**SS201 - UNINTENDED CONSEQUENCES, INDUSTRIAL ACCIDENTS,**

**AND OTHER ANTHOPOGENIC DISASTERS**

**Fall 2019**

**MSEC 103**

**TR 9:30-10:45**

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**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?”

**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, describe, and explain human behaviors and how they are influenced by social structures, institutions, and processes within the contexts of complex and diverse communities.

2. Articulate how beliefs, assumptions, and values are influenced by factors such as politics, geography, economics, culture, biology, history, and social institutions.

3. Describe ongoing reciprocal interactions among self, society, and the environment.

4. Apply the knowledge base of the social and behavioral sciences to identify, describe, explain, and critically evaluate relevant issues, ethical dilemmas, and arguments.

**Course Requirements**:

**Required Texts:**

PDFs of readings will be posted to Canvas. Students are responsible for keeping up with the reading schedule. It is strongly encouraged that students print out and annotate electronically received readings.

**Assignments**

The structure of this course requires careful reading and research in preparation for engaged class discussion. For many classes, students will be asked, either individually or in groups, to research a particular case, guided by questions set out by the professor. Other days will have assigned readings. Students will be expected to have carefully read and taken notes, prior to that day’s class. Doing so will help ensure that more class time can be devoted to going beyond the readings rather than merely reviewing them.

Students missing more than two classes will incur a significant attendance grade penalty (full letter grade per day). Absences will also negatively affect the student’s participation grade. Penalties can be avoided by completing a writing assignment on a reading provided by the instructor.

This course consists of readings, short research assignments, class discussions, student presentations, two disaster analysis papers, and a final group project.

**Participation/Homework:** Students will be graded on their preparation for that days’ class, which entails having read and/or conducted brief Internet searching and thinking about the assigned example or case of an unintended consequence or accident. The latter will be proven by submitting a short write up of the student’s findings.

**Students should bring a laptop or another device for in-class research, but those distracted by their devices during lecture or class discussion will receive a zero for that day’s participation grade.** Students are encouraged to take handwritten notes so as to avoid the alluring pull of computerized distractions and should put their phones on vibrate and keep them in their book bags. Listening attentively but otherwise not participating will earn students a non-zero (but also non-passing: e.g., <50%) participation grade. Participation will also be earned through groupwork on in-class activities.

**Presentations:** Pairs of students will be responsible for preparing and giving a presentation that teaches a relevant case study to the rest of the class. Presentations will be 20-30 minutes and outline the background of the case as well as its connection to course readings. Basic source material for these presentations will be provided to the students, who will only perform outside research only if absolutely necessary to put together a cohesive presentation.

**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.

**Research Project**: Students will be divided into small groups and dedicate the last four weeks of the course to researching a case of emerging technoscience or an historic accident and characterizing it in depth using relevant course concepts. Considerable in-class time will be set aside for groups to conduct outside research, peer review, and assist one another in improving their thinking and analysis. This research will culminate in a 15-20 page paper as well as 20-30 minute presentation. Fairness in grading will be assured through self and peer evaluations.

**Course Schedule**:

**Section I: Unintended Consequences**

**Tue Aug 20 –** Review of Course & Syllabus – Unintended Consequences I: Complex Webs of Relationships

**Thu Aug 22 –** Unintended Consequences II – Vicious Cycles

**Tue Aug 27 –** Unintended Consequences III – Perverse Adaptations & Emergence

**\*\*\*Choose Round I Presenters**

**Thu Aug 29 –** Unintended Consequences IV – Complexity: Ecological Destabilization

**Tue Sep 3 – Student Presentations – Unintended Consequences**

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

**Thu Sep 5 –** Film: TMI; Reading: Perrow – “Disaster at Three Mile Island.”

**[Professor at Conference – Homework: Online Submission of Film Reflection]**

**Tue Sep 10 –** Discuss TMI – Why are some technologies more prone to disaster than others?; Reading: Perrow/Sagan – “Normal Accident Theory”

**\*\*\*Choose Round II Presenters**

**Thu Sep 12–** News Articles: Boeing 737 MAX. What went wrong?

**\*\*\*Choose Disaster Assignment Topics**

**Tue Sep 17– Student Presentations – Normal Accidents**

**Thu Sep 19 –** Reading Sagan – “Garbage Can Organizations” – More Examples

**\*\*\*Choose Round III Presenters**

**Tue Sep 24 –** Observation and Analysis – Watch a “Seconds from Disaster” Documentary

**Thu Sep 26 - Student Presentations – Garbage Can Organizations**

**Tue Oct 1 –** Disaster Analysis Workshop Day – Features of Good Writing – Bring in Rough Drafts

**Thu Oct 3 –** Film: “Command and Control” or “To the Brink of Eternity” **[Disaster Analysis Paper Due Friday at 5pm]**

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

**Tue Oct 8 –** Whetmore – “Amish Technology”

**\*\*\*Choose Round IV Presenters**

**Thu Oct 10** – Woodhouse – “More Intelligent Trial and Error” – Additional Examples

**Tue Oct 15 – Student Presentations – ITE**

 **[Move relevant cases to GCO sections/presentations]**

**Thu Oct 17 –** Rochlin et al. – “The Self-Designing High-Reliability Organization: Aircraft Carrier Flight Operations at Sea.” **\*\*\*Choose Risk Assignment Topics**

**Tue Oct 22 –** Sagan – “High Reliability Organizations” – Additional Examples

**Choose Round V Presenters**

**Thu Oct 24 –** Kletz – “Inherently Safer Design” – Additional Examples

**Tue Oct 29 –** **Student Presentations** **– HRO/Inherent Safety**

**Thu Oct 31 –** Risk Avoidance and Mitigation Assignment Workshop Day – Bring in Rough Drafts

**Tue Nov 5 –** Film: To Err is Human. **Assignments Due**

**Section IV: Application**

**Thu Nov 7 –** Pick Groups/Projects

**Risk Avoidance and Mitigation Assignment Due**

**Tue Nov 12 –** Open Work Day; Assemble Research Materials

**Thu Nov 14 –** Workshop I: Background; Characterizing the Technology.

**Tue Nov 19 –** Workshop II: Organizational Problems

**Thu Nov 21 –** Workshop III: Toward Better Risk Mitigation

**Tue Nov 26 –** Final Project Presentations

**Thu Nov 28 –** **[Thanksgiving]**

**Tue Dec 3 –**Final Project Presentations

**Thu Dec 5 –** Final Project Presentations

**[Final Paper Due Friday at 5pm]**

**Grading**:

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 20%

Case Study Presentation 15%

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.

**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 of Counseling and Disability Services (OCDS) as soon as possible. To schedule an appointment, please call 835-6619.

**Counseling Services:**

New Mexico Tech offers mental health and substance abuse counseling through the Office of Counseling and Disability Services. These confidential services are provided free of charge by licensed professionals. To schedule an appointment, please call 835-6619.

**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.

**Presentation Topics**

Unintended Consequences

Introduction and Strengthening of Pests

Effects of New Sports Technologies

Natural and Manmade Environmental Disasters

Automation and Pilot Performance

Is Google Making Us Stupid? Digital Devices and Mental Life

Suburbanization

Unintended Consequences of Green Technologies

Normal Accidents

Petrochemical Plants

Financial Meltdowns

Aloha Flight 243

ValuJet 592

Fukushima

Garbage Can Organizations

Florida’s Infrastructure and Hurricanes

Mobile Home Industry

Guadalupe Dunes Oil Spill

Columbia Disaster

Newsroom Normal Accidents

High Reliability Organization

Diablo Canyon Nuclear Plant

US Air Traffic Control

US vs. Soviet Submarine Programs

Aircraft Carriers

Intelligent Trial and Error

Wind Energy (Denmark vs. US vs. Germany)

Hurricane Katrina

Channel Tunnel

Biotechnology

**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)

**Possible Research Topics**

One of the above industrial accidents

Driverless Cars

Fossil Fuel Driven Climate Change

Pesticides, Consumer Plastics, or Any of Toxic Chemical

Super Intelligent Artificial Intelligence

Agricultural Crops Modified Through rDNA (and Similar) Techniques

Biotechnological Research Focused on Recreating or Modifying Deadly Diseases

Human Cognitive Enhancement

Companion Robots and Other Social Surrogates

Burying of Alaskan Way Viaduct

Or any other risky or potentially catastrophic instance of technoscience