

The Environmental Effects of Projected Container Terminal to the Safely Manoeuvring

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ABSTRACT: This paper investigates vessel traffic risks that are exposed by a new port installation. A vessel traffic risk analysis was performed by the Ship Handling Simulator team for container terminal installation in Izmit Bay. The main purpose is to evaluate whether the container terminal project shall affect the proper operation of nearside Oil Refinery Terminal. Construction and revision of shore structures may form significant threats for masters in ports and narrow waterways. The Ship handling simulator of ITUMF presents the environmental objects' effects, vessel traffic and weather conditions. Furthermore, the Environmental Stress Model of Inoue (2000) may give an opportunity to analyse vessel traffic risks quantitatively by SHS.

1 INTRODUCTION

Merchant vessels reach to projected container terminal in Izmit Bay by a narrow strait (see Figure 1). Izmit Bay has over a hundred ports and terminals inside with an intensive maritime traffic. Many commercial vessels that berthing and unberthing expose a restricted and congested vessel traffic flow. The projected container terminal shall be located 18.8 miles after the Izmit Bay entrance. Petrochemical and oil refinery complex is also located 140 metres nearside the planned container terminal. A buoy mooring combination is used to handle vessel queue of oil refinery. In this respect, a conflict between the cross vessel traffic of two port establishment should be analysed quantitatively and take balance of judgement of terminals into serious consideration.

Three dimensional (3D) model of this geographic area is created by geographic position, oceanographical, meteorological and topographical structure, vessel traffic data of Petrochemical and oil refinery complex and planned container terminal. Vessel traffic and manoeuvring stresses that caused by

ports and effect safely manoeuvring, are investigated by Environmental Stress Model (ES) due to simulation applications. Environmental Stress model is widely used tool to evaluate manoeuvring results with a quantitatively way by an ability to determine indexes in order to standard limit conditions of ship handling operation. ES model was developed at "Inoue Laboratory" of Kobe University, Japan in 1995 and is revised continuously.

Current study of petrochemical and oil refinery terminal intensified to quantitative analysis of safely manoeuvring restrictions by planned container terminal in this local area that limited by refinery establishment, due to investment projects of petrochemical and oil refinery terminal to supply national demand.

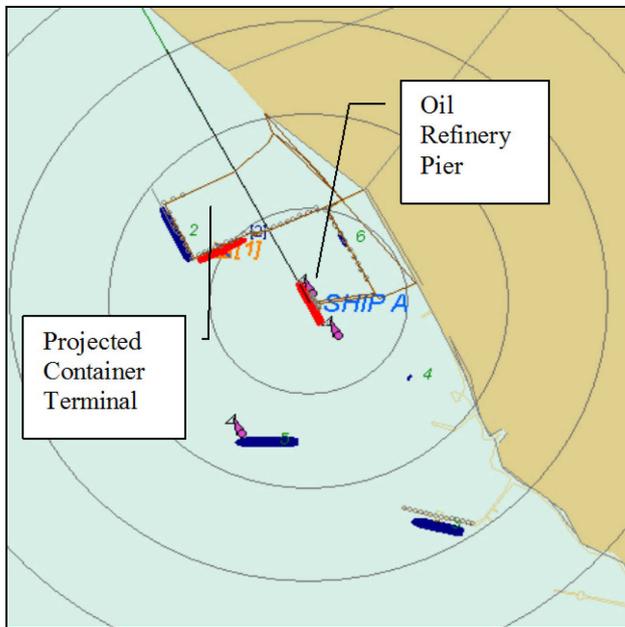


Fig. 1. Objective area of projected container terminal

The study is completed by the stages of:

- I. Data introduction of environmental conditions that included by the terminal area to the simulation system interface.
- II. Design of simulation scenarios due to port vessel traffic data.
- III. Application of scenarios in different variable conditions of weather, sea, length of vessel etc by experienced pilots of Izmit Bay in Full Mission Bridge Simulators as a Real Time Simulation process.
- IV. Output analysis on ES model that obtained from applications.
- V. Risk evaluation of ES model results.

2 METHOD

2.1 Simulation Process

Istanbul Technical University Maritime Faculty Japan Marine Science (JMS) Bridge Simulators have an ability to construct required geographic terrain by a single operator and simulate all geographic effects. Introduction of environmental data like depth, bank effect and berth equipments, meteorological and oceanographical effects are performed by an operator too. (see Table.1) For this purposes, interface software of JMS and 3D design software of Multigen Paradigm, Creator v2.0 are used for data entrance and 3D object rendering.

Table 1. Sea and weather condition at applications

Application No	Weather	Current	Wave
#1	SSW 2-3m/s	SW 0.2kt	SW 1m
#2	SSW 3.0m/s	SW 0.2kt	SW 1.4m
#3	SW 2.5m/s	SW 0.2kt	SW 1m
#4	SSW 2.5m/s	SW 0.2kt	SW 1m
#5	WSW 3m/s	SW 0.4kt	SW 1.4m
#6	SW 2-4m/s	SW 0.4kt	SW 1.4m
#7	SSW 2.5m/s	SW 0.2kt	SW 1m

Probable vessel traffic shall be generated on the simulation system that provides to analyse safely manoeuvring risks in a realistic environment. Operated vessels are 100.000 DWT Aframax Tanker, 37.000 DWT Handymax Bulker and 10.000 DWT Handysize Tanker. 5.000 GRT coaster is used inside the port. 4.000 TEU Panamax container ship is also berthed to the container terminal and mooring arrangement tests are performed to determine maximum handling weather conditions. Tug boats are taken into assistance due to scenario that have a variety of characteristics; 30 tons of bollard-pull and horse power in the range of 2500-4000.

2.2 ITUMF Full Mission Bridge Simulator System (FMBS)

ITUMF full mission bridge simulator has the latest generation equipments that can be found on a newbuild commercial vessel. FMBS provides the manoeuvring in a restricted narrow waters and operation of bridge consoles by actual equipment instruction with a real psychological circumstances. The system includes two independent cubicles; main bridge and secondary bridge that can be operated as dependent in a same scenario or independent in different scenarios.

Main bridge represents the core module of system. It has a 240 degrees view that is generated by 7 CRT projectors (wing to wing) and 360 degrees view can be provided by view point move as well. Bridge equipments that interconnected with computer based system include:

- Navigation console that formed by engine telegraph, bow & stern thrusters, water jet propeller, doppler log, steering gear, alarm panel, main engine alarm panel, emergency stops, internal communication, VHF phone, air horn and multi function monitor.
- Display panel that formed by engine revolution, speed gauge, rudder gauge, rate of turn gauge, wind speed & course monitor and ship's clock.
- Steering console.
- Gyro repeater.
- Magnetic compass.
- Radar/ ARPA.

Manoeuvring has been performed mostly with the help of the pushing tugs. A fast forward motion towards the projected pier and the anchored LPG tanker has been avoided, causing an increased but acceptable manoeuvring time (see Figure 4).

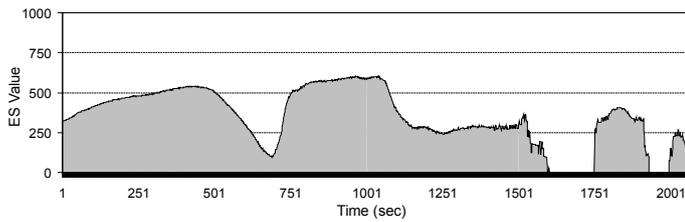


Fig. 4. ES value graphic for Application #3

Application #4: This consists of a port side docking tanker of 37,000 DWT under calm weather conditions. The obvious effect was getting too close to the ships docked alongside the planned pier on the landfill, increasing the manoeuvring risks. Non acceptable risky vessel speeds have been carefully avoided during manoeuvring. Manoeuvring area gets highly reduced under port side landing conditions because of the projected terminal (see Figure 5).

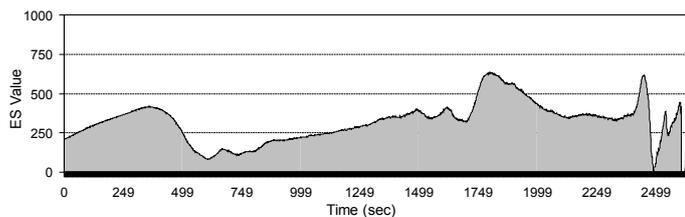


Fig. 5. ES value graphic for Application #4

Application #5: This consists of a port side docking bulk carrier of 100,000 DWT under calm weather conditions. The possible maximum landing speed has been used as a function of the container terminal location. The vessel's aft was observed to come too close to the ships docked alongside the terminal and the minimum docking time was observed to be 30 minutes (see Figure 6).

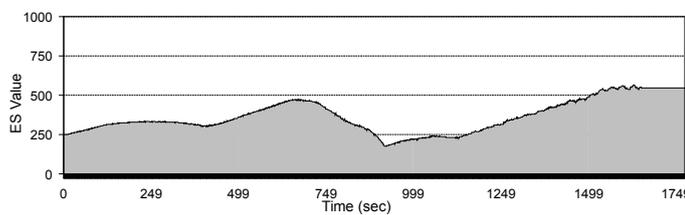


Fig. 6. ES value graphic for Application #5

Application #6: This consists of a starboard side docking tanker of 100,000 DWT under calm weather conditions. 3 tugs have been used. Docking time was observed to be 55 minutes and this should be considered as the longest estimated docking time in all simulations. The vessel speed has been greatly

reduced during docking to decrease risks (see Figure 7).

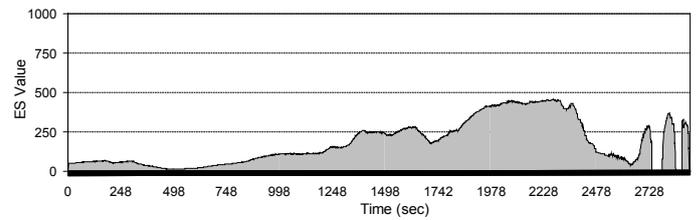


Fig. 7. ES Value graphic for Application #6

Application #7: This consists of a starboard side docking bulk carrier of 100,000 DWT under windy weather conditions. The turning radius was large and combined with the wind effects; this caused the vessel to drift on top of the pipeline marker buoys. This scenario clearly showed that at the presence of the wind and an anchored ship, starboard side docking is a high-risk operation (see Figure 8).

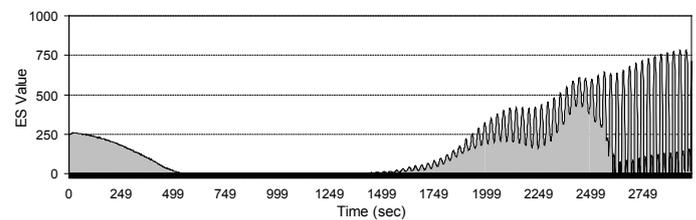


Fig. 8. ES Value graphic for Application #7

3.2 Investigation of Simulator Application. Results

3.2.1 Risk Analysis in order to Manoeuvring Difficulties

- 1 Projected container terminal restricts the manoeuvring area of tankers that berthing and unberthing to refinery piers and also other assistance like tugs.
- 2 Manoeuvring duration is determined maximum 55 minutes and minimum 30 minutes by simulation experiences.
- 3 In terms of difficulty and manoeuvring duration, starboard berthing is found less feasible than port berthing.
- 4 Applications were carried out with taking care of ship speed that expected not to excess higher risk. The case formed to keep risks at minimum.
- 5 In port berthing, nearmiss risks are found to be existed by the vessels that berthed on east piers of container terminal. Therefore, manoeuvrings are advised to be carried out in a special care on higher beaford forces.
- 6 Mooring safety of a full loaded 4000 TEU container vessel is tested on 5 m/sec. south and northeast winds. In order to mooring tests, container vessel remains on safe berth at south winds, but she loses position and takes free

movement at northeast winds. The vessel cuts the bow line at 77 minutes after the beginning of scenario and takes a dangerous case for any vessels nearside region that containing refinery terminal installations. However, if necessary measures are taken into pilotage and mooring policy, that minimizes remaining risks (see Table 3.)

3 0.6% critical levels must be reduced in any case for safety of navigation and berthing. 0.6% ratio of critical levels may not be accepted as preventable and it is seriously taken into project plan to remove.

4 CONCLUSION

A container terminal installation on a shore structure brings some additional risks in this port region. Quantitative analysis of the risks that caused by the maritime traffic is a considerable tool to measure safety and determine safety policy of the local area. Furthermore, separation of negligible or critical risks is a useful and vital opportunity for masters and pilots. Research exposed that concerned refinery terminal manoeuvres reached to 0.6% critical ratio. Critical ratio introduces risks that must be reduced mostly and it may cause an accident. 0.6% critical ratio is lower as an ordinary level that may be observed in any berth-pier combinations. Absence of catastrophic ratio indicates that there is no need to revise project.

Quantitative analysis of maritime traffic risks is an important part of emergency case plans in a waterway region. It is expected to apply for the all ports of Turkiye as well.

ACKNOWLEDGEMENT

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Table 3. Drifting records of container vessel on berth

Weather Time	3 - 4 . (5 m/s) NE Wind		
	Bow cm/s	Mid kt	Aft cm/s
30 sn	Ø	Ø	Ø
60 sn	18 ▶	Ø	◀ 6
90 sn	27 ▶	0,1 ↓	3 ▶
120 sn	46 ▶	Ø	4 ▶
150 sn	69 ▶	Ø	7 ▶
180 sn	83 ▶	Ø	9 ▶
210 sn	110 ▶	0,1 ↑	2 ▶
240 sn	122 ▶	Ø	17 ▶
270 sn	120 ▶	0,1 ↑	54 ▶
300 sn	122 ▶	0,1 ↑	58 ▶
330 sn			

3.2.2 Risk Analysis for Manoeuvres in Harbour

Risk analysis is carried out by introduction of quantitative results of simulations to ES model. The model results give some forecoming evaluations about risks that refinery installations are effected by projected container terminal manoeuvres. Environmental stresses that exposed by vessel traffic and risk measures are investigated below.

- 1 As pointed out on Figure 9, ES values are determined as 82% negligible, 17,4% marginal and 0.6% critical levels.
- 2 In spite of 82% negligible risk level, 17,4% marginal risk that means a dangerous situation may be occurred in any time, observed due to restrictions of maneuvering area. A good manner and experienced assistance should be provided for mentioned refinery terminal by masters and marine pilots. Otherwise, marginal levels can reach to unpreventable realizations.

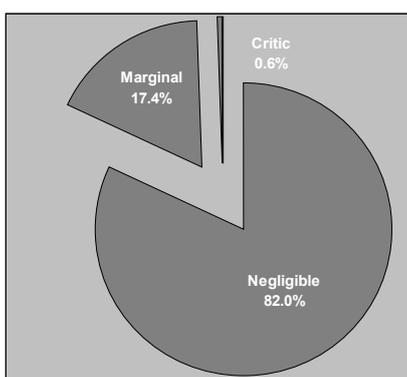


Fig. 9. Risk Distribution of ES Model