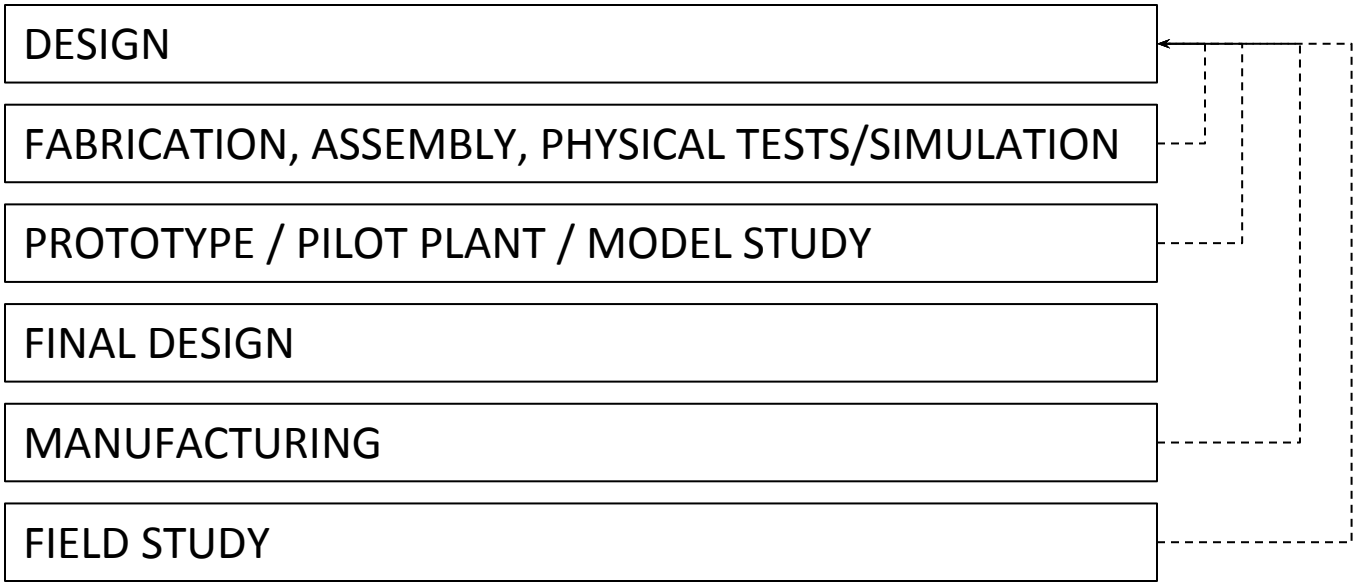
Engineering is an experiment, not conducted solely in a controlled environment of laboratory, it is an experiment on a social scale involving human subjects.

Engineering as Social Experimentation

Engineering as Experimentation- Engineers as responsible Experimenters- Industrial Standards – Titanic disaster as Case Study

DEVELOPMENT OF PRODUCT OR PROJECT IS AN EXPERIMENT

DESIGN: AN ITERATIVE PROCESS



There are similarities between engineering experiments and standard experiments

Engineering experiments Vs Standard Experiments

- Both are conducted at state of partial ignorance
- Outcomes in both are uncertain

We Engineers are required to work

a. With all scientific knowledge
b. With hypothetical assessment of safety, health, environment, social influences

There are similarities between engineering experiments and standard experiments

Engineering experiments Vs Standard Experiments

- Both need continuous monitoring
- Learning from the past

We Engineers are required to work

a. Based on information conducting experiment on public
b. Based on product history, our experience and competitor's statistics

There are contrasting features too!

Engineering experiments Vs Standard Experiments

- Experimenter exercises control in standard experiments. The client exercises control in engineering experiments.
- Engineering experiments involve human objects: needs / expectations / views

What users will do with the product?
Where will the users apply this product?
Will it be subjected to unforeseen stresses?

There are contrasting features too!

Engineering experiments Vs Standard Experiments

- Standard experiments do not need informed consent, where as engineering experiments informed consent is considered ethical to be practiced.
  - Is the subject given all relevant information?
  - Is the consent voluntary?
  - Is the subject capable of rational decision making?
- The contribution of engineering experiment to new knowledge development is rather low. Rather it helps to verify the design, to check for stability and to prepare for unexpected outcomes

The engineer as an experimenter owe several responsibilities to the society

Engineers as responsible experimenters

- A conscientious commitment to live by moral values

As an engineer, are you sensitive to full range of moral values and responsibilities relevant to prevailing situation?

Do you have the willingness to develop the skills?

Do you have the willingness to put the efforts needed?

While engineers seek to enrich knowledge, to garner profit, to follow rules and care for the beneficiaries….

It is essential that they respect safety and health of the affected. They must protect the human rights.

The engineer as an experimenter owe several responsibilities to the society

Engineers as responsible experimenters

- A comprehensive perspective on relevant information.

  - Expected to conduct full scale social impact study and environmental impact study, but is it possible?
  - Expected to ensure upkeep of moral values at each step.
  - Forecasting and monitoring with emphasis on ethics

- Moral autonomy: Unrestricted free personal involvement in all steps of the project / product development

The engineer as an experimenter owe several responsibilities to the society

Engineers as responsible experimenters

- Accountable for the results / performance of the product or the project developed.

Real life constraints arise

- Reduced personal responsibility with fragmentation of work
- Diffused responsibilities due to hierarchy
- Meeting schedule gains greater priority to personal care
- Inertia to follow laid down rules to avoid litigations

Industrial standards help the manufacturer, customers and the public. These help us achieve quality, interchangeability and standardization

Industrial standards

Aspects	Purpose
Product Quality	To map the price
Service quality	To assure
Safety	To safeguard
Uniformity	To ensure interchangeability

- International Standards Organization
- Bureau of Industrial Standards

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Titanic disaster: A case study

Name: RMS Titanic
Owner: White Star Line
Builder: Harland and Wolff, Belfast
In service: 10-15 April 1912
Fate: In its maiden voyage, hit an iceberg and sank

The Titanic Timeline

30/04/1907: Idea to build the Titanic, the Olympic and the Britannic is conceived over dinner between Bruce Ismay (MD of White Star Line) and W J Pirrie (Chairman of Harland and Wolff)
31/05/1909: Titanic's keel laid down at yard 401 of H & W shipyard, Belfast
31/05/1911: Titanic's hull successfully lunched and towed to fitting out basin
11/10/1911: Maiden voyage date announced to be 10/04/1912 (Originally 20/03/1912)
31/03/1912: Completion of construction
02/04/1912: Sails from Belfast to Southampton
03/04/1912: Titanic arrives Southampton
10/04/1912, 12.00 hrs: Titanic sails from Southampton to Newyork

The Titanic Timeline (14/04/1912)

09.00 hrs: Wireless operator Jack Phillips receives warning of iceberg from liner Caronia
10.15 hrs: Edward J Smith (Captain) is passed the first telegraph of iceberg warning
11.00 hrs: Scheduled lifeboat drill cacelled by Captain Smith
12.00 hrs: Philips receives large iceberg warning from steamship Baltic
14.00 hrs: Captain Smith passes second warning to Bruce Ismay
17.30 hrs: Air temperature drops to 0.5 degree C
17.50 hrs: Titanic changes course. Delay by 20 minutes to avoid iceberg enroute
19.20 hrs: Assistant wireless operator Harold Bridge picks up ice warning from S S California
Smith had already left to dine with passengers. Passed to someone
20.55 hrs: Smith checks in with Bridge, conditions moonless, clear, calm

The Titanic Timeline (14/04/1912)

21.40 hrs: Phillips receives iceberg warning from S S Mesaba not prefixed with MSG, remained busy with passengers' telegrams

23.00 hrs: California messages: she has stopped sailing due to ice; Philips replies Shut up, I am busy. I am working with Cape Race

23.30 hrs: The iceberg lies just 4 miles and 10 minutes ahead

23.39 hrs: The iceberg lies just 1000 yards ahead; Frederick Fleet calls Iceberg, right ahead

23.40 hrs: Murdoch demands the engines to be put in reverse and ship steers away

The Titanic hits the iceberg, striking the starboard bow

Several passengers and crew asleep

Many others assume, the ship survived a glancing blow

The Titanic Timeline (15/04/1912)

00.00 hrs: Captain ordered emergency request to be broadcast
SS California (20 miles away) has turned off her wireless
00.20 hrs: Captain ordered lifeboats to board women and children first
00.25 hrs: The Carpathia (58 miles away) replied they are heading for the Titanic
00.45 hrs: The first life boat lunched with 28 passengers (Capacity 65)
02.20 hrs: Titanic slips beneath the surface of water (close to freezing temperature)
03.30 hrs: The Carpathia's rockets are spotted
04.10 hrs: The Carpathia arrives and plucks the survivors
05.30 hrs: The California alerted
08.30 hrs: The last life boat is rescued by Carpathia
08.50 hrs: The Carpathia sets sail for Newyork

The Titanic Timeline (18/04/1912-)

The Carpathia arrived Newyorl. 705 survivors aboard.
1522 victims lost in the sea,

“Deeply regret advise you Titanic sank this morning after collision with iceberg, resulting in serious loss of life. Full particulars later”
Bruce Ismay, in his wire to the White Star Line

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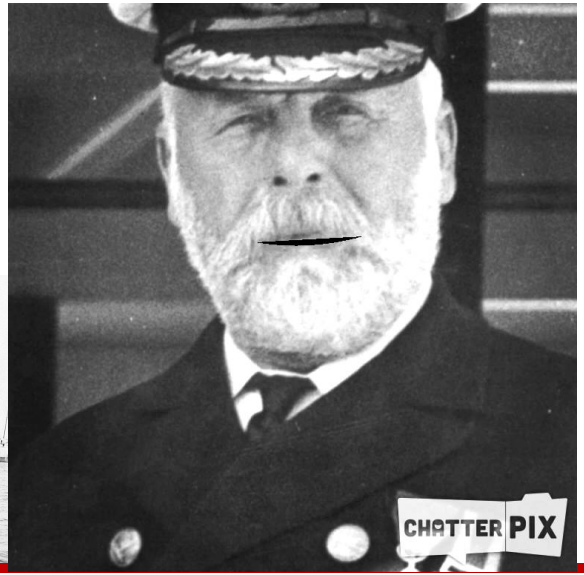
Titanic disaster: A case study



CAPTAIN E J SMITH
ON THE RETIREMENT TRIP

ETHICAL ISSUE
DID HE IGNORE THE SEVEN ICEBERG WARNINGS FROM CREW AND OTHER SHIPS

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Titanic disaster: A case study

J BRUCE ISMAY
MANAGING DIRECTOR, WHITE STAR LINE

ETHICAL ISSUE
COMPROMISED ON SAFETY!
UNRESPONSIVE TO ICEBERG WARNING!

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Titanic disaster: A case study

HARLAND AND WOLFF

THE BUILDERS

ETHICAL ISSUE

WRECKAGE ANALYSIS SHOWS SUBSTANDARD IRON USED IN SOME OF RIVETS AND HULL PLATES

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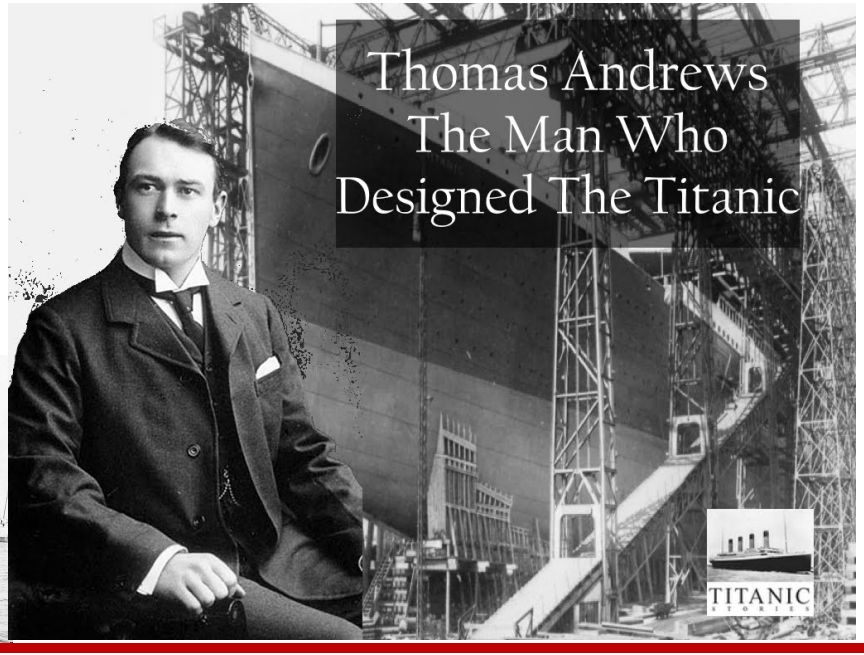
Titanic disaster: A case study



HAD HE INSISTED TO MAINTAIN HEIGHT OF WATER TIGHT COMPARTMENTS? OR TO INCREASE LIVING SPACE FOR FIRST CLASS PASSENGERS HE AGREED WITH A LOWER ONE?

Questions (Group 1)

1. What are the similarities between engineering and general experiments?
2. What are the differences between engineering and general experiments?
3. What are the general features of morally responsible engineers?
4. What are the conditions necessary for a consent to be valid?
5. What role do industrial standards have in engineering?

Questions (Group 2)

1. It is easy to exercise control during General experiment. In engineering it's almost impossible. Why?
2. There are constraints which oppose engineers exercise conscientious moral commitment most of times. Discuss each of those.
3. Developing a comprehensive perspective is required. However its difficult. Comment
4. It's noticed that engineers are not held accountable for many of the lapses. Why does this happen?
5. In the case study discussed relating to Titanic disasters, discuss possible reasons of Titanic failure