Have you ever installed commercial software on your computer without paying for it?
CLICKER QUESTION

George was showing Amita a copy of a drawing software package he got from a friend.

Amita says to George, “Hey this is great, but you didn’t pay for it, you shouldn’t really be using it.”

George says, “Look, I wouldn’t have bought it because it is too expensive and I can’t afford it, so the company hasn’t lost a sale. Besides I didn’t take a physical object, so it isn’t stealing.”

Talk to your neighbor and record what you think:

a) George is right – there is no problem, he isn’t stealing from the company
b) George should delete the software from his computer
c) George shouldn’t pirate software, but the company is not going to find out, so he should not delete it
C L I C K E R  Q U E S T I O N

On his way home from work, George goes into a Walgreens, picks up a candy bar and walks out without paying. Ethically, is this the same as pirating software?

A. YES
B. NO
C. In some ways yes and some ways no
OUTLINE:

- Moral Reasoning & Case Analysis – Techniques
- Applying Techniques to a Real Case
Part 3: Moral Reasoning & Case Analysis
What is required in Moral Reasoning

- **Identifying the situation.**
  - What is being asked of you or your company?

- **Recognizing the relevant factors.**
  - Who are the parties? What are their rights? What are your companies obligations and their rights?

- **Applying moral considerations.**
  - What are the consequences? What are the intentions of the actors? What moral obligations are at play? What virtues are at play?

- **Proposing a position-of-action.**
WHAT IS NOT REQUIRED IN MORAL REASONING

- Having a defensible and thought out position-of-action *does not* require that there are *no* other defensible alternative positions of action.

- Having a defensible and thought out position of action *does not* mean that you *don’t* have to listen to and reason with others who are relevant parties.

- Having a defensible and thought out position of action *does not* mean you should not seek advice also.
CASE ANALYSIS (I)

- We learn to reason morally and come up with a position-of-action by doing case analysis.

- Studying cases gives us an environment in which we can practice reasoning about morality and what to do in problematic situations without causing harm.

- Some cases are hypothetical, in that they never actually occurred, but they could occur. Some cases are actual, in that they actually occurred.

- In case analysis it is important to study both hypothetical and actual cases.
CASE ANALYSIS (II)

The steps for case analysis:

1. Read the case carefully.
2. Identify all the parties involved.
3. Identify all the obligations and rights involved.
4. Apply moral considerations.
5. Come up with a position-of-action.
**The Table Technique I**

Step 1: make a table charting the relevant factors.

<table>
<thead>
<tr>
<th>Party Involved</th>
<th>Intention: Positive or Negative</th>
<th>Consequences: Cost and Benefit</th>
<th>Rights / Duties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**THE TABLE TECHNIQUE II**

- Using the information in your table:

- Choose some combination of relevant factors to come up with a position-of-action.

- Write out your position-of-action as an argument that uses the factors you have chosen as reasons for your position-of-action.

- Attempt to defend your position of action against responses a person may have to your position.
A person that is good at moral reasoning can often perform the following task:

- Defend a position, regardless of whether they believe it.
- Reason for the opposing position, regardless of whether they believe it.
- Identify possible positions that further discussion.
Part 4:
Application to Real Case
A RECURRING ETHICAL DILEMMA

Engineering commitment to safety vs. All of the factors management must consider

“It’s time to take off your engineering hat and put on your management hat.”

Morton Thiokol Senior Vice President Jerry Mason
THE CONFLICT BETWEEN

Professional goals or virtues of engineers

A. Upholding high standards of professional competence and expertise

B. Holding paramount the health, safety & welfare of the public

Professional goals or virtues of managerial decision-makers:

A. Maximizing the well-being of the organization

B. Upholding organizational employee morale and welfare
WHAT DOES IT MEAN WHEN SOMETHING IS SAFE?

- Does it mean - - 100% chance nothing bad will happen?
- Does it mean 1 in a million change something bad will happen? 1 in 100,000? 1 in a billion?
Acceptable Risk

“A thing is safe if, were its risks fully known, those risks would be judged acceptable by reasonable persons in light of their settled value principles.”

William W. Lowrance, 1976

If I told you that the probability of a poisonous release occurring from the Student union construction in one year is 1 in 20,000 – would you consider that acceptable risk?
Acceptable Risk

- If I told you that the annual probability of you dying from a transport accident is 1 in 6,000, how would you feel about the 1 in 20,000 odds of the poisonous release?

- Finally – If I told you that the annual odds of you dying from a fall is also 1 in 20,000, does that change the way you feel about the student union?
Today we will consider a case with this potential conflict

A famous case and a national disaster:

The **Challenger Disaster**

(January 28, 1986)

cited in the first lecture
Challenger Crew
(front row) Michael J. Smith, Dick Scobee, Ronald McNair
(back row) Ellison Onizuka, Christa McAuliffe, Gregory Jarvis, Judith Resnik
The Short Story

*Challenger* lifts off at 11:37 AM
73 seconds after lift-off, smoke was seen billowing out from the right solid rocket booster followed by several explosions
Smoke plume of the Space Shuttle, *Challenger* at 73 seconds after launching
Technical Details

The primary component of the vehicle assembly was the **Orbiter**, the reusable, winged craft containing the crew that actually traveled into space and returned to land on a runway.
The Orbiter alone did not generate enough thrust or carry enough fuel to get into orbit.

Additional thrust was provided by two large Solid Rocket Boosters
- Attached to the side of the External Tank by means of two struts
Once the two solid rocket boosters had lifted the Shuttle to an altitude of about 45,760 m (roughly 28.4 miles), they were jettisoned.
- Two-thirds of the External Tank was filled with liquid hydrogen; the top third with liquid oxygen

- This fuel supplied the three main engines of the Orbiter until about 8 1/2 minutes after liftoff

- Then the External Tank would be jettisoned at about 111,355m (roughly 69.2 miles).
DESIGN OF THE SOLID ROCKET BOOSTER

- SRB built in Utah and shipped by train to launch pad
- The four segments of each booster were joined by what is known as tang and clevis joints.
Each tang and clevis joint was sealed by two rubber O-rings.

The intended design: Rubber seals fill the joints, preventing the hot exhaust from escaping.

As pressure increases inside the SRB, it pushes the tang away, but also flattens out the O-ring to seal the gap.
This picture was taken on the morning of the *Challenger* launch January 28, 1986.

With temps in 20°s overnight and 36° at launch, it was the coldest day in history that a shuttle had been launched.
Failure

- O-ring seal in the right SRB failed to remain sealed.
- O-ring failure allowed a flare of pressurized hot gas from the SRB.
- Resulting flames burned the adjacent SRB attachment hardware -- the strut -- and ignited the liquid hydrogen and oxygen in the external fuel tank.
- Various subsequent structural failures caused orbiter to break apart.
Roger Boisjoly, chief O-ring engineer at Morton Thiokol, had warned his colleagues that O-rings lose their resiliency at relatively low temperatures.

August 19, 1985 - NASA Level I management briefed on booster problem.
DAY OF THE LAUNCH

- Engineers, including Roger Boisjoly, could not supply conclusive data regarding at what temperatures it would be **unsafe** to launch the Challenger.

- According to a Marshall Space Flight Center manager no one had performed a statistical analysis correlating past O-ring performance with either temperature or leak check pressure.
Hindsight:
Each of the four launches below 61° showed thermal distress to at least 1 O-ring
NASA MANAGER ANXIOUS TO LAUNCH

- Economic considerations
  - Delays are costly

- Political pressures
  - Competition with European Space Agency & Russians
  - Need to justify budget requests
  - Possible pressure to launch before presidential speech

- Scheduling backlogs
  - Many delays in previous shuttle mission
  - Several days of bad weather, electronic switch malfunction
Final Decision

- After much back and forth discussion with NASA, Jerald Mason told Morton Thiokol supervising engineer, Robert Lund: “take off your engineering hat and put on your management hat.”

- Without firm figures to determine that the launch was unsafe, the earlier recommendation to delay the launch was reversed.

WHAT ARE THE CONFLICTS HERE?

Based on What You Know So Far
Was there a conflict between

Professional goals or virtues of engineers

A. Upholding high standards of professional competence and expertise

B. Holding paramount the health, safety & welfare of the public

Professional goals or virtues of managerial decision-makers:

A. Maximizing the well-being of the organization

B. Upholding organizational employee morale and welfare
Do you think NASA should have launched?

Is there a clear moral issue here?

Did NASA take unnecessary risks because of external pressure?

Did M-T engineers violate their duty to put public safety first?
Actually the case is much more complex

Rather than only looking at the facts after the disaster – let’s look at what was happening in real time
QUOTES FROM INVESTIGATION

Larry Sayer – Engineer at Morton Thiokol
- [W]e had a very weak engineering position when we went into the telecom

Ben Powers – Marshall Space Flight Center
- I don’t believe they did a real convincing job of presenting their data … The Thiokol guys even had a chart in there that says temperature of the O-ring is not the only parameter controlling blow-by. In other words, they’re not coming in with a real firm statement. They’re saying there’s other factors. They did have a lot of conflicting data in there.
MORE ABOUT INTERNAL DISCUSSIONS

- Unusual situation
  - First time in the life of project that a contractor had made a recommendation not to launch. Usually NASA called for a delay

- NASA engineers did not know that the final M-T “Launch” decision was not unanimous

- While concerns about O-rings had been raised, the concerns had not been specifically about launching a low temperatures – NASA taken somewhat by surprise
Benefit – Cost in Decision Making

Wouldn’t the NASA manager think the potential costs were too great?
- Human lives
- His reputation
- Criminal charges
- 100% of the blame on him
- Suspension of the shuttle program

Wouldn’t the M-T managers come to the same conclusion?
IF YOU WANT TO DIVE INTO THIS CASE MORE DEEPLY

- Elements of whistle blowing
- Many more uncertainties associated with technical issues – conflicting data
- Issues of poor communication
- Poor decision making based on “group think”
In the cases we’ve consider before, we’ve frequently seen that ethical dilemmas often appear as a **hard choice**. You have to choose between the lesser of two evils.

In the Challenger disaster, obviously the lesser of two evils choice should have been to **delay the launch**.
But we’ve also discussed that good ethical reasoning arrives at a ‘creative solution’ which satisfies both the obligations that are pressing on the decision-makers.
A final question

Can you suggest a creative middle way solution between the disastrous decision to launch the Challenger on January 28, 1986 and to postpone it?

The creative middle way solution should address both the goal of eliminating the risk of the malfunctioning O-rings and at the same time allow NASA to keep its commitments for on-schedule launches.
1. Engineering professional goals or virtues, such as protecting public safety and client and employee honesty, lead to the trust and progress of the engineering profession.

2. Ethical problem solving, whether personal or professional, strives to find a creative ways to reconcile conflicting goals.