

Human Error in Complex Systems

ISYE 348 Fall 2024 Lab 4

Aakash (@nimRobotics)

2024-10-07

This lab assignment is due in class on 2024-10-07. If you have any questions or need clarification, please reach out to me via email or during office hours. The report will be graded on **20 points** based on the following criteria:

Question	5 (Exceptional)	4 (Very Good)	3 (Satisfactory)	2 (Needs Improvement)	1 (Poor)	0 (No Credit)
1. Incident Overview and Root Cause	Comprehensive summary with multiple factors and strong root cause analysis.	Strong summary with several factors and good analysis.	Adequate summary with some factors, basic analysis.	Lacks details, identifies few factors, limited analysis.	Incomplete, fails to identify meaningful factors, poor analysis.	No response or off-topic.
2. Communication and Safety Culture	In-depth analysis with examples, identifies key factors and missed opportunities.	Strong analysis with examples, identifies key factors.	Adequate analysis, identifies obvious factors.	Superficial, few examples, misses key factors.	Minimal analysis, fails to identify key factors.	No response or off-topic.

Question	5 (Exceptional)	4 (Very Good)	3 (Satisfactory)	2 (Needs Improvement)	1 (Poor)	0 (No Credit)
3. Human-System Integration	Detailed description of interfaces, proposes insightful improvements.	Clear description, proposes practical improvements.	Adequate description, proposes reasonable improvements.	Vague description, proposes limited improvements.	Inadequate description, fails to propose improvements.	No response or off-topic.
4. Decision Making	Identifies decisions with insightful analysis of biases, suggests strategies.	Identifies key decisions with strong analysis, suggests practical strategies.	Identifies some decisions with basic analysis, suggests reasonable strategies.	Identifies few decisions with limited analysis, suggests weak strategies.	Fails to identify meaningful decisions or strategies.	No response or off-topic.
5. Lessons and Prevention	Extracts meaningful lessons, proposes actionable recommendations.	Identifies important lessons, proposes actionable recommendations.	Identifies basic lessons, proposes general recommendations.	Identifies few lessons with vague recommendations.	Superficial lessons, fails to propose recommendations.	No response or off-topic.

Submission: There is no submission required for this lab. You will work in your groups and discuss the case study assigned to you. You will then present your findings in class using the points provided (~10 mins per group).

Collaboration with your classmates is encouraged, and you will work in groups of three and present your findings in class.

Late submissions will be penalized by a 1 point deduction every hour past the deadline.

Please read the course policy on academic integrity and collaboration on the course syllabus. If you have any questions about what is permissible, please ask before submitting your work.

Introduction

Human error is a significant factor in many accidents and incidents across various industries, including aviation, healthcare, manufacturing, and transportation. Understanding the nature of human error, its causes, and its consequences is crucial for designing systems that are resilient to human fallibility

Objectives

Our goals for this lab are:

1. To understand the factors contributing to human error
2. To discuss the implications of human error for system design and safety
3. To analyze case studies of human error in real-world incidents
4. To propose strategies for reducing and mitigating human error in complex systems

Factors Contributing to Human Error

Some factors that can contribute to human error include:

- **Fatigue:** Sleep deprivation and long work hours can impair cognitive function and decision-making.
- **Stress:** High-pressure situations can lead to tunnel vision, reduced situational awareness, and poor decision-making.
- **Distractions:** External distractions or interruptions can disrupt task performance and lead to errors.
- **Lack of Training:** Inadequate training or experience can result in errors during complex tasks.
- **Poor Communication:** Miscommunication or lack of information sharing can lead to misunderstandings and errors.
- **Equipment Design:** Poorly designed tools or interfaces can increase the likelihood of errors.
- **Organizational Culture:** A culture that discourages reporting or learning from mistakes can contribute to human error.
- **Cognitive Biases:** Mental shortcuts or biases can lead to flawed decision-making and errors.
- **Task Complexity:** Complex tasks or procedures can overwhelm cognitive resources and increase the risk of errors.
- **Time Pressure:** Tight deadlines or time constraints can lead to rushed decisions and errors.
- Several other factors can also influence human performance and contribute to errors in complex systems.

Case Studies

Each group will work on only one of the following case studies. Please refer to the assigned case study for your group and answer the discussion questions provided.

Case Study	Groups
C1: Boeing 737 MAX Crashes	1,4,7,10,13
C2: USS Fitzgerald Collision	2,5,8,11,14
C3: Medical accident at St. Mary	3,6,9,12,15

The readings for each case study are provided on canvas (i.e. case study 1 starts with C1_...).

C1: Boeing 737 MAX Crashes

The Boeing 737 MAX crashes in 2018 and 2019 were the result of a series of design flaws, regulatory failures, and human errors.

C2: USS Fitzgerald Collision

The collision of the USS Fitzgerald with a cargo ship in 2017 was caused by a combination of human errors, poor communication, and inadequate training.

C3: Medical accident at St. Mary's Hospital in Madison

A medical accident at St. Mary's Hospital in Madison in 2006 resulted in the death of a patient due to a series of errors in medication administration.

Discussion Questions

For your assigned case study, please answer the following questions. Your responses should be based on the information provided in the case study and your understanding of human factors principles. Please ground your answers in relevant concepts and theories from the course material covered in ISY349.

1. Incident Overview and Root Cause Analysis

- Provide a brief summary of the incident.
- What were the immediate causes of the accident/incident?
- How would you classify the human error(s) involved in the incident (e.g., slips, lapses, mistakes)?
- Identify at least three underlying systemic factors that contributed to the event.
- How did these factors interact to create the conditions for the accident/incident?

2. Communication and Safety Culture

- Analyze the role of communication (or lack thereof) in the incident.
- What aspects of the organization's safety culture, if any, contributed to the event?
- Identify any missed opportunities for intervention or reporting that could have prevented the incident.

3. Human-System Integration

- Describe the key interfaces between humans and systems (technological, procedural, or organizational) involved in the incident.
- How did the design of these interfaces contribute to the occurrence of errors?
- Propose at least two specific design improvements that could help prevent similar incidents in the future.

4. Decision Making Under Uncertainty

- Identify critical decisions made during the incident or in events leading up to it.
- What cognitive biases or decision-making pitfalls may have influenced these decisions?
- Suggest strategies or tools that could have supported better decision-making in this scenario.

5. Lessons Learned and Future Prevention

- What are the three most important lessons that can be drawn from this incident?
- Propose specific, actionable recommendations for preventing similar incidents in the future.
- Discuss potential challenges in implementing these recommendations and how they might be overcome.