SNS COLLEGE OF ENGINEERING
Coimbatore-107

19GE701 - PROFESSIONAL ETHICS IN ENGINEERING

UNIT- 2

ENGINEERING AS SOCIAL EXPERIMENTATION

CASE STUDY: THE CHALLENGER

- Main engines fuelled by liquid hydrogen
- The thrust was provided by the two booster rockets.
- The casing of each booster rocket - four-field joints and they use seals consisting of pairs of O-rings made of vulcanized rubber. The O-rings work with a putty barrier made of zinc chromate.

The engineers were employed with Rockwell International (manufacturers for the orbiter and main rocket),
Morton-Thiokol (maker of booster rockets), and they worked for NASA.
Launch of Challenger was set for morning of Jan 28, 1986.
Allan J. McDonald was an engineer from **Morton-Thiokol**
Arnold Thompson and Roger Boisjoly, the seal experts at MT explained to the other engineers about the **O-ring**
On many of the previous flights the rings have been found to have charred and eroded
"From the past data gathered, at temperature less than 65 °F the O-rings failure was certain. But these data were not deliberated at that conference as the launch time was fast approaching."

CASE STUDY: THE CHALLENGER

–Space Shuttle

Mr. Boisjoly testified and recommended that no launch should be attempted with temperature less than 53 °F.

"These managers were annoyed to postpone the launch yet again."

At 11.38 a.m. the rockets along with Challenger rose up the sky. The cameras recorded smoke coming out of one of the filed joints on the right booster rocket. Soon there was a flame that hit the external fuel tank. At 76 seconds into the flight, the Challenger at a height of 10 miles was totally engulfed in a fireball. The crew cabin fell into the ocean killing all the seven aboard.

CASE STUDY: THE CHALLENGER

Moral/Normative Issues

1. The crew had no escape mechanism. Douglas, the engineer, designed an abort module to allow the separation of the orbiter, triggered by a field-joint leak. But such a ‘**safe exit’ was rejected as too expensive,** and because of an accompanying reduction in payload.

2. The **crew were not informed** of the problems existing in the field joints. The principle of informed consent was not followed.

3. Engineers gave warning signals on safety. But the **management group prevailed over and ignored the warning**

CASE STUDY: THE CHALLENGER

Conceptual Issues

NASA counted that the probability of failure of the craft was one in one lakh launches. But it was expected that only the 100000th launch will fail.

There were 700 criticality-1 items, which included the field joints. A failure in any one of them would have caused the tragedy. No back-up or stand-bye had been provided for these criticality-1 components.

CASE STUDY: THE CHALLENGER

Factual/Descriptive Issues

Field joints gave way in earlier flights. But the authorities felt the **risk is not high.**

NASA has disregarded warnings about the bad weather, at the time of launch, because **they wanted to complete the project**, prove their supremacy, get the funding from Government continued and get an applaud from the President of USA.

The inability of the Rockwell Engineers (manufacturer) to prove that the lift-off was unsafe.
This was interpreted by the NASA, as an approval by Rockwell to launch.

A BALANCED OUTLOOK ON LAW

The ‘balanced outlook on law’ in engineering practice **stresses the necessity of laws and regulations and also their limitations in directing and controlling the engineering practice.**

Laws are necessary because, people are not fully responsible by themselves and because of the competitive nature of the free enterprise, which does not encourage moral initiatives.

Laws are needed to provide a minimum level of compliance.

Examples

1. Code for Builders by Hammurabi

Hummurabi the king of Babylon in 1758 framed the following code for the builders:

"If a builder has built a house for a man and has not made his work sound and the house which he has built has fallen down and caused the death of the householder, that **builder shall be put to death.**

If it causes the death of the householder's son, they shall put that **builder's son to death**.

If it causes the death of the householder's slave, he shall give slave for **slave to the householder**. If it destroys property, he shall replace anything it has destroyed; and because he has not made the house sound which he has built and it has fallen down, he shall rebuild the house which has fallen down from his own property.

If a builder has built a house for a man and does not make his work perfect and the wall bulges, that builder shall put that wall in sound condition at his own cost"
This code was expected to put in self-regulation seriously in those years.

2. Steam Boat Code in USA

“Whenever there is crisis we claim that there ought to be law to control this. “

Whenever there is a fire accident in a factory or fire cracker’s store house or boat capsize we make this claim, and soon forget.

Laws are meant to be interpreted for minimal compliance. On the other hand, laws when amended or updated continuously, would **be counter productive**.

Laws will always lag behind the technological development. The regulatory or inspection agencies such as Environmental authority of India can play a major role by framing rules and enforcing compliance.

In the early 19th century, a law was passed in USA to provide for inspection of the safety of boilers and engines in ships. It was amended many times and now the standards formulated by the American Society of Mechanical Engineers are followed.

3. Proper Role of Laws

Good laws when enforced effectively produce benefits.

They establish minimal standards of professional conduct and provide a motivation to people. Further they serve as moral support for the people who are willing to act ethically.

Thus, it is concluded that:

1. The rules which govern engineering practice should be construed as of **responsible experimentation rather than rules of a game**. This makes the engineer responsible for the safe conduct of the experiment.

2. Precise rules and sanctions are suitable in case of ethical misconduct that involves the violation of established engineering procedures, which are **aimed at the safety and the welfare of the public.**

3. In situations where the experimentation is large and time consuming, the rules must **not try to cover all possible outcomes**, and they should not compel the engineers to follow rigid courses of action.

4. The regulation should be broad, but **make engineers accountable for their decisions**, and

5. Through their professional societies, the engineers can facilitate framing the rules, amend wherever necessary, and enforce them, but without giving-in for conflicts of interest.