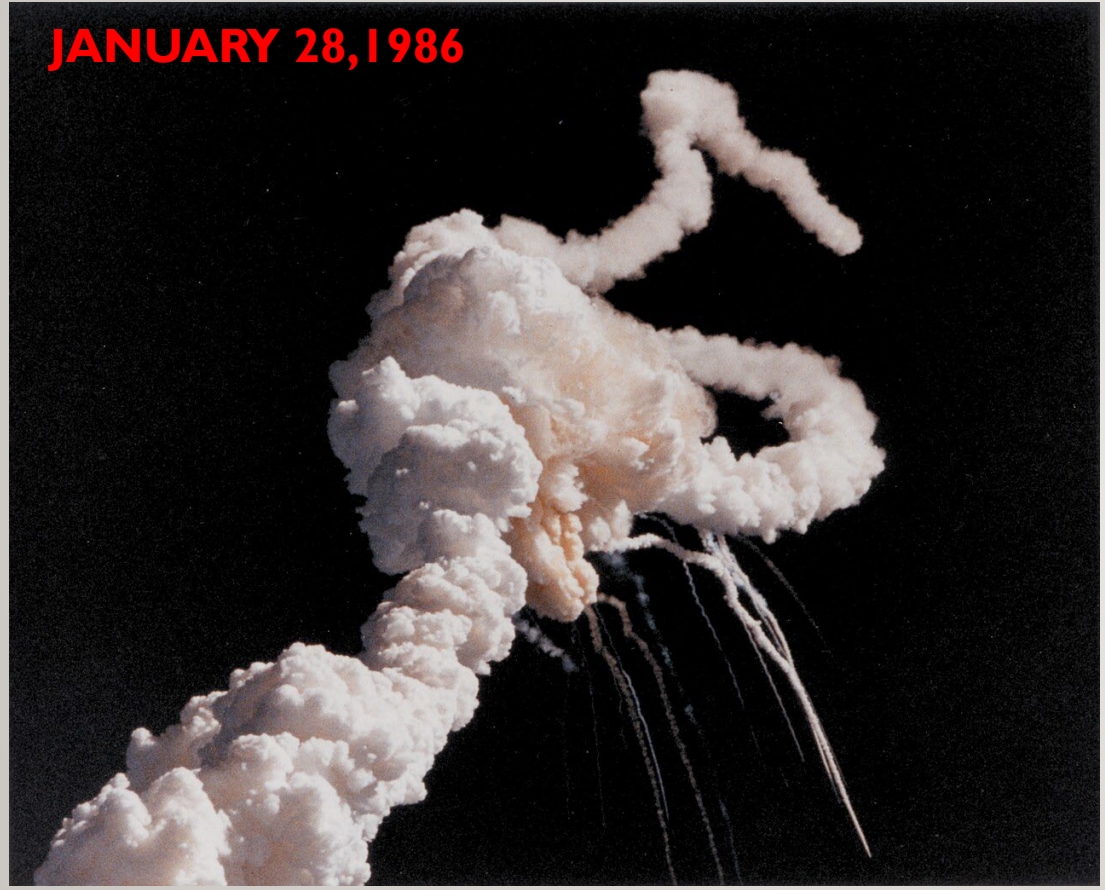
ENGINEERING ETHICS



NENO NOVAKOVIC, P.E.

IEEE

SPACE SHUTTLE CHALLENGER DISASTER

The space shuttle **Space Shuttle Challenger** exploded shortly after launch, killing seven astronauts.
The cause was failure of **O-ring seals** in the rocket boosters at low temperatures.
Engineers at Morton Thiokol warned about the risk, but management proceeded with the launch due to schedule pressure from NASA.

Ethical issue: Ignoring engineers' safety concerns and prioritizing schedule over safety.

NSPE ENGINEERS' CREED (2021)

As a Professional Engineer, I dedicate my professional knowledge to the advancement and betterment of public health, safety, and welfare.

I pledge:
To give the utmost of performance;
To participate in none but **honest enterprise**;
To live and work according to the **highest standards** of professional conduct;
To place **service before profit**, the honor and standing of my profession before **personal advantage**, and the **public welfare above all** other considerations.
In humility, I make this pledge.

IEEE

ENGINEERING ETHICS DEFINTION

The set of moral principles and professional standards that guide engineers in making decisions that prioritize the safety, health, and welfare of the public while acting with honesty, integrity, and responsibility.

Key elements of engineering ethics:

- **Public safety first** – Protect human life above all else
- **Honesty and integrity** – Be truthful about data, risks, and results
- **Accountability** – Take responsibility for decisions and outcomes
- **Competence** – Work only within your area of expertise
- **Fairness and respect** – Treat clients, colleagues, and society ethically

IEEE

AND FINAL WORD IS

ENGINEERING ETHICS IS NOT JUST ABOUT WHAT IS TECHNICAL;

IT IS ABOUT WHAT IS CONTEXTUAL.

DEEPWATER HORIZON FAILURE

The Deepwater Horizon disaster violated engineering ethics because of:

1. Failure to prioritize public and worker safety
2. Ignoring safety tests and warning signals
3. Choosing cost and speed over safe engineering practice
4. Poor communication and unsafe organizational culture
5. Lack of transparency and accountability

IEEE

1. FAILURE TO PRIORITIZE PUBLIC SAFETY

A core rule in engineering ethics (e.g., NSPE Code) states that **engineers must hold the safety, health, and welfare of the public as the highest priority**.

In the Deepwater Horizon case:

- Risky drilling decisions were made to **save time and reduce cost**.
- Engineers replaced heavy drilling mud with lighter seawater earlier than recommended.
- Important safety tests were ignored or misinterpreted.

These decisions **increased the risk of a blowout**, putting workers, the environment, and nearby communities in danger.

2. IGNORING WARNING SIGNS AND SAFETY TESTS

Engineering ethics requires **careful analysis, testing, and verification** before operating complex systems.

However:

- The **negative pressure test** indicated possible well instability.
- Instead of stopping operations to investigate, the team **continued drilling**.
- The **blowout preventer**—a critical safety device—failed to seal the well during the explosion.

Ignoring these warning signs violates the ethical duty of **competence and diligence**.

3. COST AND SCHEDULE PRESSURE OVER SAFETY

The project was:

- **$58 million over budget**
- **About six weeks behind schedule**

Because of this pressure, managers and engineers reportedly **chose faster and cheaper methods** rather than safer alternatives.

This violates engineering ethics because **financial goals should never override safety considerations**.

4. POOR COMMUNICATION AND ORGANIZATIONAL CULTURE

Engineering ethics also requires **honest communication and transparency**.

Problems included:

- Workers felt afraid to report unsafe conditions.
- Safety concerns were not effectively communicated to decision-makers.
- Organizational culture discouraged questioning authority.

A culture that discourages reporting hazards **prevents engineers from fulfilling their ethical responsibilities**.

5. LACK OF PROFESSIONAL INTEGRITY AND ACCOUNTABILITY

Engineers must:

- Report risks honestly
- Admit errors
- Take responsibility for failures

In this disaster:

- Some information about risks and safety problems was **not fully disclosed**.
- Responsibility was initially shifted among companies instead of immediate accountability.

This undermines the ethical principles of **honesty and integrity in engineering practice**.

IN ONE SENTENCE SUMMARY:

The Deepwater Horizon failure violated engineering ethics because decision-makers prioritized cost and schedule over safety, ignored critical risk warnings, suppressed safety concerns, and failed to uphold the engineer's duty to protect human life, the environment, and the public.

TITAN SUBMERSIBLE DISASTER

The failure of the Titan submersible from the company OceanGate in 2023 is often discussed as a powerful real-world case of engineering ethics, because it highlights what can go wrong when core ethical principles are ignored or weakened.

IEEE

1. SAFETY VERSUS INNOVATION

Engineering ethics requires that **public safety always comes first**. In the Titan case:

- The company, OceanGate, pursued innovative design choices (like carbon fiber hulls).
- However, deep-sea pressure environments are extremely unforgiving, and experimental materials require extensive validation.

Ethical issue:
Pushing innovation is not unethical—but doing so **without sufficient testing and safety margins** puts lives at risk.

2. IGNORING INDUSTRY STANDARDS

Most deep-sea submersibles follow strict certification processes by independent bodies.

- Titan reportedly **was not fully certified** by recognized classification organizations.

- Experts in submersible engineering had raised concerns prior to the incident.

Ethical principle violated:
Engineers should **adhere to established standards** unless there is overwhelming evidence and validation to justify alternatives.

3. LISTENING TO EXPERT WARNING

There were reports that engineers and industry professionals warned about potential risks.

- Concerns included material fatigue, structural integrity, and lack of testing transparency.

Ethical issue:
Engineering ethics emphasizes **respect for professional judgment and whistleblowing**. Ignoring credible warnings is a serious breach.

4. TRANSPARENCY AND INFORMED CONSENT

Passengers on Titan were paying clients, not engineers.

- Ethical practice requires that risks be **clearly and honestly communicated**.
- There is debate about whether passengers fully understood the experimental nature of the vessel.

Ethical principle:
Engineers and companies must ensure **informed consent**, especially when risks are high.

5. RESPONSIBILITY AND ACCOUNTABILITY

Engineers are responsible not just to employers, but to:

- The public
- Clients
- The profession

Ethical issue:
Decisions made during design, testing, and operation suggest that **commercial pressure may have overridden safety responsibility**.

6. PROFESSINAL INTEGRITY

Engineering codes (like those from National Society of Professional Engineers) emphasize:

- Hold paramount the safety, health, and welfare of the public
- Perform services only in areas of competence
- Issue truthful statements

The Titan case is often seen as a violation of these core values.

TITAN SUBMERSIBLE DISASTER

Bottom line

The Titan submersible disaster is not just a technical failure—it's widely viewed as an **ethical failure**:

- Innovation without adequate validation
- Dismissal of expert concerns
- Lack of transparency
- Weak adherence to safety standards

It serves as a reminder that in engineering, **ethical decisions are as critical as technical ones**—because the consequences can be fatal.

CONTACT INFORATION

- Neno Novakovic, P.E.
- neno.novakovic@hotmail.com

IEEE

QUESTIONS AND DISCUSSION