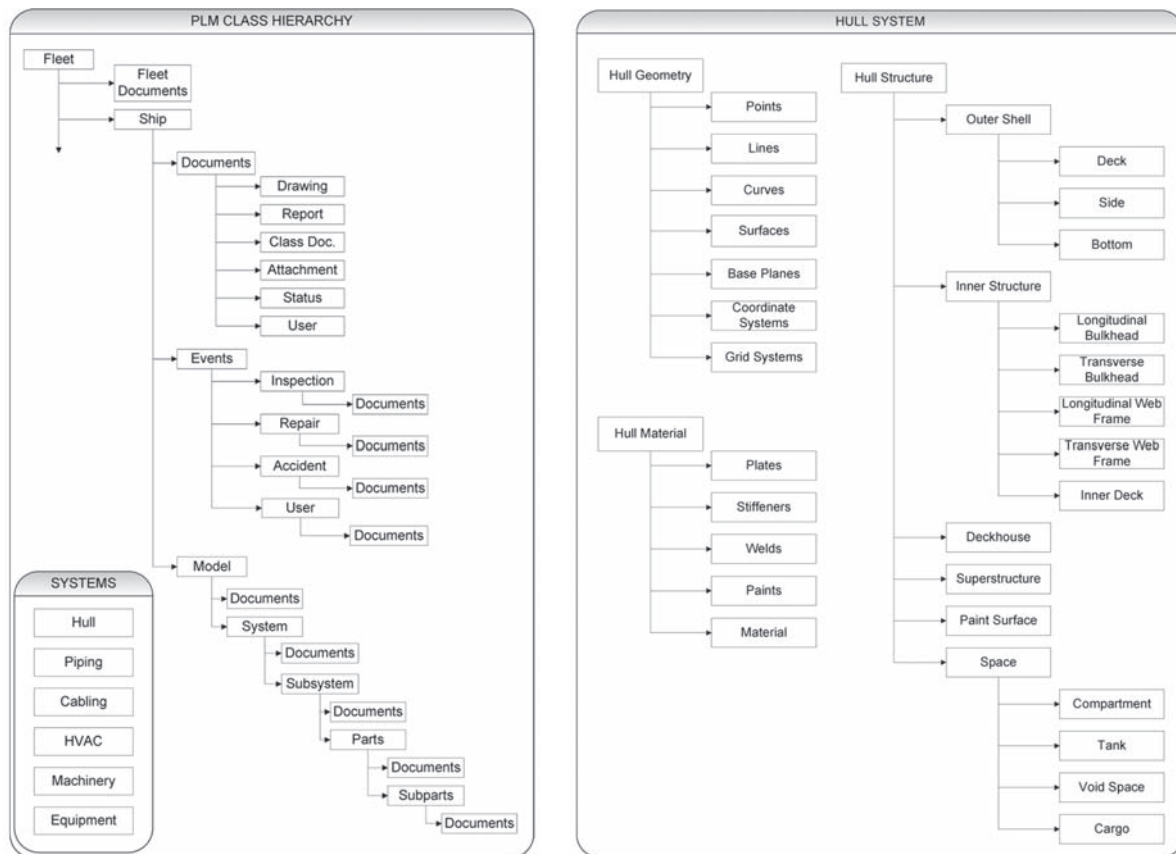


Fig. 6. Hierarchy of classes of PLM system model for ships. Hierarchy of classes of HULL system .

- ✦ Amendment of the design assumptions and the model on the basis of the two preceding points so as :
 - ▲ to make use - at the possible greatest extent - of the existing data of the MPHP and BDO,
 - ▲ to maintain the present structure of data, which – after removal of introduced extensions - will facilitate integration of the new data and corrected ones taken from the BDO and MPHP,
- ✦ Elaboration of an application program for automatic acquisition of data on water-level indications from IMGW internet portal, as well as elaboration of a simple interpolation model of water levels at particular sections of rivers.
- ✦ Digitalization of selected documents of water objects to implement PLM base and test the interface function of GIS base.
- ✦ Elaboration of “taken from nature” documentation for selected sections and objects,
- ✦ Elaboration of inventory control of the internet data sources together with their storage in a local server.

Full implementation of the model in question necessitates to realize several additional tasks as follows :

- Harmonization of the data stored in the BDO and MPHP in the range of roads and water- engineering objects (e. g. shifting the ports up to the water-course nodes, extending the roads up to the ports etc)
- Comprehensive verification and correction of the BDO and MPHP data in order :
 - ◆ to remove errors from BDO in the range of attributes and location of water -engineering objects
 - ◆ to add several water - engineering objects on the basis of maps and aerial and satellite photographs.
- Acquisition of shipping and bathymetric data and their addition to the bases.

- Elaboration and implementation of procedures for data input and update (e.g. by means of reporting errors by users via internet).
- Solution of formal and legal problems associated with making available to third parties the data acquired for the project’s purposes.

BIBLIOGRAPHY

1. Bielecka E. : *Spatial information system as a tool for aiding space management. Geo-spatial information – crucial resource for spatial planning* (in Polish). Warszawa, 2003
2. Bielecka E. : *Functions and tasks of Spatial Information System in Poland*, Reports of IGiK, vol. XLVII, no. 101, 2001
3. European Parliament, European Council : *Directive no. 2000/60/WE dated on 23 October 2000, establishing the frames for EU actions in the area of water policy* (in Polish)
4. Jankowski R., Bielecka E., Wysocka E.: *Outline of GIS architecture in Poland* (in Polish). Reports of IGiK, vol. XLVI, no. 99, 1999
5. Kadaj R. : *Principles of transformation of coordinates between different cartographic systems on the territory of Poland* (in Polish). Geodeta. Warszawa, 2000
6. Kistowski M., Iwańska M. : *Geographic information systems* (in Polish), Bogucki Scientific Publisher, Poznań 1997
7. Laska M. : *Spatial information systems* (in Polish). 1999
8. Mularz S., Jachimski J., Mierzwa W., Pyka K. : *Data acquisition for GIS systems by means of photogrammetry and teledetection* (in Polish). Proc. of Conf. on “ Spatial Information Management in the New Millenium”, Assoc. SILGIS Center, Poland. Katowice, 1999
9. Myrda G.: *GIS as a computerized map* (in Polish). Helion Publishing House. Warszawa, 1997
10. Urbański J. : *To understand GIS. Spatial information analysis* (in Polish). State Scientific Publishing House, 1997
11. Werner P.: *Introduction to geo-information systems* (in Polish). Warsaw University. Warszawa, 2004
12. *Technical guidelines for Topographic Data Base* (in Polish). Warszawa, 2003

BIBLIOGRAPHY

List of publications for the INCOWATRANS E! 3065 project
(2004 - November 2006) (all publications in Polish)

Studies

1. K. Rosochowicz: *General assumptions, goals and directions of the INCOWATRANS E! 3065 project realisation – Inland and coastal ships for East-West water transport*. 01/I/2004
2. K. Rosochowicz: *Selected problems of development of Polish East-West inland water navigation*. 03/I/2004
3. J. Michalski: *The study of Polish and international (German, EU) legal regulations in force, ecological requirements, and technical and operating conditions (PRS and GL regulations) concerning inland cargo and passenger ships (including the Vistula Lagoon)*. 71/I/2004
4. J. Kort, Cz. Szpanowski: *The study and compendium of legal and technical regulation systems concerning inland ships. Specification of regulations and conventions*. 43/I/2004.
5. W. Benedyczak: *The analysis of the existing projects concerning problems in development of Polish waterways and their infrastructure:*
 - the middle and upper Vistula river
 - the Bug river
 - the Narew river. 01/I/2004 S
6. W. Benedyczak: *The analysis of the existing infrastructure and technical means of exploitation of inland waterways from Włocławek upwards in the East-West direction*. 01/I/2004 S
7. A. Kaleta: *Ships for inland navigation – main directions of development*. 01/I/2004 PD
8. M. Koszarek: *Ships for coastal sea navigation – main directions of development*. 01/I/2004/PD
9. J. Kulczyk, R. Werszko, J. Prokopowicz, T. Tabaczek: *The condition of the domestic inland cargo and passenger fleet*. 53/I/2004.
10. R. Czermańska: *Short- and long-term prognoses for the structure of the water transport of cargo and passengers across Polish and European coastal and inland transport areas*. 04/I/2004/IM
11. R. Czermańska: *Economic and technical aspects of the water transport of cargo and passengers on Polish and European coastal and inland waterways*. 07/I/2004/IM
12. R. Rolbiecki, K. Wojewódzka-Król, U. Kowalczyk: *Organisational and legal foundations for the operation and development of inland waterways*. 03/I/2004/IM
13. E. Czermański, U. Kowalczyk: *Inland and coastal navigation in the Polish and EU transport policy*. 02/I/2004/IM
14. R. Czermańska, U. Kowalczyk: *Investigating the scale and directions of cargo transport in the East-West inland navigation*. 05/I/2004/IM.
15. S. Szwankowski, R. Czermańska, U. Kowalczyk: *A preliminary prognosis for the cargo and passenger traffic contributing to the transport via Polish inland and coastal waterways in the East-West direction*. 06/I/2004/IM.
16. M. Burchacz, R. Czermańska, E. Czermański, U. Kowalczyk, B. Łuczak: *The technical and organisational condition of the inland harbours in Poland*. 08/I/2004/IM.
17. E. Czermański, W. Kuszewski, B. Łuczak: *Technical conditions for incorporating northern Poland waterways into the European waterway system*. 09/I/2004/IM.
18. R. Czermańska: *Economic aspects of the transport of cargo and passengers on Polish inland waterways*. 10/I/2004/IM
19. B. Szwankowska: *The expected zone of development for inland and coastal water transport routes*. 12/I/2004/IM.
20. B. Łuczak, E. Ptaszyńska, J. Piotrowicz: *The potential use of inland waterways and coastal water regions in northern Poland for water tourism*. 13/I/2004/IM.
21. K. Luks, B. Łuczak: *The importance of Elbląg harbour development plans for activation of inland and coastal navigation*. 14/I/2004/IM.
22. Sinus: *The study and compendium of legal and technical regulation systems concerning inland ships. Specification of regulations and conventions*. 01/I/2005/S
23. Sinus: *The analysis of the infrastructure and technical means for the exploitation of inland waterways from Włocławek in the East-West direction*. 06/I/2005
24. Sinus: *The analysis of the existing projects concerning problems of development of Polish waterways, including their infrastructure and environment: upper Vistula, and Bug and Narew rivers*. 01/I/2005.
25. J. Kulczyk, R. Werszko: *A list of problems on the waterway and methods of their remedy*. 02/I/2005 PWr
26. J. Kulczyk, R. Werszko: *The lower Noteć river. Photo service*. CD/Photos 1; 01/I/2004 PWr
27. J. Kulczyk, R. Werszko: *The upper Noteć river. Photo service*. CD/Photos 2; 02/I/2004 PWr
28. J. Kulczyk, R. Werszko: *The Warta river. Photo service*. CD/Photos 3; 03/I/2004 PWr
29. U. Kowalczyk, W. Kuszewski, M. Słomianko-Wasilewska: *Prognoses of the development of cargo transport in inland navigation on the background of the EU transport policy assumptions*. 02/I/2005/IM
30. B. Łuczak: *The infrastructure of inland waterways in EU countries*. 03/I/2005/IM
31. R. Czermańska: *Inland navigation on the West European transport market*. 04/I/2005/IM
32. S. Szwankowski, B. Szwankowska: *Perspectives of use of East-West waterways on the background of the expected activation of the transport network in northern Poland*. 05/I/2005/IM
33. J. Kulczyk, R. Werszko: *The analysis, assessment, and needs of the inland navigation-oriented education system*. 01/I/2006 PWr
34. J. Kulczyk, R. Werszko, J. Prokopowicz, T. Tabaczek: *The analysis of the condition and hydrotechnical limitations on the Warta, Noteć, and middle Odra water lanes*. 52/I/2004
35. B. Bogdaniuk, T. Jarzębińska: *Integration of ecological water and rail transport means in northern Poland*. 01/I/06 BB

Ecological problems

36. J. Girtler: *A probabilistic model of the appearance of situations putting in risk the safety of inland passenger ships and the environment as a result of a failure of ship's engine room machinery*. 26/I/2004
37. I. Domurat, E. Krajnik: *Comparing different propulsion systems used in inland navigation objects with respect to their ecological effect, and selecting most environment friendly variants*. 47/I/2004
38. B. Łuczak, M. Kuliński, R. Opióła, R. Pyszko: *Identifying ecological threats resulting from the activation of inland navigation*. 15/I/2004/IM
39. J. Girtler: *The analysis of potential use of pro-ecological fuels in the combustion engines on inland passenger ships in the aspect of their durability, reliability, and work economy taking into account ship refuelling problems*. 01/I/05 JG
40. Sinus: *The application of gas-fed combustion engines for driving inland ships – discussion of technical, safety and ecological aspects*. 04/I/2005
41. Sinus: *Comparing different propulsion systems installed on inland water navigation objects with respect to their ecological effect, and selecting most environment friendly variants*. 02/I/2005
42. J. Kulczyk, R. Werszko: *Methods of preventing leakages of oil sewages. Sanitary waste reception and garbage disposal problems. Offshore petrol stations, the effect on the environment*. 01/I/2005 PWr
43. Cz. Kolanek, Z.J. Sroka, W.W. Walowiak: *Toxicity of the exhaust gases emitted by the propulsion systems used in the navigation*. 03/I/2005 PWr
44. J. Kulczyk, J. Prokopowicz, T. Tobaczek, R. Werszko, M. Zawiślak: *The effect of ship's motion on the waterway*. 04/I/2005 PWr

45. R. Czermańska, U. Kowalczyk: *Identifying and analysing the potential risk for the natural environment resulting from ship building, repairs, and operation on inland and coastal water transport routes*. 01/I/2006/IM
46. B. Łuczak, E. Ossowski: *The activities carried out in Polish sea and inland harbours to protect waters against pollution*. 02/I/2006/IM
47. R. Czermańska, A. Montwiłł: *Economic aspects of the environment protection in inland navigation*. 03/I/2006/IM
48. W. Kruszewski: *Modern pro-ecological technological solutions and technical devices in building and operation of inland and coastal ships*. 04/I/2006/IM
49. B. Łuczak, B. Szwankowska, S. Szwankowski: *Pro-ecological solutions concerning inland and coastal ships in operation*. 05/I/2006/IM
- Design assumptions**
50. K. Rosochowicz: *General design assumptions for a modular inland passenger ship*. 01/I/2003
51. K. Rosochowicz, G. Kulas: *Problems of revitalisation of the East-West inland waterway*. 02/I/2003.
52. A. Kniat, C. Zrodowski, R. Pyszko, D. Duda, A. Łabuć: *A preliminary concept for the INCOWATRANS project database*. 01/I/03 RP
53. K. Rosochowicz: *Baltic sea transportation system – a new proposal for its enlargement*. 02/I/2004
54. K. Rosochowicz: *A new generation of environment friendly inland and coastal ships for Polish East-West waterways*. 58/I/2004
55. J. Michalski: *Developing a working programme concept and formulating complementary design assumptions for a modular tourist ship sailing on the Berlin-Królewiec inland route – Report 1.2 – complementary technical assumptions and design documentation*. 05/I/2004
56. J. Michalski: *Developing a working programme concept and formulating complementary design assumptions for a modular tourist ship sailing on the Berlin-Królewiec inland route – Report 1.3 – Basic and complementary ship design assumptions*. 69/I/2004
57. J. Michalski: *A preliminary analysis and design assumptions for hull installations*. 01/I/04 JM
58. D. Bocheński, A. Kubiak: *Problems in formulating design and constructional assumptions, and in current and final verification of the inland passenger ship power plant preliminary design (a critical analytical study)*. 02/I/04 JG
59. J. Girtler, A. Kubiak: *Identifying a problem of designing the power plant for inland passenger ships*. 28/I/2004.
60. J. Girtler, A. Kubiak: *A concept of designing power plants for inland passenger ships taking into account the reliability and safety of their operation, and environment protection problems*. 29/I/2004.
61. Cz. Dymarski, J. Nakielski, A. Popek: *A preliminary analysis and design assumptions for hull installations*. 35/I/2004
62. W. Łącki, W. Turecki: *Preliminary design concepts for environment friendly inland ships (cargo ships)*. 45/I/2004
63. J. Kulczyk, R. Werszko: *A study of preliminary assumption options for the design of an inland passenger and cargo ship operating on the route covering the Odra, Nogat, and Szarpawa rivers, the Vistula Lagoon, and Elbląg*. 54/I/2004
64. K. Rosochowicz: *Limiting conditions and development goals of the problems attacked by the INCOWATRANS E/3065 European project*. 01/I/05 KR
65. Cz. Dymarski, R. Rolbiecki: *Working out assumptions and general concept of the propulsion and control systems for the pushed module of the modular inland ship*. 02/I/05 CzD
66. Sinus: *Working out assumptions entitled “Preliminary design concepts for environment friendly inland ships”*. 02/I/05 S
- Ship design**
67. W. Hołowko, J. Michalski: *A conceptional design of a modular tourist ship for the Berlin-Królewiec inland route*. 04/I/2003
68. J. Michalski, W. Hołowko: *Analysing preliminary concepts of functional solutions, architectonic variants, and spatial arrangement of a modular tourist ship for the Berlin-Królewiec inland route – Report 2.1 – a study of passenger cabin module arrangement*. 70/I/2004
69. J. Michalski: *Working out the conceptional design documentation of a modular tourist ship for the Berlin-Królewiec inland route, including: Report 3.1.1 Preliminary selection of main design parameters for the ship – hull resistance prognoses*. 06/I/2004
70. J. Michalski, W. Hołowko: *Analysing preliminary concepts of functional solutions, architectonic variants and spatial arrangement of a modular tourist ship for the Berlin-Królewiec inland route – Report 2.2 – An architectonic and functional study of the hotel barge hull*. 07/I/2004
71. J. Michalski, K. Królak: *Working out the conceptional design documentation of a modular tourist ship for the Berlin-Królewiec inland route, including: Report 3.2.1 – Design variants of pusher tug and barge theoretical lines*. 08/I/2004
72. J. Michalski: *Working out the conceptional design documentation of a modular tourist ship for the Berlin-Królewiec inland route, including: Report 3.3.1 Preliminary selection of propulsion system parameters – the analysis of the resistance-propulsion parameters in the designed conditions of ship’s operation*. 09/I/2004
73. J. Michalski: *Working out the conceptional design documentation of a modular tourist ship for the Berlin-Królewiec inland route, including: Report 3.3.2 Preliminary selection of propulsion system parameters – a method of selecting optimum speeds for inland ships’ routes*. 10/I/2004
74. J. Michalski, K. Królak, T.W. Majewski: *Participation in formulating assumptions and current verification of the inland ship design documentation worked out by SINUS. Report 011-2.1 – The programme and conversion of theoretical lines of the SINE 207 hull shape from the KORAB computer system to the TRIBON system*. 11/I/2004
75. J. Michalski, K. Królak: *Participation in formulating assumptions and current verification of the inland ship design documentation worked out by SINUS. Report 011-2.2 The approximation of theoretical lines and verification of geometrical characteristics of the SINE 207 inland ship hull*. 12/I/2004
76. J. Michalski: *Calculation algorithms and design criteria applicable in the preliminary design of inland ships. Report 011-4.1 The computer algorithm for determining mass and gravity centre of the inland ship hull construction – verification of the prognosed mass of the SINE 207 ship hull*. 13/I/2004
77. J. Michalski: *Calculation algorithms and design criteria applicable in the preliminary design of inland ships. Report 011-4.2 The computer programme INLAND_SHIP_HULL_MASS.PAS and the documentation of the results of inland ship hull mass simulation calculations*. 14/I/2004
78. J. Michalski: *Calculation algorithms and design criteria applicable in the preliminary design of inland ships. Report 011-4.3 A parametric method for prognosing mass characteristics of inland ships*. 15/I/2004
79. J. Michalski, W. Hołowko: *Analysing preliminary concepts of functional solutions, architectonic variants and spatial arrangement of a modular tourist ship for the Berlin-Królewiec inland route. Report 012-2.3 An architectonic and functional study of the hull of a modular tourist ship pusher tug*. 16/I/2004
80. J. Michalski, W. Hołowko: *Analysing preliminary concepts of functional solutions, architectonic variants and spatial arrangement of a modular tourist ship for the Berlin-Królewiec inland route. Report 012-2.4 Design and manufacturing of a plastic model presenting functional and architectonic concepts of the modular inland tourist ship for the Berlin-Królewiec route*. 17/I/2004
81. J. Michalski, K. Królak: *Verification of the planned spatial hull arrangement of the SINE 207 general cargo – container type ship. Report 011-2.3 Participation in formulating*

- assumptions and current verification of the inland ship design documentation worked out by SINUS. 18/1/2004
82. J. Michalski, K. Królak: *Verification of the planned spatial hull arrangement of the SINE 207 general cargo – container type ship. Report 011-2.4 Participation in formulating assumptions and current verification of the inland ship design documentation worked out by SINUS.* 19/1/2004
 83. B. Oleksiewicz: *“Optimisation of the Fleet of Coastal Ships. Stability Aspects”.* Calculation algorithms and design criteria applicable in the preliminary design of inland ships. 20/1/2004
 84. J. Michalski, W. Hołowko: *A preliminary analysis of the general plan and specification of the modular tourist ship for the Berlin-Królewiec inland route – Part I – Passenger barge module.* Report 012_3.6.1. 21/1/2004
 85. J. Michalski, W. Hołowko: *A preliminary analysis of the general plan and specification of the modular tourist ship for the Berlin-Królewiec inland route – Part II – Pusher tug module.* Report 012_3.6.2. 21/1/2004
 86. J. Michalski, K. Królak, W. Majewski: *Design documentation of buoyancy of a tourist ship for the Berlin-Królewiec inland route.* Report 012_3.4.1. 22/1/2004.
 87. J. Michalski, K. Królak: *Design documentation of stability of a tourist ship for the Berlin-Królewiec inland route.* Report 012_3.5.1. 65/1/2004
 88. J. Michalski, K. Królak: *Verification of buoyancy in the non-damaged state of the modular SINE 208 type ship – Report 011_2.5.* 23/1/2004
 89. J. Michalski: *Evaluation of building and operating costs for a modular tourist ship designed for the Berlin-Królewiec inland route – an algorithm determining the hull construction building cost.* 66/1/2004
 90. J. Michalski: *Evaluation of building and operating costs of the verified designs of inland cargo ships – the SINE 207 ship – Report 011-3.1.* 67/1/2004
 91. E. Brzoska, A. Rogalski: *Prognosing the resistance of a ship in motion on shallow water from the results of model tests on deep water.* 56/1/2004
 92. E. Brzoska, A. Rogalski: *Prognosing the resistance and towing power for an inland tourist-hotel passenger ship.* 57/1/2004
 93. A. Rogalski, M. Grygorowicz: *Results of deep and shallow water model tests of a tourist-hotel passenger ship.* 01/1/04 JSz
 94. A. Rogalski: *Problems of turning and manoeuvring abilities of push trains.* 02/1/04 JSz
 95. J. Michalski, I. Baranowska: *Working out two versions of AutoCAD graphical format documentation drawings for general views of a modular ship pusher tug and barge, along with introducing corrections to the design solutions.* 02/1/05 JM
 96. J. Michalski: *A mathematical model of selecting optimum parameters for the inland ship propulsion system – approximation of experimental hull resistance characteristics.* 03/1/05 JM
 97. J. Michalski, K. Królak: *Design calculations of buoyancy, freeboard, and stability for the pusher tug and barge of a modular tourist ship for the Berlin-Królewiec inland route.* 04/1/05 JM
 98. J. Michalski, W. Hołowko: *Calculating masses of ship’s insides of the pusher tug and barge of a tourist ship for the Berlin-Królewiec inland route.* 05/1/05 JM
 99. J. Michalski, W. Hołowko: *Preliminary assessment of ship’s inside manufacturing costs for the pusher tug and barge of a tourist ship for the Berlin-Królewiec inland route.* 06/1/05 JM
 100. J. Michalski: *Verifying preliminary resistance assessments and determining mathematical models of the designed resistance characteristics for the InCoWaTranS ship.* 07/1/05 JM
 101. J. Michalski: *Investigations oriented on determining mathematical models of screw-hull interaction characteristics for a ship sailing on a bounded water region – with computer implementation concerning the InCoWaTranS ship.* 08/1/05 JM
 102. J. Michalski: *The optimisation model of selecting main parameters for the ship propulsion system with a compromise constant-pitch screw (paper presented at the XXVI-th Marine Power Plant Symposium SYMSO 2005, Gdynia).* 09/1/05 JM
 103. J. Michalski: *Calculation algorithms and design criteria applicable in the preliminary design of inland ships.* 10/1/05 JM
 104. J. Michalski: *A method of prognosing propeller-hull system interactions applicable for preliminary design of inland ships.* 11/1/05 JM
 105. J. Michalski: *Propulsion characteristics of the INCOWATRANS passenger ship designed for operation on the Berlin-Królewiec inland route.* 12/1/05 JM
 106. J. Michalski: *The analysis of resistance and propulsion characteristics of the inland pusher tug m/v SINE 208 at changing pusher train configuration and different waterways.* 13/1/05 JM
 107. K. Królak: *Verification of unsinkability and stability in the damaged state of the pusher tug and barge composing the modular tourist ship designed for the Berlin-Królewiec inland route.* 14/1/05 JM
 108. J. Michalski, W. Hołowko: *A conceptual design of the general plan of a passenger ship designed in the recreation-sanatorium functional version for the Berlin-Królewiec inland route - a pusher tug and a barge.* 16/1/05 JM
 109. J. Michalski, I. Baranowska: *Preparing autocad drawings of the general concept plan of a passenger ship designed in the recreation-sanatorium functional version for the Berlin-Królewiec inland route - a pusher tug and a barge.* 17/1/05 JM
 110. J. Michalski, W. Hołowko, I. Baranowska: *Manufacturing a plastic model of the general plan of a modular ship functioning as the floating healing and recreation sanatorium designed for the Berlin-Królewiec inland route.* 18/1/05 JM
 111. J. Michalski: *A method of designing optimum parameters of compromise screws and sailing speed for inland ships navigating on bounded water regions” (computer implementation of the method – the source code).* 19/1/05 JM
 112. Sinus: *Working out the preliminary design of environment friendly ships (cargo ships).* 05/1/2005
 113. J. Michalski: *A structural algorithm of prognosing inland ship hull building costs at the preliminary design stage (Report 012_4).* 02/1/06 JM
 114. J. Michalski, T. Szamański: *Working out the computer system applicable as an assistance tool in inland ship preliminary design.* 03/1/06 JM
 115. J. Michalski: *Working out the computer system applicable as an assistance tool in inland ship preliminary design_011_2.* 04/1/06 JM
 116. J. Michalski: *Working out the computer system applicable as an assistance tool in inland ships preliminary design_011_2.* 05/1/06 JM
 117. J. Michalski: *Technical and functional characteristics of the modular inland ship in the cruising-passenger version, M/V Eureka I, and the sanatorium-passenger version, M/V Eureka II (Report 012_5.1).* 06/1/06 JM

Designing propulsion system and other systems

118. J. Girtler: *Problems and principles of preliminary designing of inland passenger ship power plants referring to their reliability and safety of functioning.* 05/1/2003
119. D. Bocheński, A. Kubiak: *The analysis and synthesis of the conditions of motion and determining the main drive effective power, along with proposed constructional solutions for the propulsion system and power plant taking into account the electric power demand (a critical analytical study).* 24/1/2004
120. J. Girtler: *A probabilistic model of the process of inland passenger ship power plant operation.* 25/1/2004
121. J. Girtler: *The analytical and critical study of reliability and safety of functioning of the power plant on an inland passenger ship.* 27/1/2004

122. D. Bocheński, A. Kubiak: *The analysis and evaluation of investment and energy costs for the inland passenger ship power plant (a critical analytical study)*. 01/I/04 JG
123. J. Girtler: *Problems of designing, manufacturing and operation of inland passenger ship power plants taking into account their reliability and safety of functioning*. 30/I/2004
124. J. Nakielski, A. Popek: *A preliminary design of the ballast systems for pusher tug and hotel barge modules*. 36/I/2004
125. Cz. Dymarski, G. Skorek: *The energy balance for a concept of the main propulsion system with a hydrostatic torque converter for modular inland and coastal ships*. 55/I/2004
126. Cz. Dymarski: *The analysis of concepts of propulsion system variants with a hydrostatic torque converter for a river ship*. 56/I/2004
127. Cz. Dymarski: *A design concept of the main propulsion system with a hydrostatic torque converter for modular inland and coastal ships – Part I – Schematic diagram of the propulsion system*. 59/I/2004
128. Cz. Dymarski, R. Rolbiecki: *Working out a concept of inland ship propulsion and control systems making use of a hydrostatic torque converter*. 60/I/2004
129. *An overview of the state of knowledge on optional solutions of propulsion systems. The application of gas-fed combustion engines as inland ship drives – discussion of technical, safety, and ecological aspects*. 44/I/2004
130. J. Kort, Cz. Szpanowski: *The analysis of usage of river ship steering and manoeuvring devices. Part I*. 48/I/2004
131. J. Kort, Cz. Szpanowski: *The analysis of usage of river ship steering and manoeuvring devices. Part II*. 49/I/2004
132. Cz. Dymarski, R. Rolbiecki: *Working out a preliminary comparison analysis of Diesel-electric and Diesel-hydraulic inland passenger ship main propulsion variants*. 01/I/05 JM
133. W. Hołowko: *A design of the air-conditioning system for a two-module passenger ship designed for the Berlin-Królewiec inland route*. 15/I/05 JM
134. J. Girtler: *The comparison analysis of combustion processes in self-ignition engines in case of use of conventional and pro-ecological fuels, and their effect on durability, reliability and economy of operation of these engines*. 02/I/05 JG
135. D. Bocheński, J. Rudnicki: *Analysing the effect of conditions of inland passenger ship operation on main engine and electric power plant loads in energetic aspect*. 03/I/05 JG
136. D. Bocheński, J. Rudnicki, A. Kubiak: *Identifying problems concerning the preliminary design of the inland passenger ship power plant taking into account power demand for the main drive and electric receivers*. 04/I/05 JG
137. D. Bocheński, J. Rudnicki, A. Kubiak: *The preliminary design of the combustion-engine power plant and the combustion engine/electric power plant for an inland passenger ship*. 05/I/05 JG
138. A. Popek: *Preliminary selection of ballast system components for pusher tug and hotel barge modules*. 01/I/05 CzD
139. Cz. Dymarski, R. Rolbiecki: *Working out a preliminary comparison analysis of Diesel-electric and Diesel-hydraulic inland passenger ship main propulsion variants*. 03/I/05 CzD
140. W. Litwin: *A preliminary design of water, hot consumption water, and sewage disposal installations*. 04/I/05 CzD
141. Cz. Dymarski, M. Mankowicz: *Specification of the electric part*. 06/I/05 CzD
142. W. Litwin: *Water lubricated polymer hydrodynamic bearing with full and grooved bearing bushing*. 07/I/05 CzD
143. L. Matuszewski: *A feasibility study of the adaptation of a ferrofluid seal designed for gas separation to sealing a water propeller*. 01/I/05 LM
144. Cz. Dymarski: *Preparing a patent application of a device coupling inland and coastal ship push train modules*. 31/I/2004
145. Cz. Dymarski, J. Nakielski: *The analysis of classification regulations and a preliminary design of the anchoring and mooring equipment*. 32/I/2004
146. Cz. Dymarski, P. Łubiński: *Devices coupling the modules of the modular inland and coastal ship*. 33/I/2004
147. Cz. Dymarski: *A design concept of a device coupling the modules of the inland and coastal ship push train. Part I – General concept of the device. Part II – A concept of the drive and hydraulic control of the device*. 34/I/2004
148. Cz. Dymarski, J. Nakielski: *Concepts of anchoring and mooring equipment for the barge and pusher tug*. 05/I/05 CzD
149. Sinus: *The analysis of the usage of river ship steering and manoeuvring devices - PRELIMINARY*. 03/I/2005.

Designed construction and strength

150. M. Bogdaniuk, Z. Górecki: *Calculation of thin-wall constructions – skin reduction. A method of analysing resistance of inland ship hulls*. 04/I/2004
151. M. Bogdaniuk, Z. Górecki, W. Puch: *Strength oriented evaluation and verification of the pushed barge construction designed by the SINUS design office*. 63/I/2004
152. M. Bogdaniuk, Z. Górecki, W. Puch: *Deck calculations taking into account the pressure of the transported vehicles. Strength of inland ship decks loaded with the pressure of the vehicle wheels*. 68/I/2004
153. G. Porembski, T. Dobrosielski, I. Korytkowska: *A hotel module of the inland tourist ship. Report 3D. Preliminary ship visualisation*. 38/I/2004
154. A. Szarnik, M. Augustyniak, P. Jakubowski: *A hotel module of the inland tourist ship. A construction concept on the canvassing design level*. 38/I/2004
155. P. Jakubowski, M. Augustyniak, W. Us, A. Szarnik, M. Dobrosielska: *Preliminary concept and dimensioning of the hotel barge hull construction, variant 3a and 3b. Preliminary strength assessment of the proposed panel connections. Appendix to the report*. 39/I/2004
156. A. Szarnik, M. Augustyniak, P. Jakubowski, G. Porembski: *Preliminary concept and dimensioning of the hotel barge hull construction, variant 2. Preliminary strength assessment of the proposed panel connections*. 40/I/2004
157. A. Szarnik, M. Augustyniak, P. Jakubowski: *A concept of the hotel barge pusher tug construction – variant I*. 41/I/2004
158. A. Szarnik: *Description of the preliminary design of the modular construction of a tourist ship for the Berlin-Królewiec inland route*. 01/I/2006/Des Art.
159. P. Jakubowski, M. Augustyniak: *A uniformed concept of the modular tourist ship construction – FEM calculations of the modular tourist ship hull*. 61/I/2004
160. Sinus: *Final documentation of the SINE 207 ship – Inland Cargo/Container 18/36 TEU:*
 - Theoretical 0120(1-4,9), 0160(1), 0320(1,2), 0410(1), 0420(3), 054(1)
 - Hull 1000/1, 1040/1,2, 1060/7, 1100/1, 1200(1,2) 1300/1, 1400/1, 1500/1, 1600/1, 1700/1
 - Deck Equipment 201-23-1, 2310/1, 2320/1, 2410/1, 2510/1, 2740/1, 2770/1, 2850/1, 2870/1
 - Accommodation 0110/1, 3110/1, 3410/1, 3420/1
 - Machinery 4040/1, 4040(W1, W1A, W1B), 4320/1, 5110/1, 5120/1, 5130/1, 5140/1, 5210/1,2,3, 5310/1,1,12, 5510/1, 5530/1, 5600/1,2, 5710/1, 5720/1, 503-01,
 - Electrical 601/60-01, 61100-1, 6820/1, 6830/1
161. Sinus: *A preliminary concept of the second ship SINE 208 – Tug and Barge:*
 1040-1 – Midship And Transverse Section 46/I/2004
 0110-1 – General Arrangement Plan 46/I/2004
 4040-1 – ER Arrangement, and ER List of Equipment and Mechanisms. 46/I/2004
162. M. Bogdaniuk, Z. Górecki, W. Puch: *The analysis of general, zonal, and local strength of the designed construction made of ribbed aluminium panels*. 01/I/05 ZG
163. M. Bogdaniuk, Z. Górecki, R. Łukowski: *An inland passenger assembly. Specification and construction*. 02/I/05 ZG
164. M. Bogdaniuk, Z. Górecki, W. Puch: *The analysis of the limiting load capacity of inland ship hull constructions*

in the conditions of contact with the bottom of the water region. 03/1/05 ZG

165. M. Bogdaniuk, Z. Górecki, W. Puch: *The analysis of general, zonal, and local strength of the designed construction made of ribbed aluminium panels – supplement.* 04/1/05 ZG
 166. M. Bogdaniuk, Z. Górecki, W. Puch: *The analysis of forces and deformations of a hull during its contact with a quay and an obstacle.* 05/1/05 ZG

Final documentation of the modular inland merchant vessel

167. Sinus: *Document of SINE 207 0050-1. Inland general cargo/ container 18/36 TEU.* 0050-1/1

Theoretical

168. Sinus: Body lines SINE 207 0120-1. 0120-1/1
 169. Sinus: Tables of hull form data SINE 207 0120-2. 0120-2/1
 170. Sinus: Construction lines SINE 207 0120-3. 0120-3/1
 171. Sinus: Building frames SINE 207 0120-4. 0120-4/1
 172. Sinus: The measured length SINE 207 0120-9. 0120-9/1
 173. Sinus: Tank plan SINE 207 0160-1. 0160-1/1
 174. Sinus: Lightship weight distribution SINE 207 0320-1. 0320-1/1
 175. Sinus: Statement of ship's mass SINE 207 0320-2. 0320-2/1
 176. Sinus: Hydrostatic tables SINE 207 0410-1. 0410-1/1
 177. Sinus: Intact stability and freeboard calculation SINE 207 0420-3. 0420-3/1
 178. Sinus: Print out of bending moments and shear forces SINE 207 0540-1. 0540-1/1

Hull

179. Sinus: Moulding plan SINE 207 1000-1. 1000-1/1
 180. Sinus: Midship and transverse section SINE 207 1040-1. 1040-1/1
 181. Sinus: Longitudinal section SINE 207 1040-2. 1040-2/1
 182. Sinus: Hull division plan SINE 207 1060-7. 1060-7/1
 183. Sinus: Double bottom SINE 207 1100-1. 1100-1/1
 184. Sinus: Longitudinal bulkheads SINE 207 1200-1. 1200-1/1
 185. Sinus: Transverse bulkheads SINE 207 1200-2. 1200-2/1
 186. Sinus: Shell expansion SINE 207 1300-1. 1300-1/1
 187. Sinus: Deck and hatch coamings SINE 207 1400-1. 1400-1/1
 188. Sinus: Engine room SINE 207 1500-1. 1500-1/1
 189. Sinus: Forepeak SINE 207 1600-1. 1600-1/1
 190. Sinus: Deckhouse SINE 207 1700-1. 1700-1/1

Deck Equipment

191. Sinus: Number of equipment calculation SINE 207 201-23-1. 201-23-1/1
 192. Sinus: Anchor/mooring arrangement - bow SINE 207 2310-1. 2310-1/1
 193. Sinus: Anchor/mooring arrangement - aft SINE 207 2320-1. 2320-1/1
 194. Sinus: Installation of life raft SINE 207 2410-1. 2410-1/1
 195. Sinus: Arrangement of railings SINE 207 2510-1. 2510-1/1
 196. Sinus: Arrangement of small hatches SINE 207 2740-1. 2740-1/1
 197. Sinus: Wheelhouse lifting and lowering arrangement SINE 207 2770-1. 2770-1/1
 198. Sinus: Signal mast SINE 207 2850-1. 2850-1/1
 199. Sinus: Arrangement of garbage containers SINE 207 2870-1. Nr 2870-1/1

Accommodation

200. Sinus: General arrangement plan SINE 207 0110-1. 0110-1/1
 201. Sinus: Installation plan SINE 207 3110-1. 3110-1/1
 202. Sinus: Door plan SINE 207 3410-1. 3410-1/1
 203. Sinus: Windows plan SINE 207 3420-1. 3420-1/1

Machinery

204. Sinus: Engine room & bow propulsion room arrangement SINE 207 4040-1. 4040-1/1
 205. Sinus: Engine room & bow propulsion room arrangement SINE 207 4040-W1. 4040-W1/1
 206. Sinus: Engine room & bow propulsion room arrangement SINE 207 4040-W1. Nr 4040-W1A/1
 207. Sinus: Engine room & bow propulsion room arrangement SINE 207 4040-W1. Nr 4040-W1B/1
 208. Sinus: Exhaust gas piping system SINE 207 4320-1. 4320-1/1
 209. Sinus: Water cooling system SINE 207 5110-1. 5110-1/1
 210. Sinus: Fuel oil service & separating piping diagram SINE 207 5120-1. 5120-1/1
 211. Sinus: Lubricating oil piping system SINE 207 5130-1. 5130-1/1
 212. Sinus: Compressed air piping diagram SINE 207 5140-1. 5140-1/1
 213. Sinus: Bilge water piping system SINE 207 5210-1. 5210-1/1
 214. Sinus: Ballast water piping system SINE 207 5210-2. 5210-2/1
 215. Sinus: Fuel oil transfer piping system SINE 207 5210-3. 5210-3/1
 216. Sinus: Sounding, overflow & venting pipelines plan SINE 207 5310-1. 5310-1_1/1
 217. Sinus: Sounding, overflow & venting pipelines plan SINE 207 5310-1. Nr 5310-1_2/1
 218. Sinus: Fire water piping system SINE 207 5510-1. 5510-1/1
 219. Sinus: CO2 piping system SINE 207 5530-1. Nr 5530-1/1
 220. Sinus: Ventilation plan in engine room SINE 207 5600-1. 5600-1/1
 221. Sinus: Ventilation plan outside ER SINE 207 5600-2. 5600-2/1
 222. Sinus: Sanitary & technical water system SINE 207 5710-1. 5710-1/1
 223. Sinus: Sanitary water discharge piping system SINE 207 5720-1. 5720-1/1
 224. Sinus: Symbols used in diagrams S03-01. S03-01/1
 f) Electrical
 225. Sinus designer steam: Energy balance SINE 207 601-60-01. 601-60-01/1
 226. Sinus: Electric network principal diagram SINE 207 61100-1. 61100-1
 227. Sinus: Navigation and signal lights and deck lights arrangement SINE 207 6820-1. 6820-1/1
 228. Sinus: Arrangement of cable ways and distribution boards SINE 207 6830-1. 6830-1/1

Lane infrastructure

229. M. Stawicka - Wałkowska, T. Parteka, B. Felski, M. Ptaszyński: *An extended design concept of a modular stage point for regular inland passenger navigation in the East-West relation.* 50/1/2004
 230. M. Stawicka- Wałkowska, T. Parteka, B. Felski, M. Ptaszyński: *Modular concept solutions of a stage calling base for inland passenger and cargo navigation, in the East-West relation.* 51/1/2004
 231. A. Kniat, C. Żrodowski, R. Pyszko, D. Duda, A. Łabuć, K. Czerwieński: *A concept of the data base for the Incowatrans project.* 55/1/2004
 232. R. Pyszko: *Developing a specialist data base.* 003/Sprawozd/2004
 233. C. Żrodowski, L. Szamanek: *Model formalisation – Compliance of the model and data format, and procedures of data transfer with external institutions. Developing a specialist data base.* 006pg/191/E/05
 234. A. Kniat, C. Żrodowski: *Upgrading version 4.0 of the TeamCenter system made by UGS PLM Solutions. Developing a specialist data base.* 007pg/189/E/05
 235. A. Kniat, C. Żrodowski: *Corrections to the DICTIONARY OF TERMS (modification). Developing a specialist data base.* 008pg/190/E/05

236. C. Żrodowski: *Implementation, tests and modification of the data structure for the GIS model*. 011pg/212/E/05
237. C. Żrodowski, R. Pyszko: *External consultations 2004/2005 - Report*. 014pg/E/05
238. C. Żrodowski, A. Kniat, R. Pyszko: *GIS tools to assist inland fleet development*. 015pg/E/05
- Technology**
239. R. Pyszko, Z. Górski: *Assumptions for the general technology of building a hotel barge and pusher tug*. 010pg/B/05
240. E. Marcinkiewicz: *Maintenance – an overview of maintenance techniques and technologies used for protecting steel constructions*. 009pg/E/05
241. R. Pyszko, Z. Górski: *Selected issues of technological preparation of mixed-construction river ship production*. 017pg/E/05
242. J. Michalski, A. Muczyński: *Synthetic structure of the elementary ship hull building technology costs in current real conditions of Polish market*. (Report 012-4.1).
243. R. Pyszko, Z. Górski: *Technological and constructional remarks to the worked out designs of pusher tug and hotel barge – version 2005*. 012pg/E/05
244. R. Pyszko: *Proposed solutions of panel connection centres for the designed river ships and a preliminary concept of technological hull division*. 004pg/E/05
- Annual and final reports, monographs, final reviews**
245. K. Rosochowicz: *A new generation of environment friendly inland and coastal ships for Polish waterway system in East-West relation*. 03/1/2003
246. K. Rosochowicz: *Organising the meeting of partners in the realisation of the Eureka- Incowatrans project, Gdańsk, 18 Oct, 2004*.
247. R. Czermańska, U. Kowalczyk: *Report*. 01/1/2004/IM
248. R. Czermańska: *Report*. 11/1/2004/IM
249. R. Czermańska, B. Łuczak: *Report*. 16/1/2004/IM
250. B. Łuczak: *Report*. 17/1/2004/IM
251. M. Nawalany: *Annual report 2005*. 01/1/05 MN
252. U. Kowalczyk, B. Łuczak: *Conference proceedings*. 01/1/2005/IM
253. J. Michalski: *Methods applicable in computer-aided preliminary design of inland ships (monograph), Gdańsk 2007*. 07/1/06 JM
254. J. Kulczyk: *Evaluating the SINE 207 inland ship design – The evaluation refers to the motor barge design, done by SINUS sp. z o.o. The design was worked out within the framework of the EUREKA – E13065 Incowatrans project*. 02/1/2006/PWroc
255. J. Kulczyk, R. Wieszko, Z. Domagała, M. Zawiaślak: *General evaluation of ship designs worked out within the framework of the Incowatrans project*. 03/1/2006/PWroc
256. K. Rosochowicz: *Annual report 2003*. 01/1/2003
257. K. Rosochowicz: *Annual report 2004*. 01/1/2004 R
258. K. Rosochowicz: *Annual report 2005*. 01/1/2005 R
259. K. Rosochowicz: *Annual report 2006*. 01/1/2007 R
260. *Proceedings of the final Incowatrans seminar*.
- Remark: Works completed in December 2006 and January 2007 will be collected as Bibliography – Appendix in the special issue S1/2007 of the Polish Maritime Research.

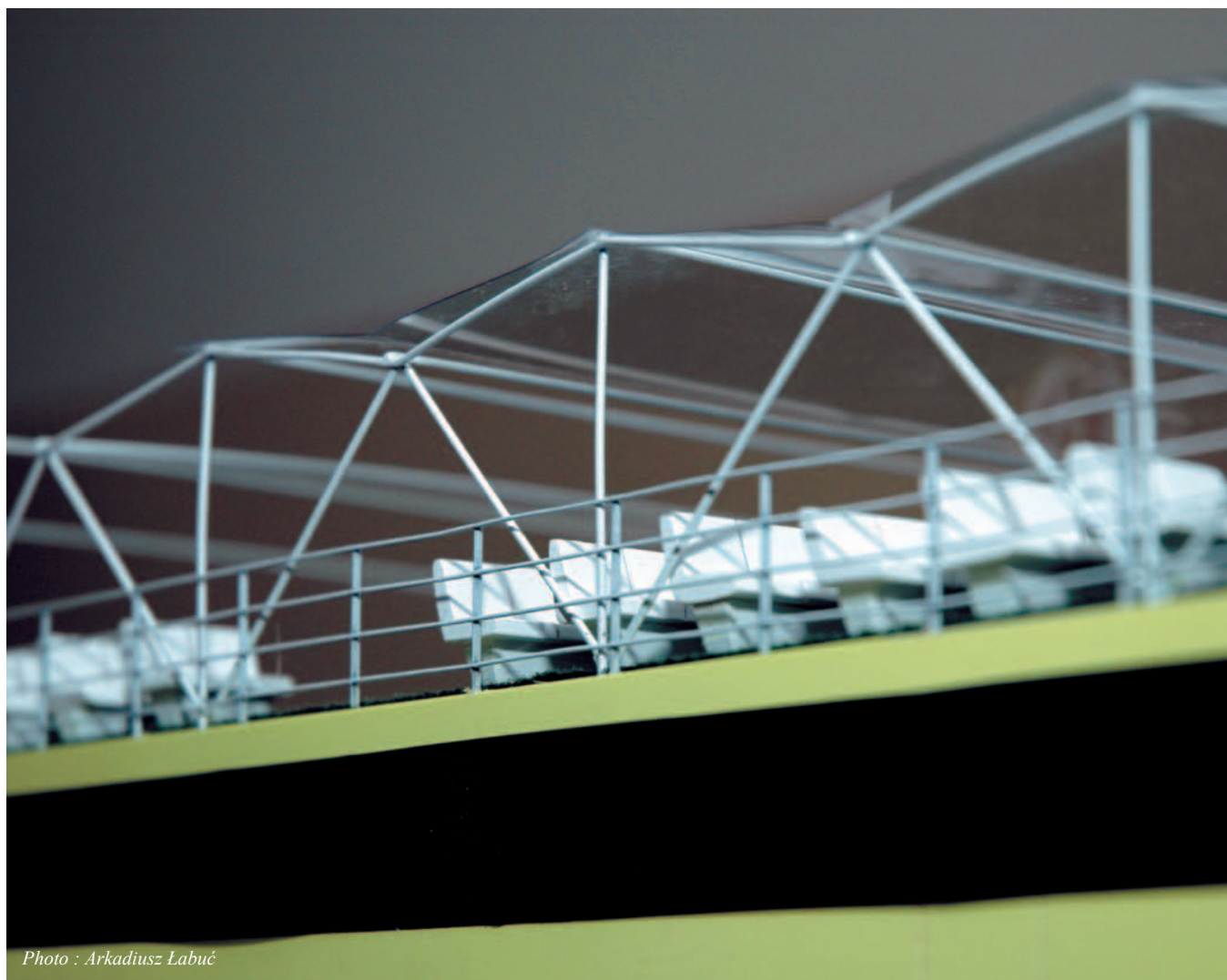


Photo : Arkadiusz Łabuć