Unintended Consequences, Industrial Accidents and Other Anthropogenic Disasters
Fall 2020
DE
TR 13:50-15:05

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Office Hours: Given the constraints of the pandemic and online delivery, I will make myself available on both Zoom and within a class group chat (app TBD in class). Zoom hours: TWR 11-12; Group chat: M through Friday, 9 to 5. Feel free to use the group chat to discuss course issues with each other, but don't expect me to respond after 5pm or on weekends.

Course Description: Examples of unintended consequences, industrial accidents, and other disasters resulting from human technological decision making are legion. Contrary to predominant techno-utopian strains of thought within Western culture, near catastrophic errors and the failure to adequately prepare for mistakes are frequently the norm rather than the exception. Managers and technical experts routinely overestimate their own knowledge and capacity for foresight, failing to either adequately account for the uncertainties and complexities of reality or subject their designs to sufficient critical scrutiny.

This course, in response, aspires to help instruct budding scientists and engineers on how to be more thoughtful and prudent through an examination of a number of cases studies of unanticipated consequences, design errors, systemic failures, and other anthropogenic (i.e., human produced) disasters. We will explore the cognitive, organizational, and technical sources of error as well as proposals developed within decision theory for more intelligently steering innovation so as to minimize harms and (hopefully) avert catastrophe. More broadly, we will evaluate different approaches to risk as political arrangements, seeing each as providing a different answer to the question: "Who shoulders which risks, when, and how?"

Mode of Instruction: This class will be held entirely online. Short "asynchronous" lectures for specific concepts and illustrative examples will be recorded by the instructor for the students to watch at their leisure. We will meet "live" or synchronously at least once per week at the scheduled class time for Q&A, informal student presentations, film days, and whenever else it makes sense (plan on at least every Tuesday). I will communicate any changes via the course Canvas website. It is the student's responsibility to read instructor communication and remember when synchronous meetings are occurring.

We may switch to fully asynchronous if a spike of cases leads to a shutdown of daycare facilities (your instructor has a two-year old) OR in response to deteriorating conditions at the university OR if the technical infrastructure at NMT does not permit a relatively seamless synchronous classroom experience OR if a supermajority of students request the switch to an asynchronous class. All synchronous material will be recorded for the benefit of students without sufficiently good Internet access, and those same students will be expected to record presentations and other forms of classroom participation.

Pre-requisites/Co-requisites: None

Place in Curriculum: General Education Core requirement, Area 4 – Social Sciences

Course Learning Outcomes: This course explores the decisions, thinking processes, technical structures, and forms of organization that lead to technoscientific mistakes. Course assignments will help students hone their analytical, writing, and oral presentation skills. By the end of the course, students should be able to: (1) Characterize the unintended consequences occurring in historical cases and the risks entailed by emerging innovations, (2) Describe risky technologies as constituted by the coupling of sociotechnical systems, (3) Evaluate historical and contemporary instances of technoscience in terms of how well "intelligent trial and error" was pursued and propose ameliorative strategies, (4) Characterize disasters and accidents as political phenomena.

Program Learning Outcomes: Students will: (1) Identify and communicate orally and in written language while attending to audience, purpose and context. (2) Apply strategies such as reading for main points; seeking key arguments, counterarguments, rebuttals; locating supportive documentation for arguments; reading from the perspective of different stakeholder lens; and rhetorically evaluate texts (3) Evaluate how well supported one's own arguments and those of others by quality sources and evidence; integrate support for their own claims with information from sources that are used and cited ethically and appropriately (4) Delineate a research problem or question. (5) Identify and gather information to address problem, and evaluate evidence and data for credibility (6) Develop conclusions, solutions, and outcomes that reflect an informed, well-reasoned evaluation (7) Draw on historical and cultural perspectives to evaluate contemporary issues, modes of thought, and or modes of expression; Recognize and articulate the diversity of human experience across a range of historical periods and/or cultural perspectives (8) Discern the ethical and civic consequences of decisions and civilly engage with others when taking a position on those decisions

Course Requirements:
Required Texts:
For most weeks there will not be a specific assigned reading. Rather, students will be assigned a set of questions about a case and tasked to locate sources to that will enable them to answer those questions. Often PDFs of or URLs for suggested readings will be posted to Canvas.

Attendance and Participation:
For synchronous days, attendance and participation is required. Credit will be given in for doing one of the following 1) Student attends Zoom session and contributes in a least one significant way 2) Student attends Zoom session or watches the recording, then submits a 150+ word reflection that can be composed of some combination of a) questions about the material or case studies b) responses to a point made by the professor or another student c) effort to draw connections between that day's material and previous days.

Classwork/Homework: Students will be assigned to briefly research an assigned example or case of an unintended consequence, accident, or disaster (roughly every week). All students will submit a short write up/presentation of the students' findings (either individually or as part of a group) by 10am the day of class. There are only three possible grades: 1) deficient (0.5 pts) 2) sufficient (1 pts) 3) exemplary (1.25 pts).

Presentations: Every week, particular groups of students will be selected ahead of time to describe their findings to the rest of the class, either live or prerecorded. This will be graded as credit/no credit, with comments provided to assist in students' development as competent communicators. In either case, students will be expected to respond to questions from

classmates and the professor (orally or in writing). Student should expect to present at least four or five times during the semester. Don't stress out too much about these. They're about learning from each other's' research. If we have to go fully asynchronous, students will upload recordings be expected to comment on and ask questions of other groups' submissions.

Diagnosing the Causes of Disaster Assignment: Pairs of students will produce a 1500 word analysis of a technical/engineering disaster, using "Seconds from Disaster" as a starting point and supplementing with online research (at least two quality outside sources). Students as write this as if they were engineering consultants brought in to settle the cause of the accident.

Risk Avoidance and Mitigation Assignment: Pairs of students will produce a 1500 word analysis of a risky scientific, technical or social undertaking, utilizing online research (at least four quality sources) to propose how to minimize the probability of error and the scale of harm produced by mistakes. Students as write this as if they were consultants brought in to help an organization better manage the risks it faces.

Final Project: Students will have three choices for their final project. Some options can only be undertaken individually, while others can be pursued by groups of up to four students. 1) Review of a book (approved by the professor) investigating a particular accident or disaster or presenting a particular theory or practice of safety (individual or pair, depending on length of the book) 2) Deeper investigation of case (groups of up to four) 3) A research paper on how people in your chosen field deal with risks and hazards, including organizational strategies (groups of up to four). Each individual student is responsible for 5 pages of writing and 5-7 minutes of presentation time.

Course Schedule: *Subject to change*

Section I: Unintended Consequences

Tue Aug 18 – [Live] Review of Course & Syllabus – Complex Webs of Relationships
Homework: Finish watching "Cane Toads"

Thu Aug 20 – Sources of Unintended Consequences: Vicious Cycles, Perverse Adaptations.
First case studies assigned.

Tue Aug 25 – [Live] Student presentations

Thu Aug 27 – More Sources: Emergence, Ecological Destabilization.
Second case studies assigned

Tue Sep 1 – [Live] Student presentations

Section II: The Roots of Disaster: Normal Accidents and Garbage Can Organizations

Thu Sep 3 – What are "Normal Accidents"?
Third case studies assigned

Tue Sep 8 – [Live] Student presentations

Thu Sep 10 – Implications of Complex/Tightly Coupled Technologies
Homework: Write short reflection paper

Tue Sep 15 – [Live] Class discussion: "Are complex/tightly coupled technologies worth it?"

Thu Sep 17 – "Garbage Can Organizations" and the Mismanagement of Risk
Fourth case studies assigned

******Pick Disaster Topics******

Tue Sep 22 – [Live] Student presentations

Thu Sep 24 - [Live?] Watch and Discuss a "Seconds from Disaster" Documentary

Tue Oct 29 – [Live] Disaster Analysis Workshop Day – Features of Good Writing – Bring in Rough Drafts -> Peer review and Instructor review

Thu Oct 1 – Work on Papers

Section III: Doing Better: Intelligent Trial and Error, High Reliability, & Inherent Safety

Tue Oct 6 – [Live?] Film: "Command and Control" **[Disaster Analysis Paper Due]**

Thu Oct 8 – Technical Precautions: Inherent Safety, Flexibility, and Human-Centered Design **Fifth case studies assigned.**

Tue Oct 13 – [Live] Student presentations

Thu Oct 15 – Cultural Precautions: High Reliability, Checklists, Phronesis **Sixth case studies assigned**

******Pick "Doing Better" Topics******

Tue Oct 20 – [Live] Student presentations

Thu Oct 22 – Political Precautions: Democratic deliberations, victims funds, polycentric governance **Seventh case studies assigned**

Tue Oct 27 – [Live] Student presentations

Thu Oct 29 – [Live] Risk Avoidance and Mitigation Assignment Workshop Day – Bring in Rough Drafts -> Peer Review/Instructor Review

Tue Nov 3 – [Live] Film: To Err is Human. **Risk Avoidance and Mitigation Assignment Due**

Section IV: Application

Thu Nov 5 – [Live] Pick Groups/Projects.

Tue Nov 10 – Final Project Work Day. **[Professor will be available during class time for Q&A]**

Thu Nov 12 – Final Project Work Day. Progress report due. **[Professor will be available during class time for Q&A]**

Tue Nov 17 – Final Project Work Day. **[Professor will be available during class time for Q&A]**

Thu Nov 19 – [Live] Final Project Presentations (if necessary)

Tue Nov 24 – [Thanksgiving]

Thu Nov 26 – [Thanksgiving]

Tue Dec 1 – [Live] Final Project Presentations

Thu Dec 3 – [Live] Final Project Presentations

[Final Paper Due Monday, December 7th at 5pm]

Grading: Students will be provided with a rubric for all major assignments
A = 100-93%; A- = 92-90%: B+ = 89-87%; B = 86-83%; B- = 82-80%; C+ = 79-77%; C = 76-73%; C- = 72-70%; D = 69-60%; F=<60%

Breakdown:
Attendance and Participation 15%
Presentations 20%
Disaster Review 20%
Risk Mitigation Analysis 20%
Final Project 25%

Academic Honesty: New Mexico Tech's Academic Honesty Policy for undergraduate and graduate students is found in the student handbook, which can be found at: http://www.nmt.edu/student-handbook. You are responsible for knowing, understanding, and following this policy.

For this course, the biggest risk lies in plagiarism, whether unintentional or not. Students are required to appropriately cite any idea that they use that came from class readings or research texts, even if the student modifies that idea. Not only is this more honest, but it demonstrates to the professor that you read and learned the material. Students may not repurpose text written for another class or have other students compose sections of their papers for them.

Reasonable Accommodations:
New Mexico Tech is committed to protecting the rights of individuals with disabilities. Qualified individuals who require reasonable accommodations are invited to make their needs known to the Office for Disability Services (ODS) as soon as possible. To schedule an appointment, please call 835-6209, or email disability@nmt.edu.

Counseling Services:
New Mexico Tech offers individual and couples counseling, safety assessments, crisis intervention and consultations through The Counseling Center. These confidential services are provided free of charge by licensed professionals. For more information, please call 835-6619, email counseling@nmt.edu or complete an Intake Form on our website at https://www.nmt.edu/cds/. All services are provided via phone or Zoom during the Covid-19 pandemic.

Respect Statement: New Mexico Tech supports freedom of expression within the parameters of a respectful learning environment. As stated in the New Mexico Tech Guide to Conduct and Citizenship: "New Mexico Tech's primary purpose is education, which includes teaching, research, discussion, learning, and service. An atmosphere of free and open inquiry is essential to the pursuit of education. Tech seeks to protect academic freedom and build on individual responsibility to create and maintain an academic atmosphere that is a purposeful, just, open, disciplined, and caring community."

Title IX Reporting:
Sexual misconduct, sexual violence and other forms of sexual misconduct and gender-based discrimination are contrary to the University's mission and core values, violate university policies, and may also violate state and federal law (Title IX). Faculty members are considered "Responsible Employees" and are required to report incidents of these prohibited behaviors. Any such reports should be directed to Tech's Title IX Coordinator (Dr. Peter Phaiah, 20D Brown Hall, 575-835-5187, titleixcoordinator@nmt.edu). Please visit Tech's Title IX Website (www.nmt.edu/titleix) for additional information and resources.

Disaster Review Topics – "Seconds from Disaster" Episodes Found on YouTube
Air Disasters

Crash of the Concorde
Florida Swamp Air Crash (ValuJet)
Plane Crash in Queens (AA Flight 587)
Collision on the Runway (Tenerife)
Trains, Submarines, Space Shuttles, Aircraft Carriers
    Space Shuttle Columbia
    Russia's Nuclear Sub Nightmare (Kursk)
    Space Shuttle Explosion (Challenger)
    Derailment at Eschede
    Aircraft Carrier Explosion (USS Forrestal)
Infrastructure/Industrial Disasters
    Meltdown at Chernobyl
    Flood at Stava Dam
    Mountain Tsunami (Vajont Dam disaster)
Bhopal Nightmare (Union Carbide plant toxic gas leak)
The Deepwater Horizon (BP Oil Spill)
Explosion in the North Sea (Piper Alpha oil platform disaster)
Building Collapses
    Superstore Collapse (South Korea)
    Skywalk Collapse (Hyatt Regency Hotel in Kansas City)
Other
    Black Hawk Down (Battle of Mogadishu)
    Kaprun Disaster (Austrian funicular)