

## TRAINING GROUND OF NAVIGATION SIMULATORS

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### ABSTRACT

Analysis of the causes of accidents on inland waterways of Russia permits to conclude that one can observe a stable trend to decreasing of professional skills of shipboard personnel of inland navigation. Navigation simulators constitute one of promising tools of professional training. Impartially, there is a problem of searching of a compromise between quality of professional training and duration of training. This problem depends directly on the contents of database of simulators.

The authors propose methodological approach towards the development of contents of database of navigation simulators on the basis of the concept of training ground taking into consideration typical elements of inland waterways, hydraulic facilities,

Practical implementation of proposed method supposes typical operations aimed at integration of the modules of fragments of inland waterways and other elements into the training ground.

The authors come to a conclusion on the practicability of creation of regional training and simulator centers for training of navigators of appropriate water areas and describe possible ways to better use navigation simulators, whose database's contents were developed in the framework of concept of training ground.

### ENGLISH SUMMARY

**Background.** Safety of navigation by inland waterways (IWW) constitutes an important factor of safe and reliable functioning of inland water transport (IWT) which is a constituent part of comprehensive national transport complex. Professional training of navigation personnel is a mandatory element of safe navigation.

Navigation simulators have been used in training and simulator centers and in educational institutions of professional education since 2000, and in advanced training of navigators since 2006 [1]. According to the order of the Ministry of transport of Russia of October, 30, 2007 the simulators should be used in area directories of public administration of IWT during qualification exams of crews [2].

Analysis of distribution of transport accidents in 1998–2010 [3] at IWW by causes and types shows that main causes of accidents are:

- insufficient knowledge by navigators of maneuvering features and capacity of navigated ships;
- violation of regulations;
- wrong interpretation of data of standard on-board navigation devices.

Annual papers of safety control agency for sea and river transport ascertain that there has been of late a stable trend towards decreasing of professional skills of shipboard personnel of IWT [4]. It proves the necessity to develop methodical foundations for the use of navigation simulators in order to teach navigators to prevent accidents.

Practical expertise of the authors in organizing of simulator classes and advanced learning of

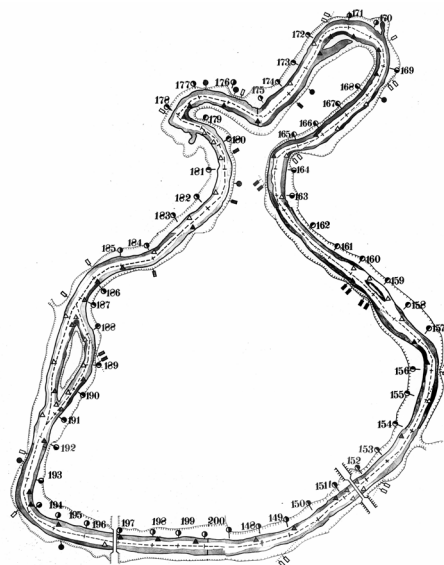




Fig.2. List of documents determining requirements to navigation simulators of inland water ways.

real sections of inland waterways. It will not be effective because of limitations referring to duration of learning and will make simulator more expensive [5].

Therefore it is necessary to find a reasonable compromise between duration of learning course and professional training quality.

**Methods.** One of possible solutions can be found through methodical approach towards creation of contents of database of simulators on the basis of the concept of a training field with typical elements of inland waterways, waterworks, ship models, while taking into account features of water areas of attendees of learning courses.

**Results.** The idea of taking into account of regional features of a water area for editing contents of database of navigation simulators was first implemented in river navigation simulator «master» in the late eighties of past century. Following expert assessments of most difficult sectors of the river of Irtysh a training ground was developed that represented 57 km of the river and consisted of 4 typical sections. The attendees were proposed to work at an established list of tasks of simulator training. General layout of training ground of simulator «master» is shown in Fig. 1.

Regardless of more than 20 years long successful experience of application of navigation training ground «master» in Ob-Irtysh water area, this method has not been widely spread [1]. The main reasons are as follow: the list of sections of training ground does not contain typical elements of IWW of other water areas; the contents of database do not include real listing of types and groups of exploited ships.

Other variants of technical decisions that were realized in modern navigation simulators [6] used model sections of IWW that represented short sections to work at very narrow list of tasks and those sections were described as «test areas» or «learning areas».

So the task of development of the content of database for promising navigation simulators for professional training of navigators of IWW should be based on the concept of training ground. While

developing a training ground, it is necessary to use modular approach, when modules represent real and/or typical difficult sections of waterways in order to provide attendees with stable practical skills of ship navigation. The distance and complexity of training grounds should be planned taking into consideration time limits, features of navigation training in accordance with syllabus and specific characteristic of local water areas.

The proceedings that should be respected regarding integration of the modular simulated sections of IWW into training ground provide for following typical operations:

- analysis of features of the water area and professional activities of navigators that attend the courses;
- primary selection of typical sections of IWW;
- analysis of topological and hydrological features of preselected typical sections and initial developing of draft outline of a training ground;
- transformation operations (scaling, turning etc.) of geometric dimensions of preselected typical sections for further non modifying concatenation;
- creation of a plan (map) of a training ground according to previous draft outline;
- shaping of flow fields and depths of training ground;
- shaping of coastal relief (profile) of locations of training ground;
- overlaying of visualization elements according to the map of training ground.

Handling modules of typical sections of IWW it is possible to develop the required number of training grounds intended for different learning tasks. All training grounds will be constituent parts of the content of database of navigation simulators.

While shaping optimum list of elements of the content of the database of navigation simulator for training and simulator center it is necessary to take into account the norms of main documents in that sphere (the authors cite valid national instructive documents, e. g. model syllabus of simulator-based training course «use of ship radiolocation stations at IWW»; model syllabus of simulator-based training course «operation of visualization systems of digital navigation maps and information»; program of qualifying exams for awarding diploma of members

of crews of inland navigation; operation and technical requirements of the Ministry of transport of Russia regarding simulators intended to train for the use of radiolocation stations for inland navigation and for exploitation of the systems of visualization of maps and information). Interrelation of main documents with additional requirements for development of the content of the database of navigation simulators is shown in Fig.2, where matrix of the elements of a database (shown in the center) depends on three groups of input data: 1) additional requirements (demand of a customer, features of attendees, features of a water area, causes of accidents) – bottom; 2) syllabus of training courses and programs of qualifying exams which lead to educational and training tasks – left; 3) technical and operational requirements – top. Matrix of the elements of the database influences the training ground and the models of ships (right). The immediate shaping of a list of the elements of a training ground of navigation simulators is made with the help of the table 1 (see Russian part of the text), which takes into consideration the norms of guiding documents and the results of previous studies [3,5–9]. By analyzing the content of the table 1 it is possible to come to a conclusion that it is necessary to

account for not less than 29 elements within the contents of database in order to realize at a full scale the tasks of training and testing of navigators. Furthermore the list of elements in Table 1 can be expanded in order to take into consideration features of one or another water area. For instance a study [10] proposes to differentiate four elements of the element «rift» (shallow) which is the most difficult obstacle at IWW, thus causing the necessity to consider 32 elements of the contents of the database. Similarly the work [11] proposes to differentiate 12 types of «sharp bend» element, etc. Besides, in order to implement full list of tasks of training of navigators of IWW using navigation simulators, and to consider features of river navigation, it is necessary to use the system of multimedia visualization of navigation environment.

**Conclusions.** Implementation of the concept of the training ground for shaping database contents of navigation simulators will contribute to raise training quality and will permit to solve a wide range of experimental and research problems, including expertise of accidents and simulation of different situations, occurring at inland waterways.

**Key words:** inland water transport, navigation simulators, database content, training ground, training area, testing area, professional training of navigators.

## REFERENCES

1. Ivanov M. A. Historical review of national simulators for training of navigation crew of inland water transport [Istoricheskiy obzor otechestvennykh trenazherov dlya podgotovki sudovoditel'skogo sostava vnutrennego vodnogo transporta]. *Rechnoy transport (XXI vek)*, 2011, № 2 (50), pp. 87–92.
2. Procedures of qualification commission... for the crews of inland water navigation. Adopted by the Ministry of transport of Russian Federation on the 30<sup>th</sup> of October, 2007 # 154 [Poryadok obrazovaniya kvalifikatsionnykh komissiy, provedeniya kvalifikatsionnykh ispytaniy, vydachi, izyatiya i annullirovaniya, a takzhe priostanovleniya deystviya diplomov, podtverzheniy k diplomam i kvalifikatsionnykh svidetel'stv chlenov ekipazhey sudov vnutrennego plavaniya. Utverzhen Mintransom RF ot 30 oktyabrya 2007 № 154].
3. Ivanov M. A. Methods of analysis of the database content of simulators intended for training of navigators of inland water transport [Metody analiza kontenta baz dannykh navigatsionnykh trenazherov dlya podgotovki sudovoditeley vnutrennego vodnogo transporta]. Thesis of a candidate for Ph.D. (Tech) degree. Moscow, MGA VT, 2012, 118 p.
4. <http://www.rostransnadzor.ru/sea/ю> Last accessed 08.05.2013.
5. Ivanov M. A., Demchenkov O. V. Comparative analysis of quality of training of navigation personnel of the ships of inland water navigation [Sravnitel'nyy analiz kachestva trenazhernoy podgotovki sudovoditel'skogo sostava sudov vnutrennego plavaniya]. *Rechnoy transport (XXI vek)*, 2011, № 4 (52), pp. 90–95.
6. Ivanov M. A. Review of equipment of training and simulator centers with navigation simulators for training of navigators of the ships of inland water transport [Obzor osnashchennosti uchebno-trenazhernykh tsentrov navigatsionnymi trenazherami dlya podgotovki sudovoditeley sudov vnutrennego vodnogo transporta]. *Rechnoy transport (XXI vek)*, 2011, № 3 (51), pp. 80–85.
7. Ivanov M. A., Demchenkov O. V. Method of Evaluation of Navigation Simulators [Metod otsenki navigatsionnykh trenazherov dlya sudovoditeley]. *Mir Transporta [World of Transport and Transportation] Journal*, 2011, Vol. 36, No 3, pp. 140–145.
8. Ivanov M. A., Demchenkov O. V. Training Content of Navigation Simulators [Obuchayuschiy kontent navigatsionnykh trenazherov]. *Mir Transporta [World of Transport and Transportation] Journal*, 2012, Vol. 44, No 6, pp. 176–183.
9. Ivanov M. A., Demchenkov O. V. Methods of substantiation of the choice of navigation simulator for training of navigators of inland water transport [Metodicheskiy apparat obosnovaniya vybora navigatsionnogo trenazhera dlya organizatsii podgotovki sudovoditeley vnutrennego vodnogo transporta]. *Rechnoy transport (XXI vek)*, 2013, № 1 (60), pp. 77–82.
10. Zemlyanovskiy D. K. Sailing directions of inland waterways [Lotsiya vnutrennih vodnykh putey]. Moscow, Transport publ., 1988, 222 p.
11. Andreev V. N., Gordeev O. I., Soldatov V. I. Model charts of river sections, difficult for navigation, for simulator-based training of navigators [Tipovye shemy zatrudnitel'nykh dlya sudohodstva uchastkov rek dlya obucheniya sudovoditeley na trenazherakh] in: Sudovozhdenie. Selected works. Novosibirsk, NGAVT, 2000, pp. 76–117.

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