POLITECNICO DI MILANO





Computer Ethics

The responsibility of engineers

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Outline

- A case of responsibility
- Why responsibility? Again the moral dimension of technology …
- Active and passive responsibility
- The ideals of engineers
- The social context of technological development

January 28 1986


"All the News That's Fit to Print"

The New York Times

Late Edition

NEW YORK, WEDNESDAY, JANUARY 29, 1986

THE SHUTTLE EXPLODES

6 IN CREW AND HIGH-SCHOOL TEACHER ARE KILLED 74 SECONDS AFTER LIFTOFF

11:39:13 A.M.

11:39:17 A.M.

Thousands Watch A Rain of Debris

By WILLIAM J. BROAD

The Challenger disaster (van de Poel and Royakkers 2011)

- *25th **launching of the space shuttle** (first time with a civilian on board: lot of media pressure)*
- *January 28th 1986: after 73 seconds the Challenger space shuttle **exploded** 11 km above the Atlantic Ocean*
- *All the seven **astronauts** were **killed***
- *After the accident an **investigation** committee was set up to establish the exact cause of the explosion*
- *The committee concluded that the **explosion** was **attributable** to the failure of the **rubber sealing ring** (O-ring)*
  - *The component was unable to function properly at low temperatures*
  - *Fuel had started to leak from the booster rocket*
  - *Then it caught fire, causing the Challenger to explode*

O-rings

A major malfunction

Challenger's brief flight

.678 seconds

Following Challenger's liftoff, a puff of black smoke — seen only by automatic launch cameras — indicates a problem with one of the O-ring seals at the joint between segments of the shuttle's right-hand solid rocket booster.

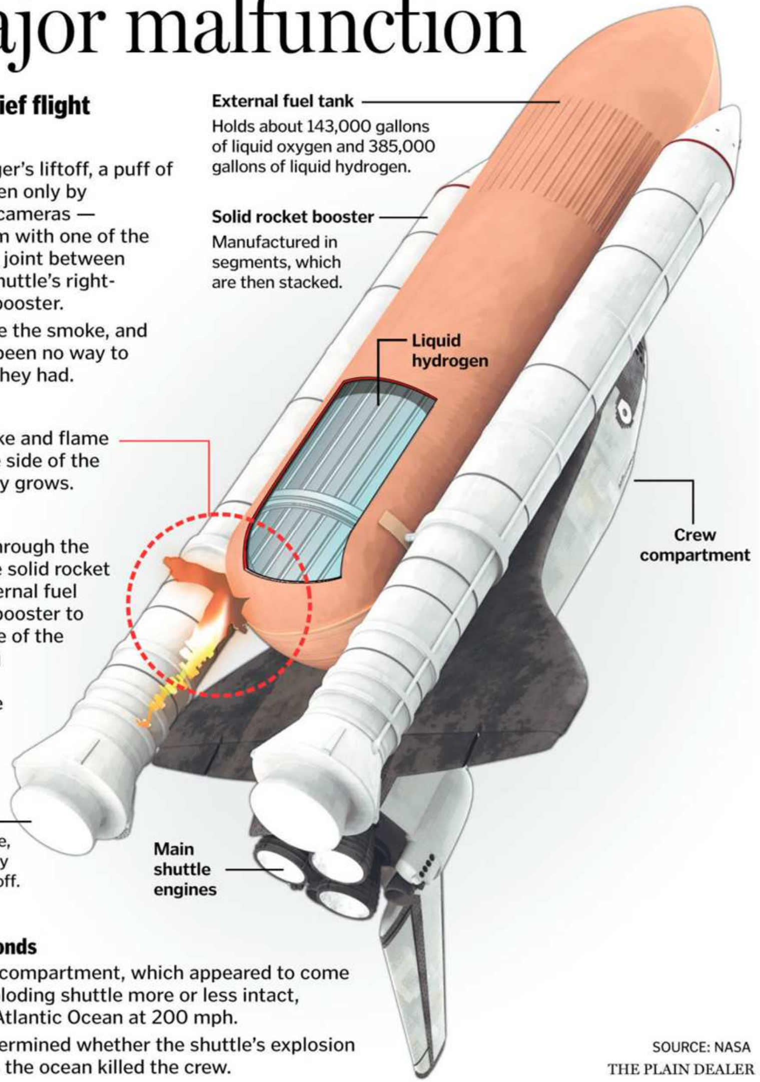
No human eyes see the smoke, and there would have been no way to abort the flight if they had.

58 seconds

A small jet of smoke and flame bursts through the side of the booster and quickly grows.

73 seconds

The flame burns through the strut attaching the solid rocket booster to the external fuel tank, causing the booster to swivel into the side of the tank. The resulting massive explosion destroys the space shuttle.



3 minutes, 58 seconds

Challenger's crew compartment, which appeared to come away from the exploding shuttle more or less intact, smashes into the Atlantic Ocean at 200 mph.

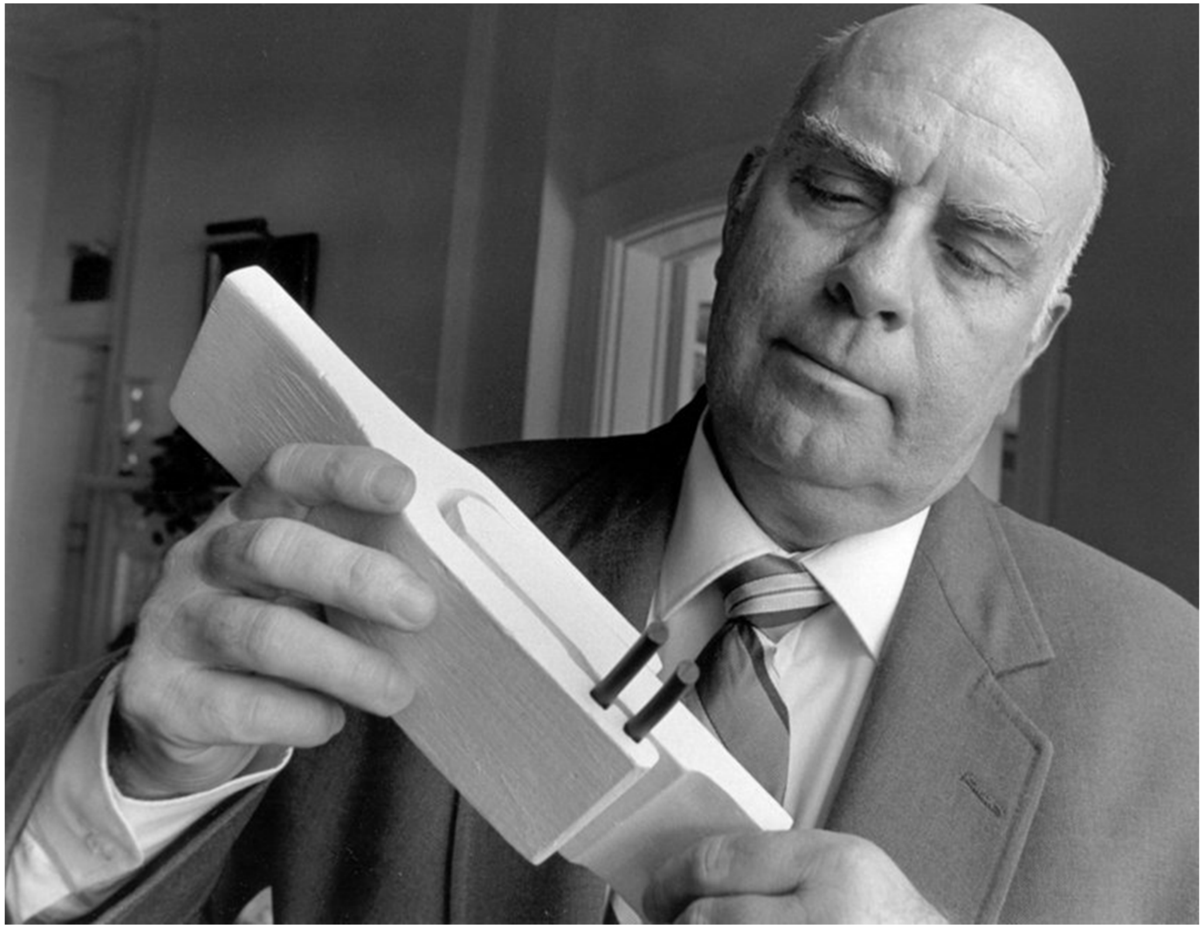
Officials never determined whether the shuttle's explosion or the impact with the ocean killed the crew.

SOURCE: NASA
THE PLAIN DEALER

The problem of O-rings

- *Morton Thiokol (NASA supplier) was the company responsible for the construction of the rocket boosters designed to propel the Shuttle into space*
- *In January 1985 Roger **Boisjoly** (an engineer at Morton Thiokol) has aired its **doubts about the reliability of O-rings***
- *In July 1985 he had sent a **confidential memo** to the Morton Thiokol management board expressing concerns about the effectiveness of O-rings at low temperatures*
- *A **project group** was set up **to investigate** the problem but with insufficient funding and information to investigate the problem*
- *One of the group managers had sent a memo headed "**Help: this is a red flag**!" to MT's vice-chairman*
- ***Nothing concrete** was actually undertaken*

Roger Boisjoly



Engineer Roger Boisjoly examines a model of the O-Rings, used to bring the Space Shuttle into orbit, at a meeting of senior executives and academic representatives in Rye, New York in Sept. 1991

The night before the fatal flight

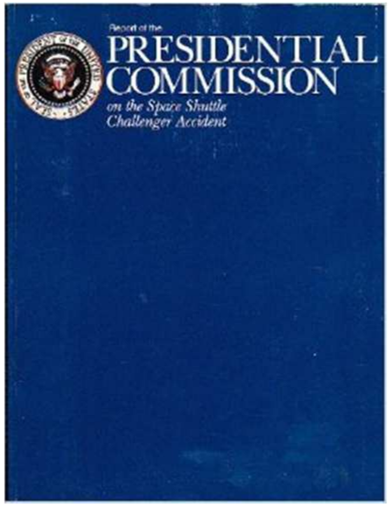
- *The **launching** was **delayed 5 times** (partly for weather-related reasons: very **low temperatures** in the night)*
- *NASA engineers confessed to remembering having heard that it **would be not safe to launch** at very low temperatures*
- *They had a **telephone conference** with representatives of Morton Thiokol, including Boisjoly*
  - *The **Morton Thiokol engineers recommended not to go ahead** with the launch below 11degrees Celsius (O-rings never tested in sub-zero conditions)*
- ***NASA** claimed that the **data were insufficient to declare the launching** – extremely important to NASA - **unsafe***

The decision

- *A brief **consultation session** was decided so that the data could once again be examined*
- *While the connection was broken the General Manager of Morton Thiokol commented that a **management decision** had to be made*
- *Later on several employees stated that shortly after the launching **NASA** would make **a decision regarding a possible contract extension***
- *For Morton Thiokol it was too much a **political** and **financial risk** to postpone the launch*
- *The 4 managers present, engineers excluded, put it **to vote***
- *They were reconnected to NASA and Morton Thiokol announced, **ignoring the advice of Boisjoly**, its **positive recommendations** (no NASA's higher management level was informed)*

The Presidential Commission and beyond

- *It determined that the whole* ***disaster*** *was due to* ***inadequate communication at NASA***
- *At the same time it argued for a change in the system that would* ***ensure transpare****ncy (the entire space program was stopped for 2 years)*
- *MT did not lose its contract with NASA but helped, instead, to work on finding a* ***solution to the O-ring problem***
  - ***Engineers*** *were given* ***more of a say*** *in matters: in the future they will have the power to halt a flight it they had doubts*



Challenger and (moral) responsibility

- This disaster and the history behind is **paradigmatic** to illustrate the concept of **responsibility**
- Whenever something goes wrong then the question who is responsible for it often quickly arises

Physicist Richard Feynman makes a point during a hearing presented by a presidential commission investigating the Challenger disaster in 1986

Responsibility

- Do you consider Roger Boisjoly morally responsible for the Challenger disaster? Why?

What is responsibility? (van de Poel and Royakkers 2011)

- Being held **accountable** for your **actions** and for the **effects** of your actions
  - Making of choices, taking decisions, failing to act, …
- Responsibility is often **linked** to the **role** that you have in a particular situation (role responsibility)
  - Since a person has different roles in life she/he has various responsibilities (both formal and informal)
- **Moral responsibility** is that based on the **obligations**, **norms**, and **duties** arising from moral considerations
- **Professional responsibility** is that based on one’s role as a professional in as far it stays within the limits of what is morally allowed

Passive responsibility (1)

- **Backward-looking responsibility** which is relevant after something undesirable occurred
  - **Accountability**: backward looking responsibility in the sense of being held to account for, or justify one's actions toward others
    - In the case of the Challenger disaster, NASA had to be able to render account for its actions to the families of the victims, to society, and to the sitting judge
  - **Blameworthiness**: backward looking responsibility in the sense of being a proper target of blame for one's actions or the consequences of one's actions

Passive responsibility (2)

- In order for someone to be blameworthy, usually the following conditions need to apply
  - **Wrong-doing**: not just in legal and organizational terms, but also in **moral** ones
    - NASA violated the norm that a flight had to be proven to be safe
  - **Causal contribution**: not only to action but also a failure to act
    - Both NASA project team and Morton Thiokol management made a causal contribution to the disaster because both could have averted the disaster by postponing the launch
  - **Foreseeability**: knowing the consequences of actions
    - In the Challenger disaster all the parties were certainly aware of the danger of a possible disaster
  - **Freedom of action**
    - Even if the NASA team project and MT were under pressure, this pressure was probably not strong enough to say that NASA, MT or Boisjoly lacked freedom of action

Active responsibility

- Responsibility **before** something had happened referring to a duty or task to care for certain state-of-affairs or persons
- **Preventing** the **negative effects** of technology but also **realizing certain positive effects** (Bovens 1998)
  - Adequate **perception** of threatened violations of norms
  - Consideration of the **consequences**
  - **Autonomy** (ability to make one's own independent moral decisions)
  - Displaying conduct that is based on a verifiable and consistent **code**
  - Taking **role obligations** seriously

Ideals of engineers

- Looking at the **ideals of engineers** to understand **active responsibility** of engineers
- Ideals are ideas or strivings which are particularly **motivating** and **inspiring** for the person having them, and which aim at **achieving** an **optimum** or maximum
- **Professional ideals** are closely allied to a profession or can only be aspired to by carrying out the profession
- Are all ideals of engineers **morally commendable**?

Technological enthusiasm

- The ideal of wanting to **develop new technological possibilities** and take up technological challenges
- Technological enthusiasm in itself is not morally improper, the possible negative effect lies in **overlooking possible negative effects**

Google behind the screen

https://archive.org/details/youtube-TBNDYggyesc#

Effectiveness and efficiency

- **Effectiveness** is the extent to which an established goal is achieved
- **Efficiency** is the ratio between the goal achieved and the effort required
- They are **apparently neutral**, objective and measurable
- Ex: Taylorism and the idea of **scientific management**
  - Attempt to efficiently design the whole production process, and ultimately society

Human welfare

- The ideal of **contributing** to or **augmenting** human welfare
  - "*Engineers shall use their knowledge and skill for the enhancement of human welfare*" (Professional code of the American Society of Civil Engineers)
- Relevant values differ depending on the particular **engineering specialization**
  - Software engineering: **privacy** and **reliability** of systems will be more important than protection of environment and health
- This ideal confirms that the professional practice of engineers is **not** something **morally neutral**
  - Engineers do more than merely developing neutral means for the goals of others

Engineers versus managers

- Quite evident in the Challenger disaster case
- Engineers have **responsibility** to the **company** in which they work and a **professional responsibility** as engineers
- Three models of **dealing with** this tension and the potential conflict between engineers and managers
  - Separatism, technocracy, whistle-blowing

Separatism

- Separatism is the idea that scientists and **engineers** should apply the **technical inputs**, but appropriate **management** and political organs should make the **value decisions**

"I must emphasize, I had to say and I never would take away any management right to take the input of an engineer and then make a decision based upon that input … I have worked at a lot of companies … and I truly believe that there was no point in me doing anything further other than what I had already attempted to do"

(Boisjoly after the Challenger disaster)

- **Tripartite model** maintains that engineers can only be held responsible for the design of products and not for wider social consequences
  - Subdivided into three segments: **politicians**, **engineers**, **users**

Technocracy

- **Govern** by **experts**
  - Frederick Taylor (1856-1915) that proposed that engineers should take over the role of managers in the **governance of companies** and that of politicians in the **governance of society**
- What do unique expertise engineers posses to legitimacy claim to the role of technocrats?
- Technocracy is **undemocratic** and **paternalistic**
- Paternalism is the making of moral decisions for others on the **assumption** that one knows better what is good for them than those others themselves

The social context of technological development

- **Engineers** are **not the only ones** who are responsible for the development and consequences of technology
  - **Developers and producers of technology** (engineering companies, industrial laboratories, consulting firms, universities, research centers)
  - **Users** who use the technology and may formulate certain wishes or requirements for the functioning of a technology (both **companies** and **citizens**)
  - **Regulators** (organizations) who formulate rules or regulations that engineering products have to meet (rulings concerning health and safety, but also linked to relations between competitors)
  - **Others** such as professional associations, educational institutes, interest groups and trade unions

Responsibility again

- Do you consider Roger Boisjoly morally responsible for the Challenger disaster? And do you think his separatist argument is sound?

Technology assessment (TA)

- **Systematic method** for **exploring future technology developments** and assessing their potential societal **consequences**
- **Collingridge dilemma** (Collingridge 1980)
  - On the one hand it is not possible predict the consequences of new technologies already in earlier phases
  - On the other hand, once the negative consequences materialize, it often has become very difficult to change the direction of technological development
- **Constructive technological assessment** (CTA) is an approach in which TA-like efforts are carried out **parallel to the process of technological development and** are fed back to the development and design process

References

- Bovens, M. (1988). *The Quest for Responsibility. Accountability and Citizenship in Complex Organizations*, Cambridge University Press
- van de Poel, I. and Royakkers, L. (2011). *Ethics, Technology, and Engineering*, Wiley-Blackwell