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ANALYZING A BLACK SEA NAVAL ACCIDENT THROUGH THE STAMP METHOD

NOVAC Valerian [1] & RUSU Eugen-Victor-Cristian [2]

[1] "Dunarea de Jos" University of Galati, The School for Doctoral Studies in Engineering, 111 Domneasca Street, 800201, Galati, Romania, e-mail valeryannowac@yahoo.com
[2] "Dunarea de Jos" University of Galati, The School for Doctoral Studies in Engineering, 111 Domneasca Street, 800201, Galati, Romania, e-mail evcrusu@gmail.com

Abstract: The article presents an in-depth analysis of the most significant accident ever in Constanta harbour using a method that goes beyond the chain of events that trigger an accident. In the introductory part, the authors present the features of the Black Sea basin, highlighting the eventual dangers to the ship's safety. Then the work presents the Systems Theoretic Accident Model and Process - STAMP method in brief; after that follows the modelling and analysis of the accident of You Xiu ship, and the scoop culminates with some short concluding remarks. The article serves as a base for further developments in accident analysis and an awareness instrument for scholars and practitioners regarding the general safety culture when operating a ship. Nevertheless, the work in this regard requires further research, and a comparative study using different methods and approaches should add more value to the actual efforts of the authors.
Key words: *accident, Black Sea, investigation, method, naval, STAMP*.

1. INTRODUCTION

The Black Sea basin extends amidst the southeastern part of Europe and is connected with the Marmara Sea by Bosporus Strait and the Mediterranean Sea by Dardanelles Strait. Within the north-eastern side of the Black Sea, Kerch Strait connects it with Azov Sea [1].

The sea basin is sliced by a rim located S of Crimean Peninsula in NW sub-basin defined by 100 miles wide shelves with depthless waters and a less narrow shoal in the SE half of basin hardly higher than 10 miles. The maximal value of the Black Sea depth is 2.200 m reaching S of the Crimean Peninsula [2, 3].

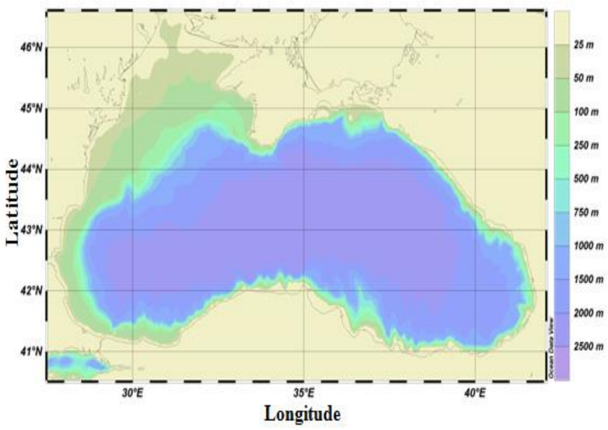

Figure 1 Black Sea bathymetry map [4, 5]

The salt content in the Black Sea is 18‰ at the surface and 22.3‰ in deeper layers. These values are reduced due to the continental river water influx (The Danube, Dnieper, Dniester, and Buh) and reduced volume exchanged with the Mediterranean Sea. It is known that there are two currents: a surface one conveying about 600 km^3/year, waters with low salinity from the Black Sea to the Mediterranean Sea, and a reverse one conveying about 300 km^3/year, Mediterranean waters with high salinity values [6].

More than 80% of global trade is conveyed by sea transport. The trend for seaborne trade was continuously ascending till 2020, when the COVID-19 pandemic containment measures seriously impacted the global economy and the seaborne trade growth decreased by 3.8%.

The global fleet's capacity is also continuously increasing despite COVID – 19 pandemic and the Russia-Ukraine conflict – 2.1 billion dwt in 2021 [1, 7].

Besides merchant fleet activity, anthropogenic activities in the Black Sea basin being a potential trigger for maritime incidents and accidents consists of industrial activities related to crude oil transport, extraction, processing, congested areas, leisure activities, bathymetry – extended shelf zone of the basin, see northwestern part of the basin.

Not at last, along with the Russia – Ukraine war that started on 24 February 2022, one more danger has arisen – sea mines. The sea mines drifting after their removal from barrages meant to protect Ukrainian Black Sea ports have become a reality, and Romanian and Turkish navies not only once had to dispatch their ships with EOD personnel to clear this danger [6, 8, 9].

The history of naval accidents in the Black Sea basin is plenty of events where cargo or route-related factors, human factors, technical factors, weather factors, organizational factors, or a mix of these led to naval

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disasters, which are still observable. At the Romanian shore (see figure 2), there were various types of accidents involving merchant or military ships sunk or damaged due to heavy weather conditions, sea mine explosion, onboard ammunition explosion, improper freight stowage, crew intentionally grounding of the ship with intention to cash the insurance [10, 11].

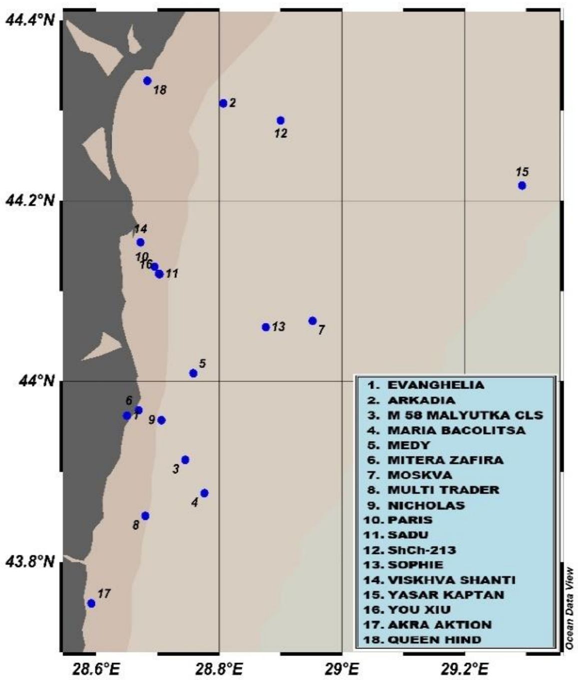

Figure 2 Wrecks along the Romanian coast of the Black Sea [5, 10, 11]

In the recent period (2019), the Black Sea was the scene of an unusual accident in the Media harbor basin when the livestock carrier Queen Hind capsized after a possible grounding when at berth. The ship was carrying 14,600 ships that died shortly after the incident. The accident was triggered by human, technical, and organizational factors [11].

Later, in 2021 another accident occurred with cargo ship Arvin, 46 years old, which broke into two parts when at anchor off the Turkey coast. The disaster concluded with the sinkage of the ship; four crew members died, six were rescued, and two were missings. In this case, the mix of technical, human, and heavy weather factors contributed to this tragedy [12].

A maritime accident is an erratic and unexpected event occurring due to an unknown means or can be an infrequent effect of a frequent cause. Accidents seriously impact marine ecosystems, property (ship and cargo), and crew life or health [11, 13-17].

Further, the article will analyze the sunk ship You Xiu case and the accident that occurred on 04.01.1995 in the outer basin of Constanta Port during a heavy and utterly unusual storm [18].

2. METHODOLOGY

This article section presents the primary data regarding the accident and the STAMP features.

Table 1. Details of wrecks resulted from naval accidents [10, 11, 13]

No	Ship name and type	Year of accident and cause
1.	Evanghelia	1968
	Cargo	Grounded by own crew
2.	Arkadia	1945
	Cargo	Mine explosion
3.	M 58 Malyutka cls	1941
	Submarine	Own torpedoes explosion
4.	Maria Bacolitsa	1980
	Bulk carrier	Unknown
5.	Medy	2010
	Cargo	Heeling then sunk (unknown)
6.	Mitera Zafira	1973
	Cargo	Grounding then fire
7.	Moskva	1941
	Destroyer	Mine explosion
8.	Multi Trader	2007
	Cargo	Cargo unbalanced
9.	Nicholas	1920
	Cargo	Mine explosion
10.	Paris	1995
	Bulk carrier	Heavy storm
11.	Sadu	1988
	General cargo	Heavy storm
12.	Shch-213	1942
	Submarine	Mine explosion
13.	Sophie	1921
	Cargo	Mine explosion
14.	Viskhva Shanti	1968
	Cargo	Heavy storm
15.	Yasar Kaptan	2001
	Cargo	Engine room flooding
16.	You Xiu	1995
	Bulk carrier	Heavy storm
17.	Akra Aktion	1981
	Cargo	Heavy storm
18.	Queen Hind	2019
	Livestock carrier	Grounded, overloaded, capsized

2.1 Storyboard of the accident

The bulk carrier ship You Xiu was built in 1992 in Japan and had a crew of 27 mates, a displacement of 26,802 dwt, and a maximum length of 167.2 m.

The ship arrived in the outer basin of Constanta Port on 28.10.1994, waiting at anchor to load 20,000 tons of urea.

03.01.1995 – Port authorities issue a storm warning message to all ships at 13.00LT;

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04.01.1995 09.00LT - Port authorities issue a new storm warning message to all ships and instruct all of them to enter the inner basin of the port or to start moving to the open sea – You Xiu and Paris disobey the orders;

04.01.1995 17.00LT - Port Control instructs You Xiu to change the anchorage place being too close to the Paris ship (0.6 nautical miles) and issue a new storm warning message to all ships;

04.01.1995 18.00LT - You Xiu at 1.9 nautical miles from the northern breakwater of the Constanta Port;

04.01.1995 18.10LT – Port Control instructs You Xiu to start moving to the open sea, but the ship reports a defective main engine;

04.01.1995 18.30LT - You Xiu at 0.9 nautical miles from the northern breakwater of the Constanta Port. Port Control warn the ship regarding its drift;

04.01.1995 18.40LT - You Xiu at 1.25 nautical miles from the northern breakwater of the Constanta Port. Port Control warns the ship regarding its position and drift;

04.01.1995 18.45LT - You Xiu at 0.3 nautical miles from the northern breakwater of the Constanta Port. Port Control warn the ship regarding its position and drift and recommend them to request assistance;

04.01.1995 20.20LT – You Xiu launches first S.O.S signal;

04.01.1995 20.25LT – the shipping agent informs Port Control that the engine room is taking water and the crew no longer obeys the captain's orders;

04.01.1995 20.50LT – the rescue tug Viteazul reached the end of the northern breakwater and reported that is not able to leave the port due to high seas;

04.01.1995 21.13LT – You Xiu informs Port Control that the ship is taking water;

04.01.1995 21.13LT – You Xiu informs Port Control that the ship is listing and sinking;

04.01.1995 21.13LT – the You Xiu captain inform Port Control that the ship is broken and sinking and request assistance;

05.01.1995 00.30LT – the rescue tug Viteazu informs Port Control that it can see only You Xiu mast and no survivors.

The accident resulted was the loss of the ship and the lives of all 27 crew members because of the late decisions of the captain to obey instructions given by the port authorities to ask for assistance.

Despite the actions taken by port authorities to support You Xiu and another ship – Paris, in a similar situation, due to adverse weather conditions: wind of 31 m/s, waves 10 – 11 m in height, and abysmal visibility, the disaster has happened, and the two ships were lost, and 54 sailors lost their lives [18 - 21].

2.2 STAMP method features

There are many methods to investigate incidents, accidents, or safety events like equipment malfunctions, but most focus on the cause that triggers the effect or the chain of events that eventually lead to an accident.

The Systems Theoretic Accident Model and Process – STAMP approach is not merely assumed that for every because we have an effect but focuses on the system.

This predictive method iterates the system from top to bottom, increasing precision and going deeply into a more detailed analysis with every iteration.

The method also models the links and relationships between all stakeholders in the event.

Broadly we can consider the model of STAMP considering the following:

- the response for a requirement – action mandatory but not executed as directed;
- unsafe act occurrence;
- incorrect order/command or time;
- duration of actions – too long or too short [22 - 25].

For our model, we will establish the following levels of hierarchy:

- the regulatory framework – including authorities;
- the ship management company;
- the crew and ship.

In the next section, it is analysed all intricacies and links between all stakeholders and their actions.

3. RESULTS AND DISCUSSION

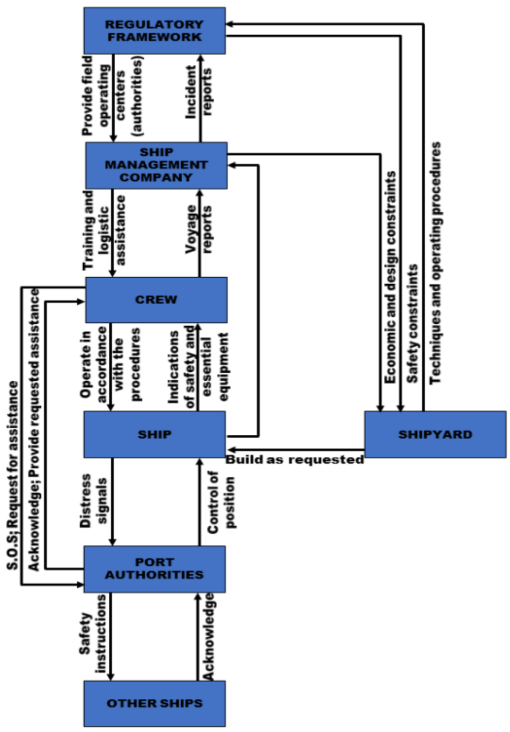

Figure 3 STAMP model of the accident – author work after [23]

It is evident from the storyboard of the accident that the ship was almost new and created following the requirements of the international conventions applicable at that time.

The crew training and organizational culture are questionable as they failed to comply with Port Control instructions and even, at one tense point, refused to obey the captain's orders. The captain decided to comply with Port Control instructions very late when the situation went out of control.

Despite their synergic actions, the port authorities were unable to send any actionable means of support to reach the incident scene and provide the minimum of assistance [21].

On top of all controls, actions, and decisions, the weather factor was crucial for this tragic event.

4. CONCLUSIONS

The accident trigger is well established and consists of a mix of factors ranging from highly adverse weather, failure of compliance with Port Control instructions, or the lack of capable means of salvage and rescue at port authorities' disposition.

In order to avoid such events in the future is highly requested to provide port authorities with capable means for almost all weather or environmental conditions, including modern uncrewed vehicles.

Besides, adequate means of intervention at the Port Authority level must be operating a response cell comprising all stakeholders able, by any means, to support the intervention and further the accident relief actions.

Not, at last, the Port Authority must have the adequate means, both procedural and actional, to enforce their instructions onboard the ships in the port where they are responsible.

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