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The Virtual Model of Deep Water Container Terminal T2 in Port Gdańsk

P. Zwolan
Polish Naval Academy, Gdynia, Poland

K. Czaplewski
Gdynia Maritime University, Gdynia, Poland

ABSTRACT: The level of education of seafarers currently depends among other things on the use of simulators in the training process. The reliability of the computer simulation depends on several factors such as own ship models or virtual training areas. Currently available software on the market allows you to edit and create virtual areas for specific manoeuvring trials. Having a faithful copy of a real basin is an important element of harbour pilots courses or in carrying out a wide range of navigational analyses. In this paper the authors describe the process of creating Container Terminal T2 at DCT Gdańsk in the simulator environment.

1 INTRODUCTION

Navigation and manoeuver simulators certified by appropriate classification institutes are essential equipment for academies and universities concerned with educating vessel staff. They are utilized for training, research or as a tool for students working on their theses. As of last year such simulators are key equipment used during qualification exams for the watch officer diploma. Real life vessels and bodies of water are key influences on simulation credibility and training realism. To ensure the consistency of the presentation of virtual bodies of water as a reflection of existing ones, software developers include tools that allow for editing. Precise models of real life bodies of water have great influence on manoeuvring parameters within the simulation process. The commanding officer's decisions are forced by the effects created by seabed shape or port canals' walls. It is especially important when training port pilots, for whom it is crucial to observe the precise movement of vessels in given circumstances. The dynamic development of ports on the Polish coast forces simulation operators to constantly update bodies of water present in their database. It is a process that is both time consuming and requires knowledge of additional applications which are not a part of the main software.

In the article the process of body of water editing based on the port of Gdańsk will be presented. DCT Container Terminal exemplifies the magnitude of changes that can occur within a body of water in the space of a few years.

2 DEEPWATER CONTAINER TERMINAL (DCT) GDAŃSK CHARACTERISTICS

2.1 *Technical characteristics*

Currently DCT Gdańsk SA exploits the deep-water container terminal DCT T1and T2, which is located in the eastern part of Gdańsk North Harbour and encompasses both land and sea. It is the first terminal in the area of the Baltic Sea that allows for handling of Post - Panamax type vessels, providing safe depth of the approach path, anchor ground, mooring space and the following infrastructure and equipment [https://dctgdansk.pl]:

2.1.1 *DCT T1:*

DCT T1 has two storage squares which were made by creating space on land- adjacent waters. The containers are stored in blocks and serviced with gantry cranes. The storage square located in DCT T1's waterside area has been divided into 4 sectors, where containers are stored in so-called blocks of seven units next to each other in 4 layers. Each sector is 8 blocks large. The other storage square is located on the pier with 32 storage blocks. Cooling containers are stored in especially designated areas in layers of 3, and powered with electricity by transformers located near the container storage blocks. Container transportation between sectors is performed within especially designated communication lanes. The container terminal has a developed railway system which contains 4 handling lanes which are connected to junctions on both sides. In the area of DTC the following can be found: handling work warehouse, administration building, gate complex, main energy source unit, fire prevention water container, a separate transformer station and port workshop building.

Technical parameters of DCT T1 Container Terminal:
- safe length of handling quay is 650m
- maximum depth at quay is 17m
- area of location is 50ha, including 28,5ha of LANDED PORT WATERS
- DCT T1 quay is divided into two handling sectors, one 385m in length, the other 265m
- 6 STS (ship to shore) quay gantry cranes of the “post - Paramax” type
- 20 storage place gantry cranes
- 25 tractors for storage trailers
- pump trucks for empty and full containers
- 4 railway tracks with combined length of 2.5km
- Navis terminal operating system

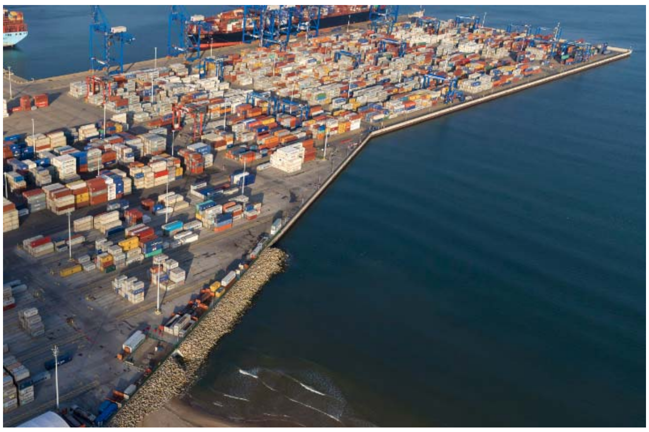

Figure 1. Deepwater Container Terminal – T1 [source: https://dctgdansk.pl]

2.1.2 *DCT T2:*

The DCT T2 deep-water container terminal was constructed as a response to the growing demand for more efficient and economical transport solutions within the Baltic Sea area, which will successfully be able to compete with services in the ports of northern Europe. T2 Container Terminal is located in the eastern part of the North Port between two existing piers: Rudowy (Ore) and DCT T1, and encompass both land and sea sections. On the sea side the area is protected by breakwaters of the North Port. The location is beneficial as it exploits the existing road and rail infrastructure of the T1 Container Terminal. DCT T2 Container terminal have full container storage squares with 5+1 storage height, approx. 8225 places for 20-feet container storage (capacity for approx 32900 containers with area of approx. 343778 m2). Cooling containers' storage places – approx. 210 places for cooling containers storage (20 or 40-feet) with the area of approx. 18848 m2. Empty container storage – capacity for approx. 996 20-feet containers, with the area for storage squares approx. 4868 m2. Containers with hazardous materials are not stored in one designated space, but in compliance with regulations concerning transportation of hazardous materials.

Technical parameters of DCT T2 Container Terminal:
- handling quay length approx. 650m
- maximum depth in port 17 m
- terminal's area will be 48 ha
- 7 STS quay gantry cranes
- 55 truck tractors (utilized to transport containers between storage spaces)
- 17 pump trucks for full containers
- 12 pump trucks for empty containers
- 15 fork lifts
- 25 RTG gantry cranes for storage squares
- 7 hydraulic cranes
- 2 gate gantry cranes for rail handling

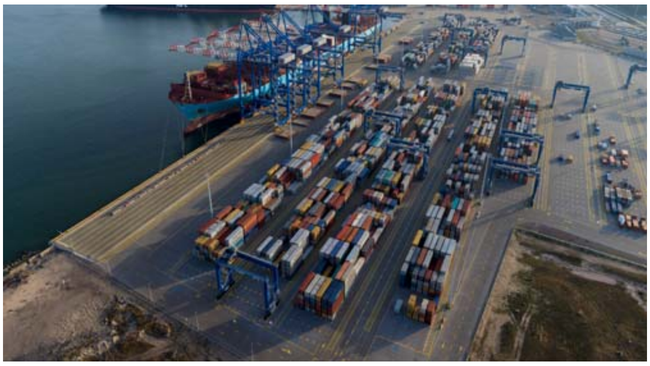

Figure 2. Deepwater Container Terminal – T2 [source: https://dctgdansk.pl]

2.2 *Navigational characteristics*

The approach path to North Port begins after passing buoys MG-A and MG-B which designate safe deepwater (16,5m). This information is crucial as various shallow waters appear nearby (up to 13m). The approach fairway to the port are two designated lanes, one in each direction, with the width of one nautical mile. They are separated by a no traffic zone that is 0,5 nautical mile wide. The distance from P1 – P2 buoys to the main entrance of the North Port (3,35 NM) is completed with a leading light 253,6° (Oc. Or. 5s) with 7Nm range. The fairway has the depth of 17,5m and width at sea bed of 350m, however, the North Port can accept ships with maximum displacement of 15m and maximum length of 350m. The DCT can accept ships with 400m of maximum length. The P-1 buoy, as the one initiating the approach path, is equipped with a flashing light which repeats flashes at regular intervals of 10s (Lfl.G.10s). The P-1 is equipped with RACON. The Sopot lighthouse and the North Port lighthouse in good weather conditions, can be used to maintain terrestrial navigation within viewing distance. The path is further designated by buoys P-5 Fl(2)G.10s, P-9 Fl(3)G.10s i P-13 Fl(4)G.10s and P-2 LFl.R.10s , P-6 Fl(2)R.10s, P-10 Fl(3)R.10s, P-14 Fl(4)R.10s, P-18 Fl(2)R.6s on the A strong northern current can be encountered between buoys P-1 and P-13, which is the result of wind blowing 5°B. Southern currents can be encountered between the isle breakwater and buoy P-13. At the end of the path there is an entrance turning circle 670m in diameter and 17m deep. It is surrounded by the Liquid Fuel Terminal, isle breakwater and from the south confined by the port's body of water. The next two turning circles are placed respectively: the second between the Coal, LPG and Ore Piers and a breakwater and are 670m and the third between the DCT terminal, Ore Pier and the breakwater and is 650m [BHMW 2016, 2017a, 2017b].

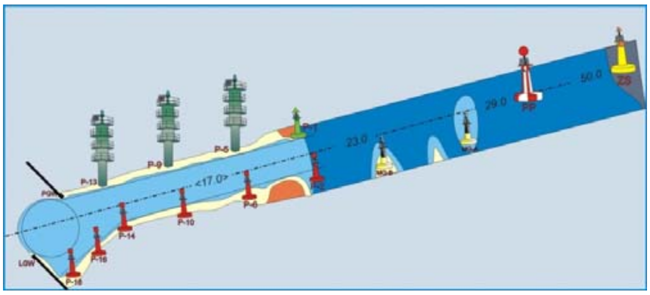

Figure 3. DCT fairway

3 THE PROCESS OF CREATION DCT T2 IN THE SIMULATOR ENVIRONMENT

Model Wizard software was used to create a virtual model of the body of water. It is an additional component in the Navi_Trainer Professional 5000 simulation software. It is comprised of two main modules [Transas Marine 2011a, 2011b]:

- Scene editor – software allowing for the creation and editing of training bodies of water
- Prototype editor – software used to create objects placed in bodies of water

In such a case, when the simulator library does not have buildings in its' database characteristic of the modelled body of water, an external 3D modelling software must be used. Any software able to generate object in the 3ds format can be used. Below, the process of creating a virtual DCT model is presented with each individual step described in detail [Czaplewski K., Zwolan P., 2016, 2018].

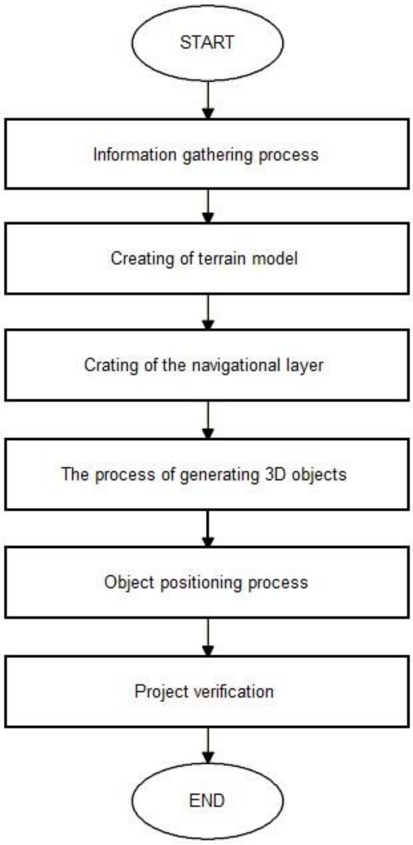

Figure 4. Process of a virtual DCT model construction

1 Information gathering comprises of creating a database of photographs, plans and maps necessary to generate an area. Photographs of objects will serve to create their virtual counterparts to make the model more realistic. Distinctive objects are also useful as reference points while manoeuvring in the port. To create the T2 terminal port development plans, ENC current map in the S-57 format were obtained and a series of photographs were made while visiting the port.
2 Creating terrain model encompasses the creation of the bathymetric and terrain layer especially focusing on port areas and the seaside landform. The basis of T2 terminal creation was an existing area with previously created T1 terminal and the most up-to-date ENC electronic map unit encompassing the Port of Gdańsk. During this stage the conversion from the S-57 format to the TX-97 format, used by the software, occurs. The process of creating a shoreline with bathymetric layer and basic signage is automatic. The next step includes putting object layer with port development plans onto the map base. It enables the molding of new quay layout and assigning the appropriate attributes pertaining to the function they will serve (mooring).

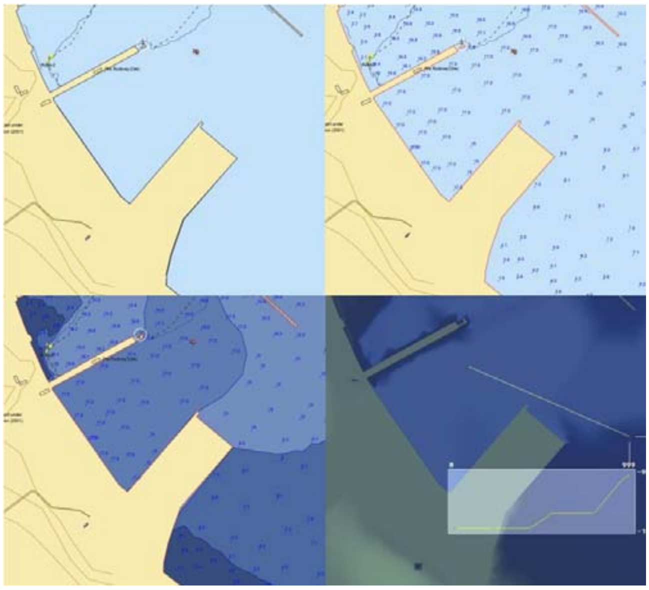

Figure 5. Creating terrain model

The last stage of this process is the verification of barometric layer and putting textures that reflect the real-life conditions onto the terrain.

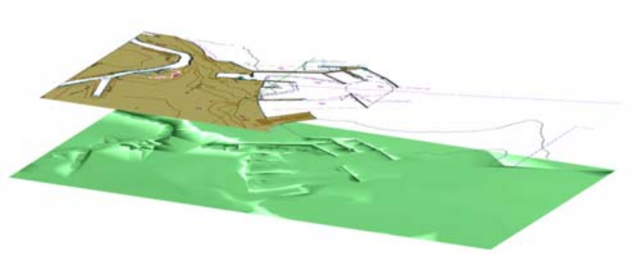

Figure 6. Verification of barometric layer

3 Crating the navigational layer comprises of entering the navigational infrastructure in accordance with the information found in official publications.

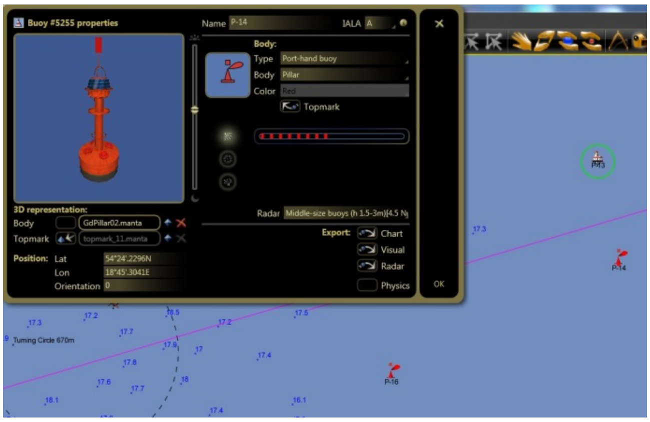

Figure 7. Crating of navigational layer

4 The process of generating objects was based on the 3D StudioMax software and Prototype Editor module. It enables generating and exporting objects in 3D in the 3ds format. Below are examples of the objects used to create the terminal model.

Figure 8. Examples of 3D objects

5 Object positioning is done by placing them based on a layout obtained from satellite photos or the knowledge of its exact coordinates. It is necessary in the case of objects of navigational importance.

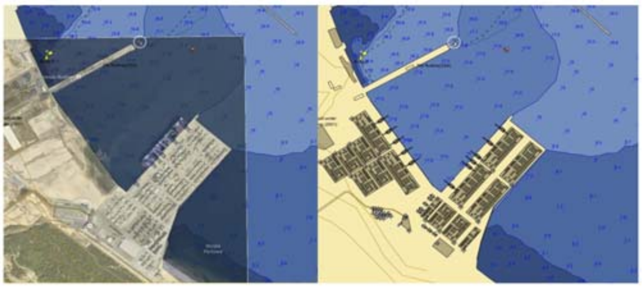

Figure 9. Object positioning process

6 Project verification is done by generating a 3D visualization.
The last stage includes generating the area in the form of a file and installing it in the simulators environment, which should be followed by a verification process, that is manoeuvring trails using a vessel.

Figure 10. DCT 3d visualization

Results of research work described in the article will be presented at the IAIN World Congress in Japan in November 2018.

4 CONCLUSIONS

Modern navigational simulators allow their widespread use not only in education. Additional modules responsible for editing virtual manoeuvring areas increase the realism of training and the reliability of research results based on simulation software. The use of outdated data makes it impossible to use the stimulator to carry out research projects and draws wrong conclusions from the course of the simulation.

REFERENCES

[1] BHMW, 2016. *Locja Bałtyku 502*, Gdynia.
[2] BHMW, 2017a. *Oznakowanie nawigacyjne – System IALA*. Gdynia.

[3] BHMW, 2017b. *Spis Świateł i Sygnałów Mgłowych 521.* Gdynia.
[4] BHMW, 2018. *Komórka ENC S-57 pl5Gdans.* Gdynia.
[5] Czaplewski, K., Zwolan, P., 2016. *A Vessel's Mathematical Model and its Real Counterpart: A Comparative Methodology Based on a Real-world Study*, Journal of Navigation vol. 69/6 2016, str. 1379–1392, ISSN: 0373-4633, London, UK
[6] Czaplewski, K., Zwolan, P., 2018. *Multicriteria Analysis Method for Evaluation of Vessel Simulation Models in Open Waters*, in printing, Journal of Navigation, London UK
[7] https://dctgdansk.pl
[8] Transas Marine, 2011a. *Navi-Trainer Pro 5000 Ship Motion Model*. Saint Petersburg, Russia
[9] Transas Marine, 2011b. *Navi-Trainer Pro 5000 Ship Mathematical Model*. Saint Petersburg, Russia