GLOBAL TECHNOLOGICAL POLICY MAKING

INTRODUCTION TO CLASS WORK

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DECISION THEORY

Cost Effectiveness Analysis

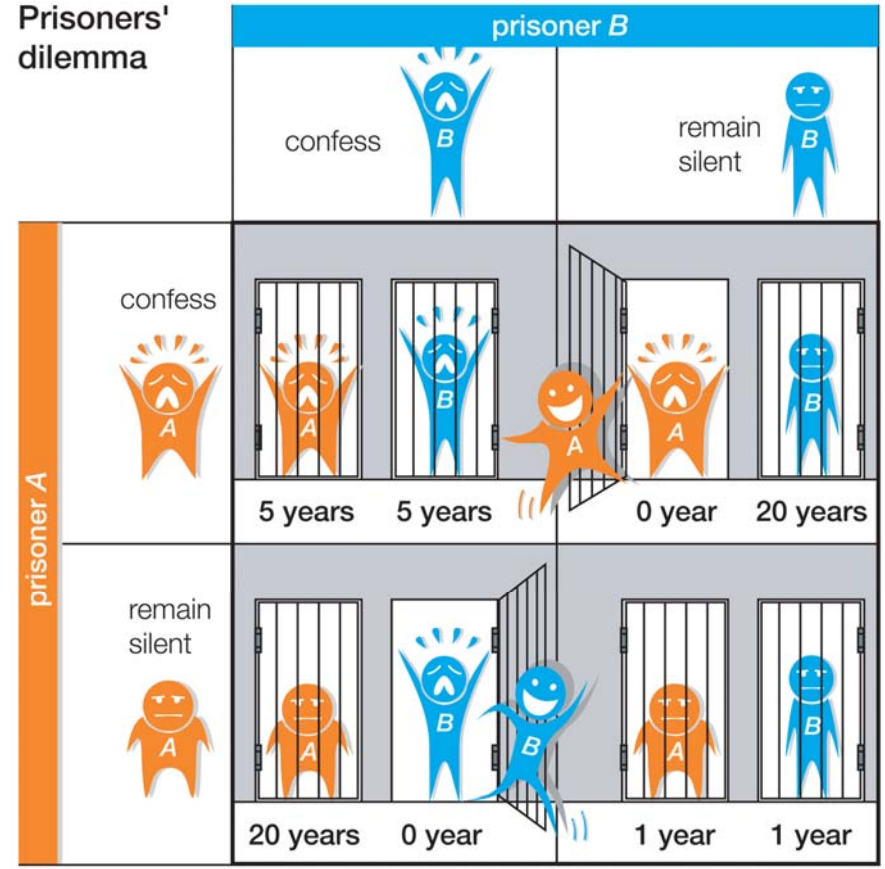
- Compare cost (in a broad term including risks) and outcomes (effect) of two or more courses of action

Choice under Uncertainty

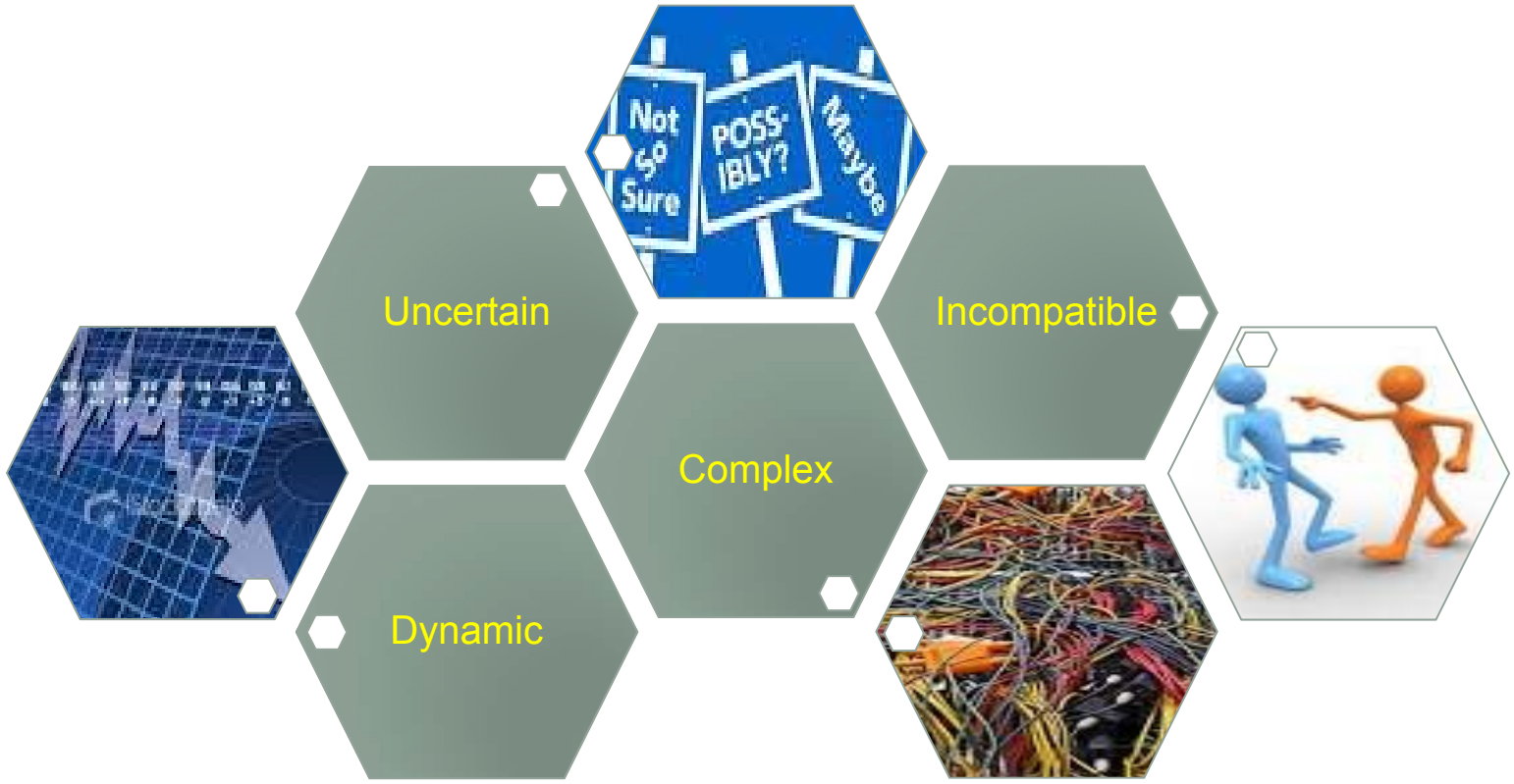
- In case of more than one possible outcome with different probabilities, the rational procedure is to identify all possible outcomes, determine their values (positive or negative) and the probabilities that will result from each course of action, and multiply the two to give an expected value.
- The action to be chosen should be the one that gives rise to the highest total expected value.

A CLASSIC EXAMPLE IN GAME THEORY

- Because betraying your partner (by confessing) always rewards more than cooperating with them, all purely rational self-interested prisoners would betray the other, and so the only possible outcome for two purely rational prisoners is for them to betray each other.
- The interesting part of this result is that pursuing individual reward logically leads both of the prisoners to betray, but they would get a better reward if they both cooperated.



PROBLEMS IN REAL WORLD

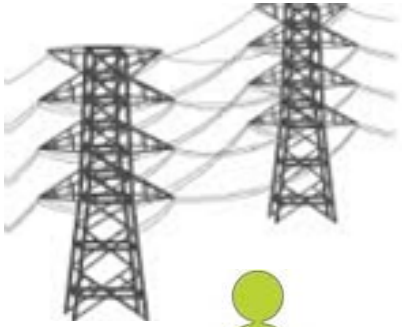


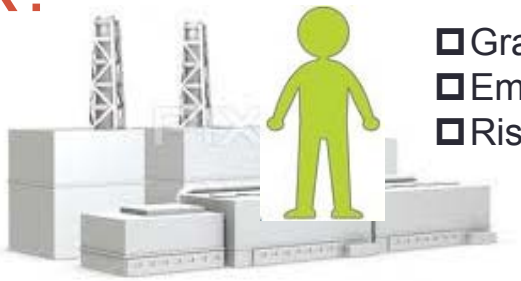
WHAT COULD HAPPEN IN REALITY_FDPP

- Monday, 7 March 2011
  - TEPCO submits a report to Japan's nuclear safety agency which predicts the possibility of a tsunami up to 10.2 metres high at the Fukushima Daiichi nuclear plant in the event of an earthquake similar to the one that devastated the area in 1896. TEPCO actually made this prediction in 2008 but delayed in submitting the report because they *"did not feel the need to take prompt action on the estimates"*.
- Friday, 11 March
  - 15:46 (approximate): A 14-metre tsunami, unleashed by the earthquake, overtops the seawall disabling the backup diesel generators.
  - With the loss of all electrical power supply, most of the emergency core cooling system. Fukushima plant officials focused their attention on a damaged storage pool for spent nuclear fuel at the No. 2 reactor. The shutdown of the other reactors then proceeded badly, and problems began to cascade.
  - 18:00: The falling water level in reactor 1 reaches the top of the fuel, and the core temperature starts climbing.
  - 19:30: The fuel in reactor 1 becomes fully exposed above the water surface, and fuel damage in the central core begins soon after.
  - 21:00: TEPCO announces that the pressure inside reactor unit 1 of Fukushima I is more than twice normal levels.
- Saturday, 12 March
  - 05:30: Despite the high risk of hydrogen (produced from the water in the containment vessel) igniting after combining with oxygen from water or in the atmosphere, and in order to release some of the pressure inside the reactor at Fukushima I unit 1, the decision is taken to vent some of the steam (which contained a small amount of radioactive material) into the air within the metal container building surrounding the unit.
  - 06:50: Although unknown at the time, the core of reactor 1 has now completely melted and falls to the bottom of the reactor pressure vessel.
  - 14:50: Fresh water injection into reactor 1 is halted.
  - 15:36: There is a massive explosion in the outer structure of unit 1. The concrete building surrounding the steel reactor vessel collapses as a result of the explosion; however no damage is believed to have been sustained to the reactor itself. Four workers are injured.
  - 19:00: Sea water injection into reactor 1 is started. TEPCO orders Daiichi to cease seawater injection at 19:25, but Daiichi plant boss Masao Yoshida orders workers to continue with the seawater injection.

BALANCING COST AND BENEFIT AMONG MANY STAKEHOLDERS, CAN IT BE FAIR?

- Energy consumption
- Electricity cost





- Grant
- Employment
- Risk

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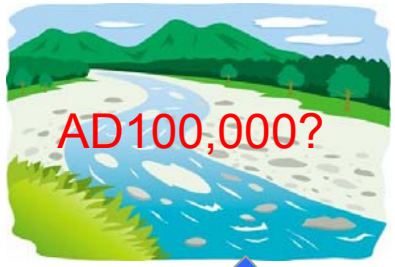
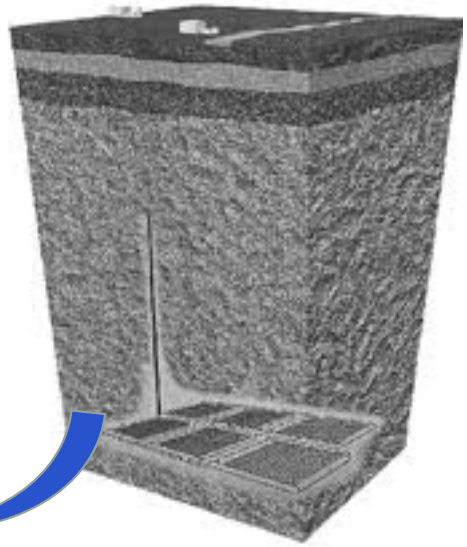
- Risk

- Contamination due to nuclide migration



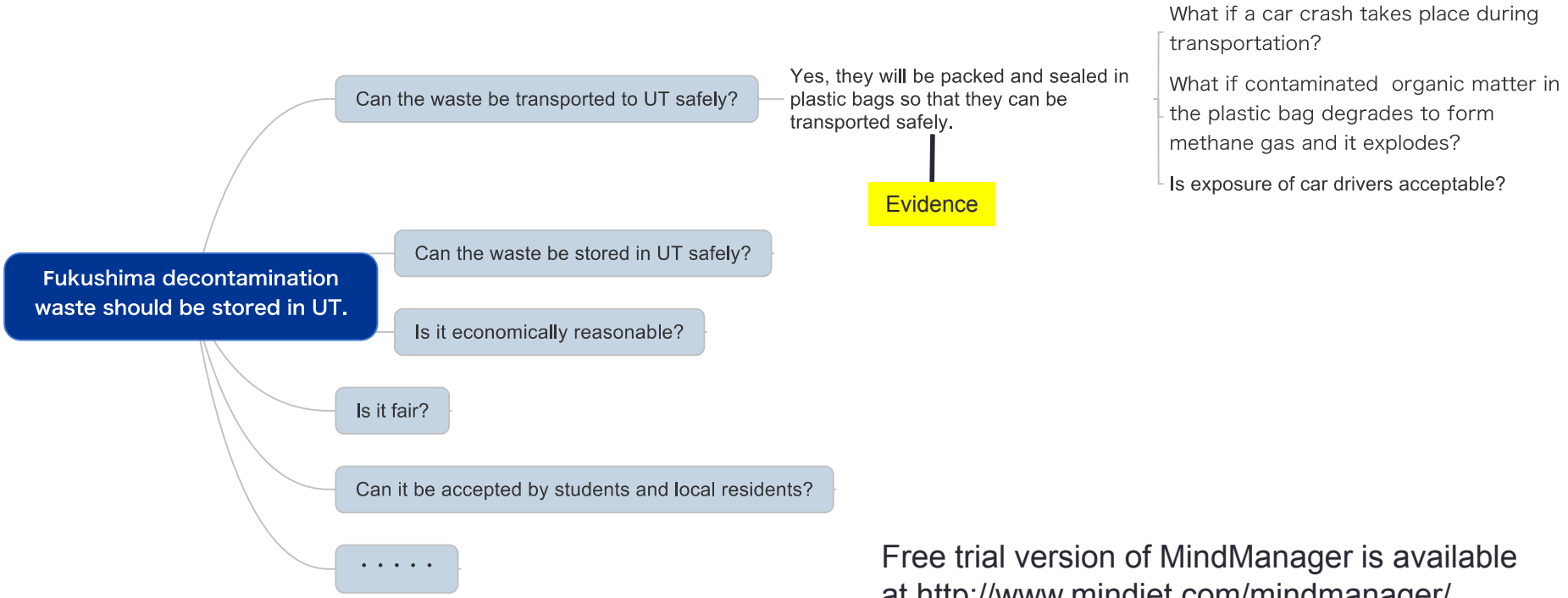


CLASS WORK

- **Should we store some of Fukushima decontamination waste in the University of Tokyo in proportion to the electricity that we have used here?**
  - ✓Task 1: Development of argumentation model for
  - ✓Task 2: Development of argumentation model against
  - ✓Task 3: FMEA for transport and storage at UT

EXAMPLE OF ARGUMENTATION MODEL FOR

- Structure arguments for (or against) transport & storage of Fukushima waste at UT as chains of questions and answers.
- Evidence supporting key arguments should also be presented.
- Criticize your argument by asking as many “tough” questions as possible to strengthen it!

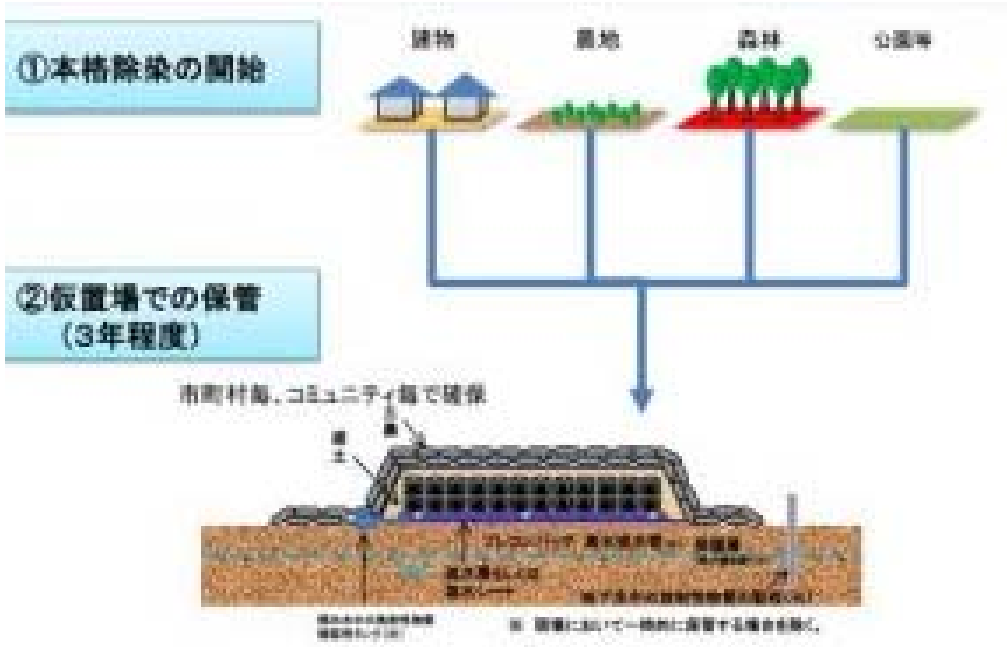


Free trial version of MindManager is available at http://www.mindjet.com/mindmanager/

FMEA FOR TRANSPORT AND STORAGE OF FUKUSHIMA DECONTAMINATION WASTE AT UT

FMEA http://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis)

- Failure Mode and Effects Analysis (FMEA) was one of the first systematic techniques for failure analysis. It was developed by reliability engineers in the 1950s to study problems that might arise from malfunctions of military systems.
- A FMEA is often the first step of a system reliability study. It involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes, and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded.
- A FMEA is mainly a qualitative analysis.



A SIMPLIFIED FMEA PROCEDURE

STEP 1: DEFINE SYSTEM COMPONENTS AND MISSION PHASES

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STEP 2: IDENTIFY FAILURE MODES USING TIME-SPACE MATRIX

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STEP 3: EVALUATE PROBABILITY OF OCCURRENCE OF EACH FAILURE MODE

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STEP 4: EVALUATE SEVERITY OF EFFECT OF EACH FAILURE MODE

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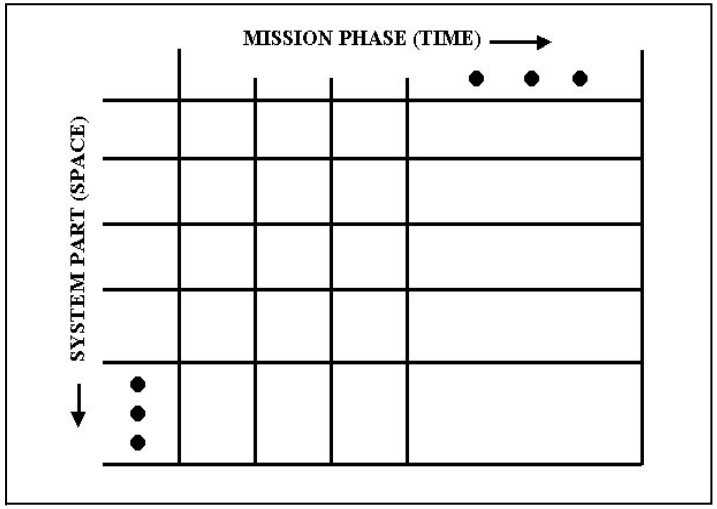
STEP 5: ASSESSMENT OF RISK LEVEL OF EACH FAILURE MODE



FMEA TOOL BOX

PROBABILITY RANKING

Rating	Meaning
A	Extremely Unlikely (Virtually impossible or No known occurrences on similar products or processes, with many running hours)
B	Remote (relatively few failures)
C	Occasional (occasional failures)
D	Reasonably Possible (repeated failures)
E	Frequent (failure is almost inevitable)

SEVERITY RATING

Rating	Meaning
I	No relevant effect on reliability or safety
II	Very minor, no damage, no injuries, only results in a maintenance action (only noticed by discriminating customers)
III	Minor, low damage, light injuries (affects very little of the system, noticed by average customer)
IV	Moderate, moderate damage, injuries possible (most customers are annoyed, mostly financial damage)
V	Critical (causes a loss of primary function; Loss of all safety Margins, 1 failure away from a catastrophe, severe damage, severe injuries, max 1 possible death)
VI	Catastrophic (product becomes inoperative; the failure may result complete unsafe operation and possible multiple deaths)

RISK LEVEL (P*S)

Probability / Severity -->	I	II	III	IV	V	VI
A	Low	Low	Low	Low	Moderate	High
B	Low	Low	Low	Moderate	High	Unacceptable
C	Low	Low	Moderate	Moderate	High	Unacceptable
D	Low	Moderate	Moderate	High	Unacceptable	Unacceptable
E	Moderate	Moderate	High	Unacceptable	Unacceptable	Unacceptable

PLAN FOR NEXT CLASS

- Presentation of home works (10 minutes each)
- Discussion
- Brief lecture on consensus building
- Group work
- Presentation from each group
- Discussion