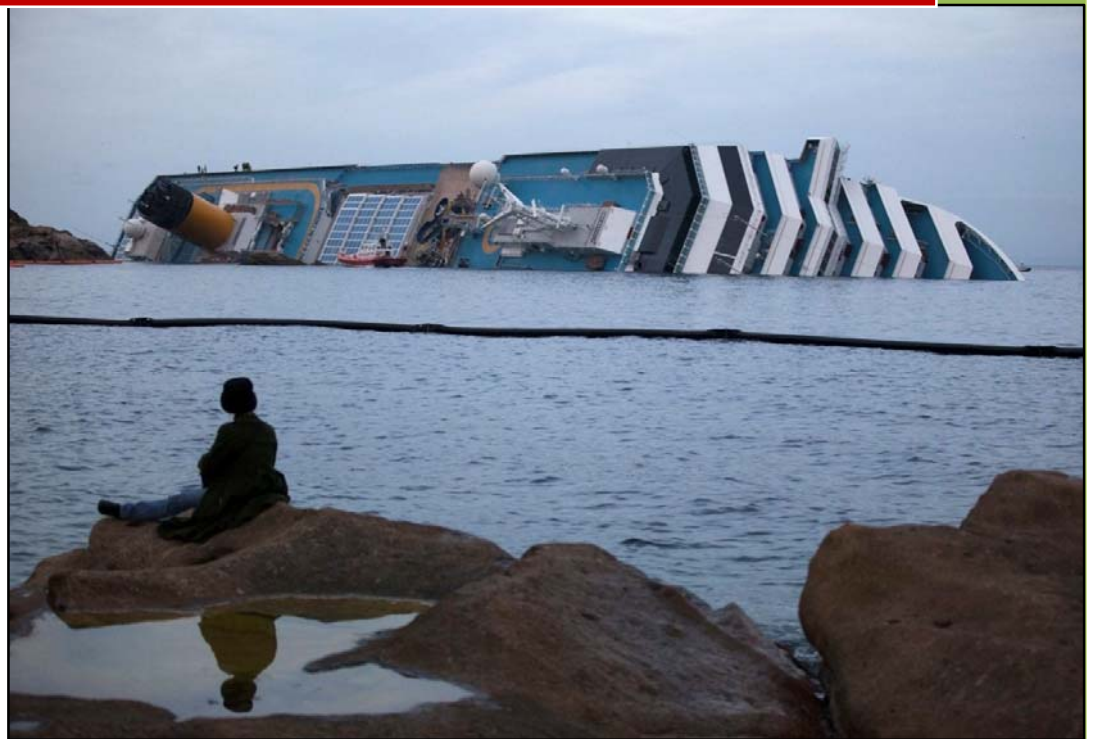


# TRIPOD thoughts after COSTA CONCORDIA Accident



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## The Cruise Shipping Business

Cruise ships undoubtedly house a high-risk organisation within the magnitude of their hull. This is the reason that led Charles Perrow to include Maritime operations, among the top risk business activities, into his book “Normal Accidents” back in 1984. That reality did not seem to have put cruise shipping into a trap; on the contrary, “sea tourism model” remains a thriving industry, especially during those recent years, in which it incessantly strengthened its global presence. This year’s (2018) forecasting for passenger population globally choosing a cruise for their holidays speaks of 26.0 million customers, while the overall annual growth rate since 1980 was found to be 7, 1%. However, reality is that during the previous years, those being characterised as belonging to the era of International financial crisis, growth curve presented signs of fatigue.

In 2018 and into the following year, 15 new ships are expected to enter in service, representing a total capital investment of \$6, 2 billion. Contemporary cruise ship models rely on improved technology to lower the cost on on-board communications and provide more efficient passenger service. Simultaneously the tonnage is growing to offer more luxury and ships resemble less with buoyant structures and more with floating huge hotels that offer an increasing number of amenities.

Prior to the known accident ,Costa Concordia was definitely included among the most luxurious ambassadors of cruise shipping, although its name finally left 4062 souls with a terrible story to remember and 32 passengers lost forever, near Giglio Island in Italy, back in January 2012.

After the accident, an excessive number of articles had overwhelmed public opinion, with bad thoughts and feelings against the sole person to whom blame had been apportioned, that of the ship Master. Captain Schettino had been found guilty and

sentenced to 16 years prison, for his role in the deadly 2012 shipwreck. Not to forget that in the eyes of public opinion, mass media made him look like grave a criminal, although he kept saying that he regarded himself as the “ideal scapegoat” of this disaster.

### The Costa Concordia Official Investigation

The official accident report, which had been released by the Italian Ministry of Infrastructure and Transport to analyze the accident, is full of “facts” that had been used by the investigators to demonstrate the “guilty intentions” of the shipmaster that had led to the accident. Within the 176 pages of it, the reader realizes that “Humans perform either safely or unsafely”, an axiom in line with a just “Person” model of managing Safety, as causes of the sinking of Costa Concordia, truly lie among human errant actions mostly of its master, according to the authors of the report. It had been evident that her Captain had chosen the unsafe behavior pattern and no one could have stopped him.

Apart from perhaps making it easier for justice to separate victims from culprits for its mandate, the previous report did not shed the necessary light to the infinite “whys”, “how”, “when” that might had explained the Captain’s fallibility, based perhaps on misalignment of human interface and machinery. On such an occasion Maritime stakeholders would have been much happier, since then they could definitely have been in a position to better understand the accident under “an engineering doctrine” of managing Safety, which could have ended with the formation of a wide array of causes for remedy, for future use.

### The Need for another Investigation Analysis

For those who under those terms do not feel happy with the explanations that were given and would like to test the existing rational paths and analyze the accident via a thinking out of the box approach that could invest into more efforts to explain the

shipmaster's fallibility, it is evident that another accident analysis approach is needed.

Those are exactly the intentions of this marketing edition paper, to present a TRIPOD Accident Analysis within Maritime Environment not in full extent though, with the Costa Concordia Accident as the case study and concurrently to intrigue readers as much as possible.

Contrary to any swaying belief suggesting that, perhaps, Cruise shipping may have vested interests opposing an official accident investigation report from releasing underlying causes of the accident, as those may inflict severe financial burden on the ship-owners, the author of this paper totally disagrees.

It is a widespread truth that, whenever a high scale accident occurs, within a high reliability organisation, like Costa Crociere, infinite troubles arise. After the loss of Costa Concordia the company entered in turmoil, suffering from financial losses, related with either immediate loss of business market share, or of an immediate noticeable decrease of its stock exchange market value, altogether with the need to take over further expenditures related to salvage costs, compensation packages and infinite similar excuses. Evidently, apart from financial burden Costa Crociere has had to also handle the impact of the accident, over its image in the market, as this is what happens after grave accidents. Organisations suffering from it undoubtedly capture a big portion of public interest over their performance that lasts for long periods. All signs after Costa Concordia accident were in favor of an organisation under crisis with limited time to plan its revival and earning back its sound operation tribute. Respectively high-risk entities, in Maritime also, after facing an accident, put their perseverance at stake.

It might seem convenient that a shipmaster hold the blame in all accidents and be put in jail but this cannot decrease accident rates. Reality is that Carnival - during the last years of its operation, prior to the Costa Concordia's sinking outside Giglio

island waters-have had consecutively signs of a negatively challenging accident rate record in its fleet. A series of incidents or other accidents (e.g. Deliziosa, Splendor, Fascination, and Europa) were revealing that, the company has had difficulties in coping with the “accident messages” interpretation, after suffering from every accident on board its ships.

Answers that might have explained that unpleasant safety performance could be given only by dealing with the problem under different a viewpoint. Maritime Industry belongs to a high-risk spectrum of making business, which leaves its entities with not many options to deal with safety. Undeniably as irrational, it might seem that Costa Concordia’s Master had lost his mind and had led his ship aground, it is even more difficult to accept that Carnival for instance is running a tremendous financial project, to operate within such a risky business environment, without taking account of all aspects of safety performance and accident prevention.

What is questionable though is if the ship-owner of Costa Concordia had managed to reach the most contemporary means to fortify safety. Contemporary Safety Management options could perhaps be identified by either examining existing categorization of accident causation theories that entail the accuracy and the sophistication of the methodology for investigation or otherwise by endorsing the latest safety managerial approach. The first selection is picked by endorsing the latest accident causation theory period academically available, that of “Safety Culture”, by fully accepting its axioms that human beings form teams, create relationships among them and also carry common characteristics that need to be studied and managed, since all those play a substantially important role in safety management and performance.

On the other hand, in case safety is decided to be managed under a businesswise standpoint, Maritime Industry, at the end, should have reached the “Organisation

Model” of dealing with safety, the one that views human error as consequences, not as causes Reason (1997).

Both proposed ways of dealing with safety lead to similar results and are honed in similar axioms. I wonder though who could have accused any entity operating within the Maritime Industry, of not earlier endorsing the latest best practices in dealing with accident prevention and safety, as far as a public Organisation, responsible to “point the way” on the latest developments for completing investigations, still applies an approach from the human error period; the era that is characterized by a straightforward accusation of persons at the sharp end of the accident. The latter is proven by the way that reports, and announcements had been made apportioning blame and the primary failure cause of the accident to humans.

TRIPOD methodology on the other hand positively contributes pretty much to a systemic approach in dealing with accidents and thus enhances the safety performance of total risk management system, with additional features that delve into the safety culture segment of the involved into the accident Organisations (the stakeholders).

### **Tripod Incident Analysis Methodology**

Accidents or Incidents are unpleasant events of a kind that no one wishes to continue speaking about, after they had occurred. In High Risk Entities at least, there is a growing tension of investigators struggling to uncover real and latent “Causes” that had led to them. The primary reason for doing so had always been the need of human nature to move further down rather than just continuing picking up the easy selection, that of casting blame upon the most obvious victims, instead of bringing over the catharsis, by letting fresh air come in, from new concepts and new investigation methodologies.

## **What is the TRIPOD Incident& Accident Analysis Methodology?**

The birth of the “Safety Culture” era - and its dominance over the previous “Socio-technical Period” in accident causation- forever altered the prevailing axioms that drive accident investigation. In Safety Culture Era, it is a given that people tend to form teams and share common characteristics that play a substantially important role into the way accidents are created; thus investigation should move down to Organisational issues rather than just apportion blame to certain individuals.

Tripod beta methodology delves into the new advents and fresh tools segment, which aims at pinpointing and analyzing the reasons for failure of a Barrier, via the application of the Human Behaviour model. That is why this Analysis not only looks at what caused the sequence of events in an incident, that is the sequence of events themselves, how the incident happened, but also which Barriers had failed or been missing.

The most important factor under examination is the reason why those Barriers had failed and the reasons that support the non-action or faulty action of the person at the sharp end of the accident.

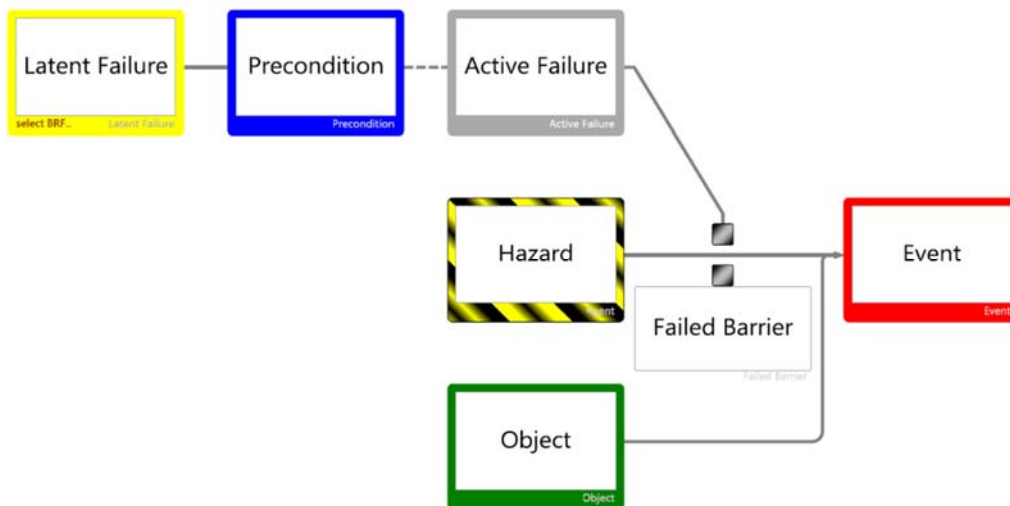
The construction of a “tree” diagram forms a graph representation of the incident mechanism, which describes the events and their relationships. The event in a TRIPOD Beta Diagram is the result of the Hazard acting upon an Object. A Barrier is something that is put in place to prevent the meeting of an object and a hazard.

When such a Barrier fails, a causation path is created to explain how and why this happened. The TRIPOD Beta method presupposes that incidents are caused by human error, which can be prevented by controlling the working Environment. The Causation path displays this by starting with the Active Failure of the Barrier, then

it investigates under what Preconditions or in what contextual state this happened and finishes up by identifying the Underlying Causes that had led to the Accident.

By delving into the “Preconditions” World “emitting” after the accident, investigators have the opportunity to broaden their knowledge about the Safety Culture segment of the Organisations involved into it and reliably identify both Behavior Norms and Shared Values that dictated the established patterns of actions which have driven the Causes of Accident.

The aim of TRIPOD Beta is not only to uncover the hidden deficiencies in an Organisation and the Latent Failures or Underlying Causes but also to offer a solid starting point to depict all subsequent changes that need to be infused into existing Organisational Cultures that had suffered from the accident. Those flaws are classified into eleven Basic Risk Factors (BRFs) categories that represent distinctive areas of management activity, where the solution of the problem lies. All the items of the TRIPOD Diagram are shown below:





## **Benefits from the Application of TRIPOD Methodology**

TRIPOD BETA is a technique that depicts into an A3 paper sheet the plot of the accident in TRIPOD terms, using up to five different TRIPODS, clearly showing all barriers that either failed or were never thought to be in place, forming the holes of the Swiss cheese slices. Most importantly, it also includes all preconditions, “the excuses of victims at the sharp end” of the accident and explains the reasons why these holes were made.

Tripod Beta Methodology assists investigators:

- To easily structure an investigation,
- To more effectively brainstorm and share ideas
- To distinguish all relevant facts
- To elaborate on causes and effects
- To alleviate the report writing task
- To increase the quality of corrective actions-recommendations
- Most importantly, to provide the Organisation with the opportunity to create a link between previous Risk Analysis and accident aftermaths that profoundly assist the creation of a Learning Organisation.

## **THE COSTA CONCORDIA ACCIDENT**

Just a few minutes after midnight on January 14 2012, it became blatant for experts that a delayed abandon ship signal and a “late” heard general emergency alarm on board a listing ship would definitely lead to a number of casualties among the crew and passengers of Costa Concordia. Therefore, there was not much left to be done to effectively protect the aggregate of “Our Object”, (Passengers & Seafarers) on

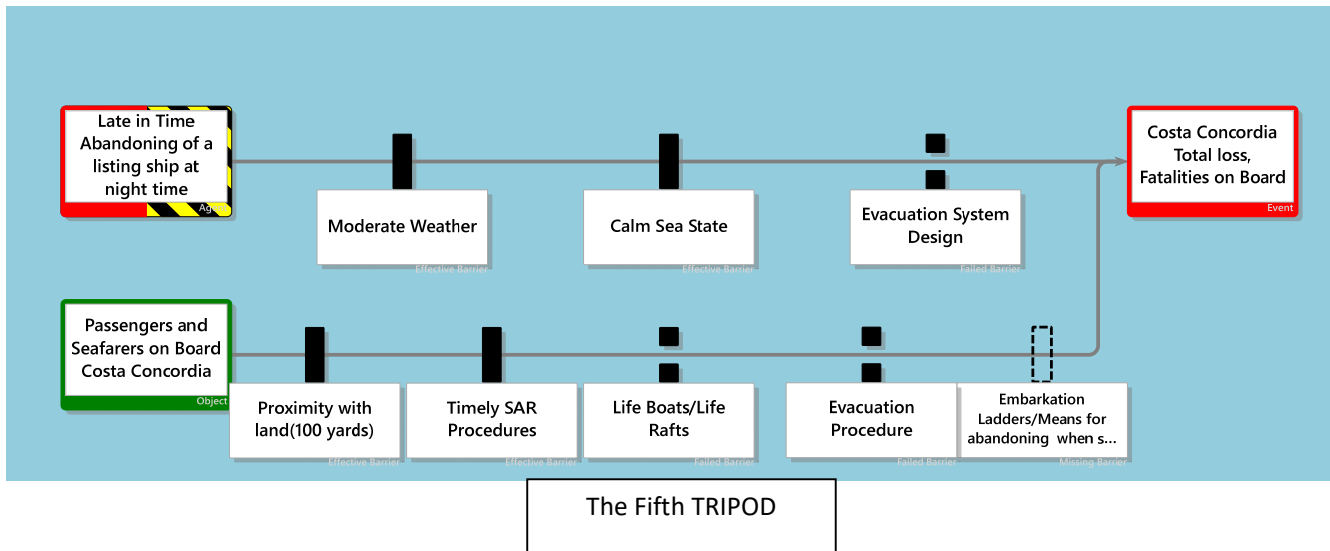
board Costa Concordia from fatalities, which was the subsequent event after the action of the hazardous Change Agent (Delayed Abandoning of a sinking and listing ship at night) on the torn apart by a long gash hull of the cruise ship.

In commencing a TRIPOD Beta Investigation, it is important to be able to create “trios”, Tripods, which are formed by three elements. The Object has the potential to “receive” change from the change agent, most of the times unwanted, which if not guarded by “Barriers” ready to be proven effective, the outcome will definitely be catastrophic. The Investigation that follows an accident aims at Barriers identification that are afterwards categorized, either as “Failed” ,“Missing” or “Effective”, the latter if only they succeeded in stopping the accident sequence .

Missing Barriers require enormous changes and consume time, from an increased number of involved entities so as to be counteracted , while Failed Barriers are easier for mitigation.

### **Building the TRIPOD Beta Tree for Costa Concordia Accident**

Accident investigation with TRIPOD Beta methodology always begins with the construction of the last TRIPOD (the fifth in our case) as the investigation with that method may include up to five TRIPODS (trios).



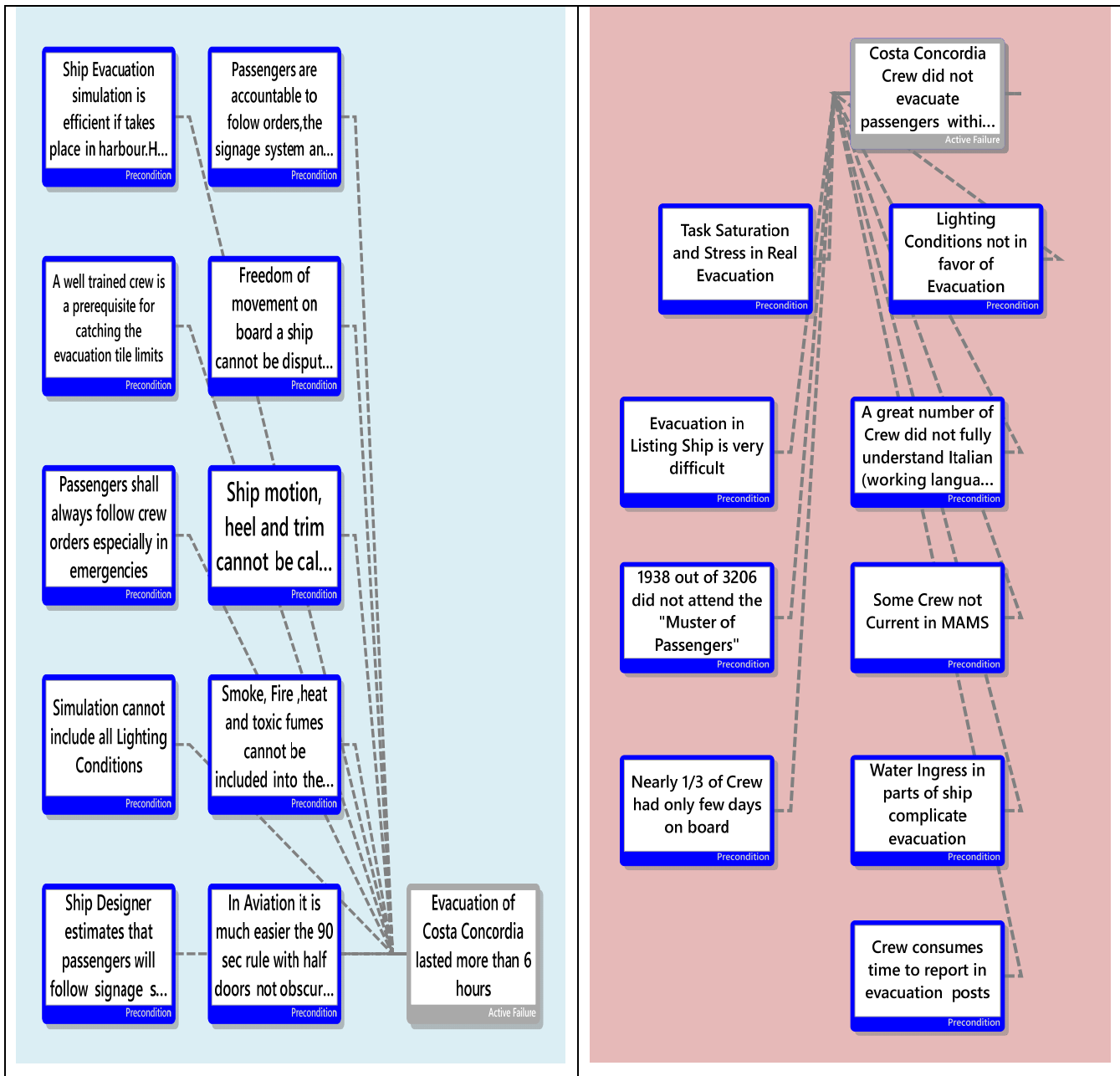
More than five trios are not manageable. Investigators begin the construction of the analysis starting from the last unpleasant outcome building a backwards time sequence (last Tripod which always comes first into the accident analysis while accident analysis continues by going back in time , normally with time selections increasing in time intervals so that analysis obtains a strategic expectancy and includes as many organisational issues as possible.

In the occasion of the Costa Concordia, accident investigators realized that the maritime Industry, after the initiation of the Evacuation process, was found in front of an MRO (Mass Rescue Operation). Undoubtedly, the results had been much better in protecting people’s lives, as, luckily, weather conditions were in favor of a mass SAR operation and additionally both the proximity with land and the SAR speedy response resulted in the saving of most of the people on board (All effective barriers). On the other hand, it seems that the Evacuation System design of Costa Concordia had failed as more than 5 hours had lapsed after the abandon signal release and still people were remaining on board. Much had been said even in the accident analysis on the official accident report about the chaos during evacuation and the non-role of the Costa Concordia crew in terms of effectively acting as a team in assisting passengers evacuating the ship. That is why the evacuation procedure had failed. The two failed barriers, those under the same title “evacuation” might seem close but the

one refers to the capability of the ship design provided to a nominal efficient crew to catch the 80 minutes rule (Msc Circ1238-Msc.1/Circ.1533) while the second is related to the specific actions and possibly errors of Costa Concordia crew. On the first occasion, the active failure had been the fact that evacuation took more than 6 hours to come to an end. On the second occasion, the active failure is obvious. Costa Concordia crew failed to succeed in the 80 minutes rule. Something worth investigating.

Preconditions as shown below present hypothetically the excuses, the thoughts of the Ship Designer that prevented him/her from earlier thinking and acting differently while designing the ship. On the other hand, again hypothetically in the right corner are the excuses of the crew and even perhaps of the ship master explaining the reasons why evacuation ended in horror. Something that we may need to include into our thinking is “Does the naval architect possess all necessary knowledge, especially in the area of human factors issues, to design such a huge ship?” The intentions of the author of the paper are to create discussions on the need for naval architects and engineers in general to include into their thinking more human factors related training and more coherently learn from older accidents, in case they concur to this idea.

Reality is that preconditions, when used, in our occasion by the ship designer for instance and the Ship Master and Crew, portray a still existing way of thinking, so they mirror not only beliefs and principles but also values; in other words the Safety Culture of Organisations involved into this accident. It is for the Maritime Industry as a whole to decide if those events and facts represent what they were expecting from their employees. The aim should be preconditions not to seem as believable excuses, something easy to accept; instead, involved Organisations shall work to change the working environment, so that agents at the sharp end will not easily find same logical excuses. Human fallibility is known so the only thing that can change is the working environment.



Active Failure-Preconditions of Failed Barriers “Evacuation”

After the accident, the investigation had brought in place Msc.1/Circ. 1533 and our role is to consider the number of preconditions that had already been addressed with the ideas included into this latter Circ. It is very important for new measures to deduct preconditions from sounding as sensible when used as excuses in the future. Otherwise, the Safety Management System still stays vulnerable and we need only wait for the new accident. Older accidents and the cost they inflict upon maritime

industry open up learning paths. Still it is laid upon the shoulders of the maritime industry management teams to learn well.

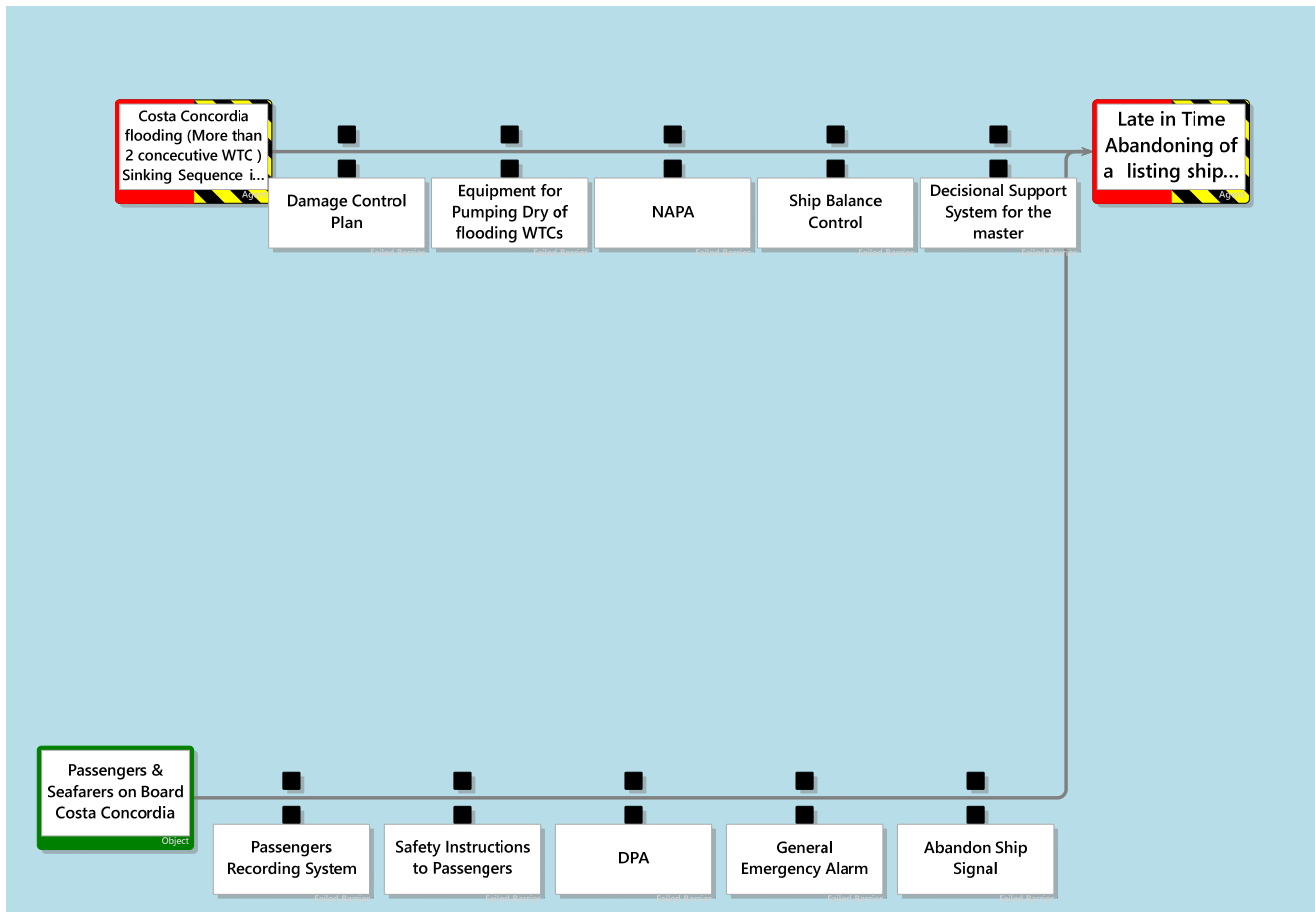
### **The Fourth TRIPOD (The Captain Schettino's Role)**

In Aviation, Flight Crews spend much of their time training for emergencies. It is believed that when they do so they get ready to effectively react when it is needed. Pilots in Command (Captains) still maintain their important role but there are a number of years now that the industry believes in the need for synchronization into teamwork, so regulatory authorities did mandate Crew Resource management initial and recurrent training to solving task saturation issues especially during emergencies.

In Maritime environment, however, you can still find perceptions of the ship master role, as the one below, expressing still a number of people concurring to its reality. “Yesterday’s master had authority to abuse. Today’s master has hardly got any authority to use for the responsibility he has got”. The phrase had been attributed to an unknown pilot and it is referring to the extent of control of the ship-owner to give him frequent and detailed instructions via the existing communications systems on board the ship.

It is evident that when more than 2 consecutive WTCs flooded during that awful January night the Costa Concordia sinking sequence had begun. The investigation shows a number of barriers that had failed but public paid more attention to the failure of the shipmaster to order an in time general emergency alarm.

The question that has not been efficiently answered yet is “How effective will our Safety Management System turn in if we only contribute failures to humans?”



The Fourth TRIPOD

The official accident investigation report characterizes the master’s attitude as “arbitrary” in reviewing the initial navigation plan (page 6 of the report) and focuses on his behaviour to decide making that hazardous passage in swallow waters. History later proved that his decision to delay the general emergency alarm definitely hindered the evacuation process and its positive outcomes. Still it does not seem that anyone had asked Captain Schettino all the Whys. All those whys which would have been his excuses for the Barrier he was held responsible, to sound the general emergency alarm on time; which were the thoughts that had prevented him from acting the way he was supposed to?

The next question is “Are the ship owners happy with his performance?” What is the cost of his decisions to them?”

On the occasion that Industry as an aggregate does not support his decisions and his behaviour, the most important task they need fulfil is asking him all the questions that were missing in the official report. Normally people do something differently when they are certain that their specific behaviour will lead to praising.

Human beings, according to the human behaviour theory, seek recognition for their actions instead of reprimanding, so perhaps it is worthy further analysing Captain's intentions for his actions.

I wonder how many would disagree with him when he might hypothetically say that "I could not have believed what I was living". "What would be the future for me in my career?" Does a person under this pressure can react well during an emergency? Is the training he received efficient to assist him overcoming the difficult situation? The difference during an accident in Maritime environment in comparison with Aviation is that the agent at the sharp end of the accident (in our case Captain Schettino) had so much time to think and portray his future in front of his eyes. On the contrary, in Aviation environment, time is such a limiting factor so it is much easier for pilots to do their best with saving at least as many lives as possible. What could we say about the legal constraints that any captain faces before he orders "abandon ship?" How easily can he/she do that while similarly he/she thinks of current salvage legislation?

As the official report presents a person who deliberately misbehaved, who else could have taken an initiative to change the root of this accident? Bridge Resource Management is not that old established a practice. Is it anything more that maritime Industry would like to propose for correcting a problem with misbehaviour even of the Captain on-board? Captain Schettino would have declared, "I had never had a Bridge Resource Management training so I could never understand its use". Who could answer back to this argument?