# An Actor-Network Theory Analysis of the OceanGate Submersible Implosion

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis- Related Assignments.

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## Introduction

**“**People are so enthralled with Titanic,” OceanGate’s founder, Stockton Rush, told a BBC documentary crew last year. “I read an article that said there are three words in the English language that are known throughout the planet. And that’s ‘Coca-Cola,’ ‘God,’ and ‘Titanic.’”(Taub, 2023) . The Titanic was the largest and most luxurious passenger ship of its time that sank in 1912 and cost the lives of over 1,500 passengers on board (*R.M.S Titanic - History and Significance*, n.d.). Since the incident, the world has always been intrigued by the story and sunken ship as a whole.

The OceanGate, founded in 2009, offered tourists the opportunity to travel on submersibles into the ocean's depths for a close-up look at shipwrecks and underwater canyons. On June 18, 2023, the submersible Titan, operated by OceanGate, imploded during an expedition to view the Titanic's wreck in the North Atlantic Ocean, near Newfoundland, Canada. The remnants of the missing OceanGate submersible, including the tail cone, were found on the ocean floor about 1,600 feet from the bow of the wrecked Titanic on June 22, 2023 (Deliso, 2023). The incident resulted in the deaths of all onboard passengers and has led to widespread speculation about the cause, with potential factors including inadequate design, insufficient testing, and the use of carbon fiber as a structural material.

There are many interpretations on who is to blame regarding the implosion. Most blame the poor materials used or blame the actual engineers who built the submersible like author Jack Huang (Huang, 2023). Others blame the OceanGate company and even the passengers on board, including author Ben Taub (Taub, 2023) . While many love to point fingers at who was at fault for the incident, authors fail to realize the multiple moving parts that collectively played a role in the implosion.

I claim that not only were their social actors at fault for the implosion, but also technical actors at fault. Drawing upon the Actor-Network Theory, I argue that the failures of this submersible can be attributed to the interplay between different actors such as the Ocean Gate employees, bad engineering design, and lack of regulatory oversight. To relate to similar authors that have discussed the possible cause of the implosion, my claim intertwines both viewpoints and unpacks why it was not just a technical issue or only a social issue, but it was a composition of both. It is important to understand the concept of all actors being at fault because it yields greater accountability and can address all faults for future designs.

**Literature Review**

A wealth of research analyzes the root causes of the OceanGate accident. These analyses typically focus on the vast, systematic, and technical failures of how the submersible imploded as opposed to the social and political failures that ultimately caused the implosion. When both sides of the story are addressed at the root cause, it is clear that both the technical and the political elements work hand and hand to impact the tragic accident.

Multiple articles have been written and interviews have been conducted spotlighting various viewpoints on what caused the implosion of the submersible. From my developed research, there has not been a source of information advocating for all actors equally being the reason why the submersible did not succeed. Rather, most have taken a single-issue approach to the topic.Jack Huang argues that the technical aspects , specifically the failure of having a "fail-safe" system implemented into the engineering design of the submersible, was the main reason why Titan imploded, causing the death of the five passengers. A "fail-safe" system is a design that is implemented in the technical object being developed to where if the technical

object is not performing successfully, then the design will ensure the safety of passengers as well as the technical object itself (Huang, 2023). This system is conducted thoroughly to examine failure situations and recommend safety design and procedures. Huang claims that if this fail-safe system was implemented in the design then the submersible would not have imploded and that the passengers would have still been alive today.

To contrast, Ben Taub argues that the social aspects, specifically the inaccuracy of people and companies contributing and then later dropping in reflection of how people such as Rob McCallum and Stockton Rush, the CEO and co-founder of Oceangate, wanted to "speed up" the process of designing and building. For example, Taub emphasizes that University of Washington's Applied Physics Laboratory who helped OceanGate during the first submarine model, Cyclops I, suddenly discontinued their aid to the project later on after McCallums, Rush, and others had more ideas for the submarine (Taub, 2023).

Both views are similar in that the designing process as a whole played a part in the disaster, Taub and Huang fail to realize that their reasons are inadequate without each other. Without trusted and loyal contributors, design methods will differentiate overtime and eventually not implement important safety tactics such as the "fail-safe" system. My argument for holding all social, conceptual, and technical actors accountable will advance the understanding of the failure of the submersible by addressing the shortcomings of the actors and their specifics.

**Conceptual Framework**

To frame my analysis, I will draw upon the STS concept of actor-network theory (ANT). Developed by Michel Callon, Bruno Latour, and John Law. ANT provides a means to describe and analyze the complex interrelationships and interactions among multiple human and

non-human actors. The theory claims that all technical projects are made up of these human and non-human actors in a network that helps achieve a particular goal (Cressman, 2009).

A network builder identifies a problem or the goal and the actors needed to solve or accomplish it. The network builder recruits actors to join the network by translating and realigning their interests to serve those of the network. The network builder also assigns roles to actors, which perform as scripted. Regarding this theory, there is power in networks. There is no single actor in a network that is more powerful, important, or influential than others (got this from slides). A technology network is a system of diverse resources or "actors" associated together by a network builder for a common purpose.

To examine such a network, I will draw on the STS framework of actor-network theory (ANT) to analyze the failure of the OceanGate submersible that was designed to tour the Titanic but imploded due to a combination of technical, social, conceptual, and economic factors. In particular, I will investigate how interactions among technical and social factors such as poor engineering designs as well as the uncertified OceanGate employees and political incorporation contributed to the submersibles failure.

**Analysis**

Current opinions indicate singular causes for the failure of the submarine such as poor engineering, OceanGate employees, poor quality testing, etc. However, this line of thinking fails to fully explain why the submarine, Titan, imploded. By only focusing on one technical aspect that led to the submarine's failure, it becomes easy to look at the issue as disconnected, individual parts rather than a holistic and intricate web of technical and non-technical actors.

*Social Actors: Titanic Popularization*

The over-popularization and fascination of the Titanic story was the first social actor that contributed to the poor development of the OceanGate submersible and implosion.

As previously mentioned in the introduction, one of the most recognized words in the English language is “Titanic”. The historical event regarding the Titanic ship has always fascinated society which ultimately intrigued engineering designers, the company OceanGate, and people like Stockton Rush. “Yet the movie was able to captivate audiences even in countries where the sinking of the unsinkable was never part of popular lore. And for them the movie became the story” (Riding, 1998). This statement that was said clearly exemplifies how well known and televised the sinking of the titanic. While most may think that the popularity of the Titanic as well as the movie based on the story has nothing to do with OceanGate’s incident, I argue that it does. Without the constant popularity and fascination of the shipwreck, the accelerated timeline of the submersible would have been slowed down with more precaution and the possibility of the idea as a whole to visit the Titanic could have been avoided.

*Social Actors: OceanGate Employees*

While most blame the poor engineering designs of the submersible, many tend to forget that these poor designs start with the designer and those in charge. I argue that the social actors such as the OceanGate employees and those affiliated in the contract, played a crucial role in what happened to the Titan.

In 2013 the company pivoted to designing its own submersibles with unique designs that were more cost effective. People like Söhnlein left the company that same year, saying that

OceanGate had transitioned from its initial phase to Rush's specialty of engineering. Söhnlein retained a minority stake (Pogue, n.d.).

As previously stated, OceanGate built the first submersible, Cyclops I, in 2015. In collaboration with the University of Washington's Applied Physics Laboratory. Were planning Cyclops I for Titanic dive and lost University of Washington as a partner even though they were less than a fifth of the way complete with their contract. The suspicion of why the University of Washington dropped out only adds on to the reasons why the submersible did not succeed. There was also a claim that some of the Engineers designing the submersible were in “their teens and early twenties” getting paid $15 per hour (Taub, 2023).

Rob McCallum told Rush that during his involvement in the design of a classed submersible the class society was supportive. He refused to be associated with the project after finding out that he was not going to class it. McCallum would get calls from tourists asking what he thought, and he would tell others not to get into an unclasses submersible. Rush also did not want the submarine classed by a marine-certification agency such as the Digital Nautical Chart (DNC) because it would mean an external evaluator. Lochridge, who was a former director of marine operations, left OceanGate in 2018. He told McCallum the sub is not safe to dive in private. Lochridge was afraid of retaliation from Rush because he had influence and wealth. During his time there Lochridge raised questions about flaws but his concerns were dismissed. He was then required to sign off on readiness for deployment, and wrote a formal report about how it should not be manned and as a result he later got fired. Lochridge filed a report to the Occupational Safety and Health Administration (OSHA). The OSHA investigator, Paul McDevitt, contacted OceanGate about Lochridge’s firing. OceanGate then blackmailed Lochridge to withdraw the OHSA claim (Taub, 2023).

As these multiple instances of people who played a part in the production, attempted to voice concerns regarding the development and soon later dropped from the process or were even fired, this evidence has shown the significance of the social actors in regards to the failure of the submersible. While there may be some that have an alternative viewpoint on why the University of Washington dropped, or the denial of Lochridge being blackmailed, a common theme is underlying all the evidence presented. This common theme includes lack of safety as well as ignoring protocol for certain designs .

As one can see, evidence in regards of the employees and their contributions to the disasters are shown. The over-popularization of the Titanic story significantly influenced the rushed development of OceanGate's submersible, contributing to its eventual implosion. This cultural fascination spurred an accelerated timeline for the project, potentially leading to compromises in engineering and safety measures. Additionally, internal organizational dynamics within OceanGate, including shifts in company focus and disregard for safety standards, further exacerbated the submersible's shortcomings. The departure of key partners like the University of Washington and the exploitation of inexperienced engineers highlight systemic issues within the company's management. Furthermore, allegations of blackmail and retaliation against employees who raised safety concerns underscore a culture prioritizing profit over integrity. In conclusion, both external cultural pressures and internal organizational shortcomings played pivotal roles in the failure of OceanGate's submersible project, emphasizing the importance of ethical leadership and comprehensive risk assessment in engineering ventures.

*Technical Actors: Fail-Safe System*

Engineering designs and materials such as the timeline of the submersible, using hull materials, not implementing a Fail-Safe system, as well as implementing unsafe features like a game-controlling steering system, were technical factors that equally contributed to the tragedy.

Titanic is 12,500 feet deep below the ocean surface, average depth of the ocean is 12,100 feet. Humans have traveled 35,849 feet successfully, this was by explorer Victor Vescovo (Street, n.d.). It took Vescovo's team over 4 years of designing and developing a submersible that "needed to be capable of multiple descents into parts of the ocean where pressure levels can reach in excess of 1,000 times that at the surface" (*Victor Vescovo: Deepest Dive by a Crewed Vessel*, n.d.). Oceangate however, built the Titan in a two year period and began their first exhibitions three years after the development. In between the three year timespan, the Titan had developed fatigue damage and was slightly repaired before exhibitions. From the time the titan was built, to the time the exhibitions began, there were poor technical choices that were made in regards to engineering designs and testing. While most would consider the timeline to be valid in perspective to other submersibles being built and used, those fail to realize that Oceangate was not under the same standards, designs, precautions, and materials as all other submersibles successfully being built like Vescovo's.

> In engineering design, a relatively new concept is a fail-safe practice that, in the event of a specific type of failure, the structure of interest will respond in a way that will only cause minimal or no harm to other equipment, the environment or people. That is, if and when a "fail-safe" system fails, it remains at least as safe as it was before the failure. (Huang, 2023)

As seen above, Huang clearly exclaims the importance of implementing a fail-safe system due to the necessities of not only keeping those at risk safe, but also the designers of the engineering design prioritizing the implementation of safe designs and upholding protocols.

To achieve this goal, failure mode and effects analysis need to be conducted thoroughly to examine failure situations and recommend safety design and procedures. Evidence concludes that Implementing a fail-safe system for the submersible would have prevented the deadly incident in case all else failed during the incident. While those who may have thought that the design was “fool proof” and did not need a fail-safe system, the evidence and the incident both prove how important this portion of the design could have saved lives (Huang, 2023).

> Steve Wright, an associate professor of aerospace engineering at the University of the West of England, says several aircraft and sea vessels are partially controlled by what looks like a video game controller. He later said "You're doing what airliners and fighter jets have been doing for decades and that is, you're just making suggestions to a computer.” (O'Kane, 2023)

This quote highlights how modern aircraft and sea vessels increasingly rely on sophisticated technology, such as video game controllers, for partial control. Steve Wright emphasizes that pilots and operators are essentially providing suggestions to advanced computer systems, which then execute commands. With this information, it was clear that O’Kane knew that the technology used to solely navigate the submersible was not a good choice in regards to ensuring a fail-safe system.

Figure 1:  Playstation Controller Used on Submersible

Wright, who spoke with CBS News from the university via Zoom, has worked with both manned and unmanned aircraft and says similar devices are used in both. But the devices he described are a bit more advanced than your average PlayStation controller (O'Kane, 2023). As seen in the quote, Wright explained how the playstation controller has been used in many submarines in the navy which could have solely given OceanGate the green light in implementing this same feature. As Wright went later on in the interview, he exclaimed that a single controller did not function the whole entire device like the Titan did. This small feature is also considered an actor for what happened because OceanGate once again took the risk of putting all power into a singular controller that was not designed to do so.

*External Actors*

External actors such as lack of engineering oversight, historical significance and design priorities, loopholing U.S. regulations, as well as insufficient product testing all played equally as a part conceptually to the OceanGate Incident. Without avoiding mandatory precautions and correct oversight, the submersible would not have missed its mark on multiple attributes that ultimately determined the performance of the submersible. Regarding conceptual actors, there is countless evidence regarding what was done behind the scenes. For instance, other companies had established frameworks of certification and verification oversight, but OceanGate wanted to go solo without official oversight (Huang, 2023). Passengers were also classified as mission specialists instead in order to move around protocol. This meant that the tourists did not buy tickets, they only contributed money. These same tourists had to sign waivers and were informed that the submersible was experimental and unclassed. It was also shown that more than three

dozen industry experts expressed concern about the titanic expedition all while Rush lied about partnerships with Boeing and NASA.

In regards to U.S. regulations, oceangate found loopholes in order to bypass third party certifications and ‘legally ’operate the submarine. It is known that even if a country tries to implement regulations on submersibles, it will be easy to bypass them unless every country does so since international waters are tricky (Chang, 2023). This evidence shows that the lack of regulation plays a crucial part to the safety of those involved as well as the technology itself. While some may argue that if regulations can be bypassed and still be successful then OceanGate could have done the same, it is shown that all it truly takes is one incident, one small factor that was not regulated, that can change the fate of history for that technology.

OceanGate also used carbon fiber as the structural material for the submarine, which is more commonly found in the aerospace industry where pressure from the inside is pushing outward, called tensile strength, rather than needing to address outside pressure from the depth pushing into the sub, called compressive strength. Carbon fiber is lightweight and has high strength, and was most likely used because it is much cheaper than machining large, thick steel or titanium structures into a sphere. These cheaper alternatives being used such as titanium, carbon fiber, and plexiglass portholes have different compressive strengths (*Was the OceanGate Sub Implosion an Engineering Failure?*, 2023) that can ultimately ruin calculations being made as well as predictions for the submersible to be unknown compared to submersibles with the correct material. While some may argue that cheaper alternatives are better if they perform the same way regarding the submersible, those fail to realize that although it may perform similar to other pre-existing submersibles, there is no way to predict what may happen every single time the submersible begins a voyage.

## Conclusion

Many can see that the network for the Titan submersible was massive. There were many red flags, and so many people were aware of the dangers associated with the design. Yet, no one took enough action to stop it from diving to the Titanic. As a result, 5 people lost their lives. Passenger submarines will have stricter classifications, more rigid design guidelines, rigorous testing, and third party investigators as society learns from this tragedy. Most importantly, viewing the disaster from the perspective of ANT shows how no actor is isolated or less important than another. As engineers, we have a moral obligation to uphold certain standards when other dangerous actors are visible to prevent tragedies like OceanGate.

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