

Engineering and construction factors that caused the titanic to fail



How Bad Decisions Would Result in Higher Risk.

The Titanic was one of the largest operating ship when it was launched on May 31st, 1911. The Titanic was 275 meters long which is equivalent to putting four of the world's largest passenger airplane, the Airbus A380 end to end. It was just a little smaller than its sister ship, the Olympic. The construction of the Olympic began earlier than the Titanic and Britannic. All three ships were built by the same company Harland and Wolff in Belfast. In this case study I would be talking about how proper engineering decisions, actions, safety rules could decide the outcome of the event, for the example of Titanic and The Sultana Steamboat.

During that time, no ship building facilities were big enough to build the three sister ships. Harland and Wolff decided to build two facilities replacing three smaller facility, huge enough to construct all three of the ship, Titanic, Britannic and Olympic two ship at a time. Harland and Wolff accepted the three huge project which has led to the major decision of materials used in the construction. The Titanic's sister ship, The Olympic went into construction much earlier than the Titanic by three months then they began the construction of the Titanic. This enormous project was hard on the steel production supplies and steel suppliers.

It was found that the brittleness of the metal for the Olympic were similar to the Titanic after a collision just a year before the Titanic's tragedy. The Olympic was built by the same company as the Titanic, Harland and Wolff. The Olympic had a collision with a British naval cruiser known as the HMS Hawke. During the Olympic's fifth voyage sailed by Captain EJ Smith sailing

across the Atlantic. The incident happened when the HMS Hawke was trying to overtake the Olympic, but due to the Olympic propellers suction power, during the overtake, the HMS Hawke was pulled in and end up crashing its front to the side of the Olympic. After the collision, the HMS Hawke's hull was bent and was still afloat with no serious water breaches. While the Olympic had a huge hole on the side of the hull. The metal did not bend at all, it was shattered instead like glass and two of the watertight compartments was already almost filled up with water. The Olympic was able to return to Southampton for repairs. The supplies used to repair the Olympic was taken from Titanic. This results in more low quality metals to be used for the construction of the Titanic, while the better quality metals were used to repair the Olympic.

The Titanic sank during its voyage from Southampton England to New York. The Titanic was carrying 2, 224 passengers excluding the crew members during the voyage. Four days into the voyage at 11: 40pm the ship hit an iceberg. The major contributing factor that lead to the sinking of the Titanic was the quality and type of materials used during the construction of the Titanic's hull, where the materials used were brittle on low temperatures that did not bend or show any sort of deformation like plastic but instead the steel shattered almost like glass, during the collision with the iceberg. The factor that caused the steel of the hull to be brittle and extremely low ductility was due to the high amount of sulphur found in the steel, it was almost ten times more brittle than the type of modern steel we used to construct today's ship. This was likely due to the practices of using a

different type of metal forging which is known as “ Open-Heart furnaces” which lead to the excessive amount of sulphur and phosphorous.

During that time, no ship building code was restricting the use of brittle metals to be used in the construction of the ship. Due to wanting to meet the intended proper timing of the completion of all three ships and saving cost, Harland and Wolff decided to mix higher quality metals and lower quality metals in the construction of all three ship’s hull plates and rivets. The higher quality metal was used in the central section of the Titanic which is still intact under the sea today. To be able to build such massive ships at the same time would require a huge amount of work force. Harland and Wolff hired about 15, 000 workers for the project. Due to the huge amount of work force required, the company might have cut costs on hiring unqualified engineers to construct all three ships as out of the 15, 000 workers, none of them said anything about the different type of metal that was used in the ship’s hull and rivets to the company.

After the titanic sunk about 80 years after, forensic study teams were able to pick up a few samples of the metal from the Titanic and tested. The test used was known as Charpy Impact Test. This test is used for various types of materials such as ceramics, polymers and metals, but was most commonly used for metals. The Charpy Test allows us to observe and evaluate the ductility, brittleness and toughness of a material. After test was done on both types of steel, it is shown that the modern steel used in ship construction did not break apart and showed some deformation, while the steel used in the Titanic’s hull had a clean break with no signs of deformation. Same with the rivets, with no deformation, the rivets just snapped into two pieces. As the <https://assignbuster.com/engineering-and-construction-factors-that-caused-the-titanic-to-fail/>

rivets were shown to contain about 3 times the amount of impurities (slags) found in the iron rivets. It was not up to code of standards of rivets for the rivets used in the construction of the ship.

The Titanic was designed by Thomas Andrews. The ship's design flaws which also affected the sinking of the Titanic, mainly due to the watertight compartments design. The watertight compartments are divided into sixteen separate compartments. The design of the ship was said to keep the ship's stability even if four of the watertight compartments was filled. But during the impact with the iceberg, at least six watertight compartments was exposed, causing the ship to tilt forward. But the watertight compartments were only watertight horizontally with the walls extended just a few feet above the water line and was not sealed at the top. The Company White Star Line did not want the walls of the watertight compartments to be too high as it would have reduced living space for the first class. If only Thomas Andrews had at least insisted on making them the correct height, it would have slowed the sinking by a tremendous amount for nearby ships to arrive. Because the top of the watertight compartments was not sealed off, and the walls of each watertight compartments was just slightly higher above the water level. With the ship tilting, the water was able to spill off the top of the watertight compartment and filling of the rest of the compartments. Thus, resulting in the ship sinking after less than 3 hours.

In 1912, the shipping industry due to advancement in ship construction and technology, they fail to care for proper technologies advancement. The Board of Trade's requirements for ships over 10, 000 metric tons to have a minimum of sixteen lifeboats. But the Titanic was over 40, 000 metric tons
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and had twenty lifeboats on board. Although Titanic exceeded the requirements of the Board of Trade's requirement standards, the twenty lifeboats was capable of fitting only half of the 2, 224 passengers onboard which was mostly the higher-class people. Titanic was designed to be able to fit at least 32 lifeboats, but Bruce Ismay, the managing director of the White Star Lines, decided to put only 20 lifeboats not to save cost but said that it would make the deck of the ship too cluttered and unappealing. The Board of Trade's felt that after Titanic was constructed with the safety features such as the sixteen watertight chambers which was deemed " Unsinkable" they assumed that travel by ship was the safest mode of transportation.

Aside from not having sufficient lifeboats to fit all the passengers aboard the Titanic, due to this over confidence of its safety features, they also failed to provide safety procedures such as during boarding of passengers, there were no passenger safety drills to give instructions on where to go or which lifeboats to board when in case of such emergency. The consequence of this over confidence led to most of the lifeboats not being filled during the sinking of the Titanic. As the lifeboats were located near the first-class area, people from the lower class were unable to find their way. Besides the passenger not knowing where to go, even the crew members were not able to manage the issue properly and panicked. Thus, resulting in lifeboats being lowered into the water without being filled to its max capacity. Most of those lifeboats that were not filled did turn around but by that time, most of the people floating above the freezing sea water were already froze to death.

Lastly, the vessel speed contributed to the sinking of the Titanic. As the ship gradually increased its speed day by day, due to competition for Atlantic
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passengers was fierce and the White Star Line wanted to show that the Titanic can make a six day crossing. To meet this schedule, Titanic could not afford to slow down it is believed that Bruce Ismay put pressure on Captain Smith to maintain full speed of the ship. This journey was Captain EJ Smith's retirement trip and all he had to do was sail the ship on record time to New York. Captain Smith was too, over confidence with the term " Unsinkable" together with the pressure put on him decided to maintain its speed and the captain ignored a total of seven warnings of iceberg in the area where the Titanic was sailing, and due to the captain's bad practices is that if the weather is clearly visible, it is safe to maintain its speed, course and trust the crew members to look out for icebergs because the captain wanted to arrive its destination early in exchange, endangering the passengers and his crew members. The ship was traveling at speed of 39. 9 kilometres per hour during the collision with the iceberg, and if the ship had collided with the iceberg at half the speed, the chance of Titanic to complete its journey was almost absolute.

Four years after the Titanic sank, Britannic was the identical ship of the Titanic. Britannic was also built by the company Harland and Wolff and was reengineered to be even more unsinkable after the Titanic's tragic fate. Double hull was implemented into the Britannic to be more resistant to icebergs. The watertight compartments were increased from 16 to 17 compartments and most importantly this time, they have increased the walls of the watertight compartments all the way to the deck which was a huge improvement. It was said that the Britannic would stay afloat even with 6 of its watertight compartments filled with water. But on April 14, 1916,

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Britannic was hit by a mine while sailing on the Aegean Sea and sank in just 55 minutes, almost four times as fast as the Titanic. But the casualties were not as high as Titanic as out of the 1030 passengers, only 30 were killed. As the Britannic's lifeboats have been increased more than double of what Titanic had which would fit 3600 passengers, more than what the number of people the Britannic could carry. Thus, resulting in 1000 more than 97% of its passengers surviving.

The 30 death was not caused by the sinking of the Britannic, but rather the lack of communication between the captain and his crew members. When Britannic was breached, the ship was nearby Kea Island. The captain was attempting to beach the ship but while the ship was moving at max speed, the crew members has already started to board passengers onto the lifeboats and lowering them into the water. With the suction power of the Britannic's propellers, the lifeboats were sucked underneath the ship and torn to pieces. Thus, resulting in the 30 deaths. The reason Britannic dint made it to shore is because the ship taking in water rapidly. Britannic sank to its side showing that the water instead flooded in between the double hull design. Thus, tilting the ship sideways which was the cause of the rapid sinking.

The physical cause of the Titanic's tragedy was due to the brittle metal used in the construction of the hull. Before the Titanic was fully constructed, it has been shown by the incident of the HMS Hawke and Olympic that the metal used for the hull was unsafe for Atlantic travel due to the temperature and iceberg but the White Star Line and Harland and Wolff ship building company was negligent about it which would be the organisational cause of the <https://assignbuster.com/engineering-and-construction-factors-that-caused-the-titanic-to-fail/>

sinking of the Titanic, that with all that luxury and expensive fit and finishes with the mahogany wood and so on with the interior, they used cheap metal to surround it with. Adding the fact that they decided not to increase the number of lifeboats mainly because it would make the ship's top deck too crowded and unappealing.

It has become obvious that White Star Line were too focused on aesthetics in exchange increasing the risk of the passengers, and Harland and Wolff did not say anything and rushing the project to make more money. The individual cause would be Captain Smith as he maintained full speed of the Titanic because he wanted to arrive New York to achieve the initial planned schedule, ignoring seven iceberg warnings. While on the Britannic, although not many lives were lost, 30 people died because of the lack of communication between the Captain and its crew members. This shows that White Star Lines has not improved or practiced safety procedures among its employees, and with the watertight compartment walls raised, there was still a design flaw overlooked on the double hull design.

Another similar disaster to the Titanic is the Sultana Steamboat disaster in 1865, when it was traveling up the Mississippi River. The steamboat exploded, killing approximately 1,800 people onboard, it was the worst maritime disaster, even worst than the Titanic in terms of the number of lives lost. The Sultana exploded in the middle of the night of April 27, 1865, passengers had no idea where dry land was, no life vests, no life boats and majority of the people that died were U. S soldiers returning from war. It was packed with approximately 2300 passengers and crew, six times the amount of passengers for such a paddle wheel vessel. There was barely enough
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room to even lie down. Three of the sultana's steam boilers exploded on the night of April 27, 1865 spreading fire all over the wooden boat. At the time of the sultana disaster, Steamboat were a common mode of transportation. Most steamboats only lasted at max five years.

The Sultana was only 2 years old at the time of the explosion. Before the explosion, it was known that all four of the Sultana's boilers needed maintenance. Before the journey started, one of the boilers were being repaired as the middle boiler sprung a leak and needed to be patched up. The Captain of the Sultana was James Cass Mason, he was known the routinely over stress the boilers to make the steamboat run faster so that he can make more trips per day and was known to bring his boilers to unqualified mechanics to have the maintenance done. The reason the Sultana was overfilled is because Cass Mason bribed one of the officers to let him bring more than 1, 300 of the soldiers on board to make more money while knowingly that the risk was high. To make matters worst, during the trip up the Mississippi river, the river was at a flood stage making the current strong and the Sultana was having trouble traveling up river due to the weight. This made Cass Mason push the boilers beyond its limits and to fight the strong current, Cass Mason was criss-crossing from one side of the river to the other.

This criss-crossing technique was tilting the Sultana side to side. As the sultana was tilting left and right, this caused the water in the boilers to flow and fill only one of the boilers, leaving one of the boilers empty. This leads to the boiler without any water to cool it off, get too hot. When the Sultana finally turns the other side, it would cause the water to flow back into the <https://assignbuster.com/engineering-and-construction-factors-that-caused-the-titanic-to-fail/>

extremely hot boiler causing the water to instantly turn into excess steam at the same time, to keep up with the speed to travel in the strong current, the steam pressure was tempered to produce more steam. With the excess steam, tempered safety valves and faulty boilers combined all the steam needed was a tiny opening which would be most likely the part where it was recently patched to cause the deadly explosion. As the patched boiler was in the middle, as the blows up, it sent metal shards flying all around causing the boilers beside it to blow up as well.

In the end, for the Titanic, the architect of the Titanic, Thomas Andrews did raise the issue of increasing the height of the watertight compartments or at least cover the top of the compartment but was ignored by the White Star Line as they were more interested in making the first class more spacious and luxury and Thomas Andrews did not do anything about it. Thomas Andrews in this sense was reckless as he did try to provide his Standard of Care as an architect but has also allowed great risk to be taken for not changing the design of the ship. Furthermore, Bruce Ismay, the managing director of the White Star Line decided to put only 20 lifeboats on board of the Titanic which is only capable of fitting half of the passengers in exchange for looks and appeal of the ship. Bruce Ismay should have practiced the factors of safety method where he should have gone above and beyond the required minimum set by the Board of Trade's sixteen lifeboats which could have saved everybody onboard and protect the image of the White Star Line. Bruce Ismay was also being negligent as he pressured Captain Smith to maintain at full speed in a zone known to have icebergs because he wanted to make sure the passengers arrived on time as promised. Captain Smith was

also being negligent as he was warned about icebergs nearby seven times but still kept the ship's speed at max and decided to depend on the crew to look out for icebergs.

In conclusion, the cause of the sinking of Titanic was not mainly due to the collision with the iceberg, but the major factor was the White Star Line and Harland and Wolff company and its employees. First of all, the engineers knew that the quality of the materials used for the hull was not up to par with the requirements for the ship. The engineers should have raised the issue with their immediate supervisor and raised the need for more testing on the materials used in the ship, but the engineers of the Titanic chose to not report the issue which led to the failure of the ship and the loss of 1, 500 lives. As for the crew members and the captain that was in charge of making sure everything runs smoothly did not practice Duty of Care where the captain and the crew of the Titanic owed their passengers safe travel on board the ship. They failed to provide their duty of care because they ignored the warnings about large iceberg ahead and kept their course and speed. They also failed to perform safety practice among the crews and passengers during boarding. As for the Sultana, the physical cause of the disaster was the boilers, but the main cause of the disaster was individual cause, which would be Cass Mason. Within the two years he would always push his boilers beyond the danger point, bad routine maintenance. Cass Mason knew that the risk was high but decided to bribe to obtain more passengers for 1 trip, resulting in death rates larger than the Titanic. He chose money over the safety of the soilders who fought for the country which is immoral and wrong.

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