



TEXAS TECH UNIVERSITY SYSTEM™

**NIST Standards Services Curricula Development
Cooperative Agreement Program
Awardee Meeting 2026**

Integrating Emergency, Disaster, and Crisis Management Standards into Engineering Curriculum

September 10, 2026

Dr. Changwon Son (PI)

Dr. Mihwa Park

Dr. Wesley Wehde

Texas Tech University

This work was performed under the sponsorship of the U.S. Department of Commerce, National Institute of Standards and Technology.

- PI: Changwon Son
- Co-Pis: Mihwa Park & Wesley Wehde
- Project period: 01/2024 - 12/2026



Background

- Engineers in the field are responsible for EDCM

Mechanical Eng.

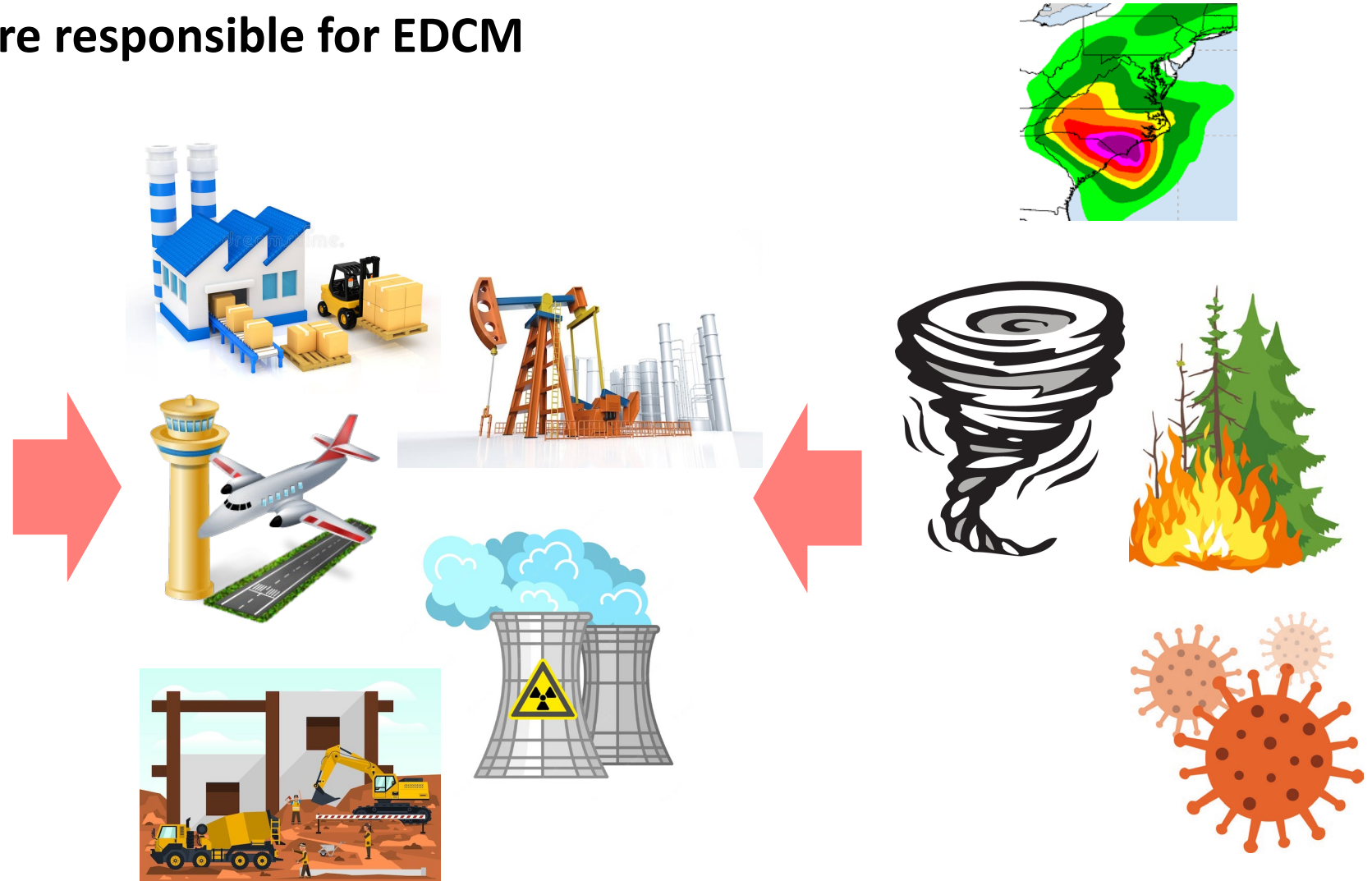
(Petro) Chemical Eng.

Civil/construction Eng.

Electrical/comp Eng.

Biomedical Eng.

Other Eng.

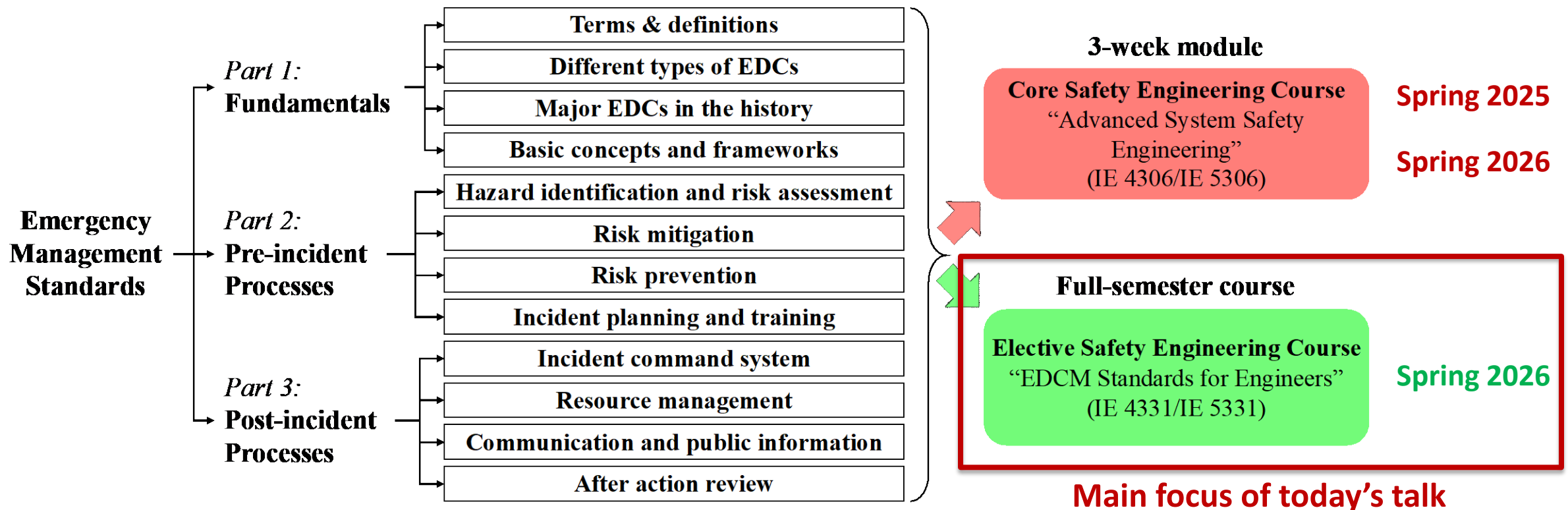


- **Limited education for engineering students on EDCM standards**

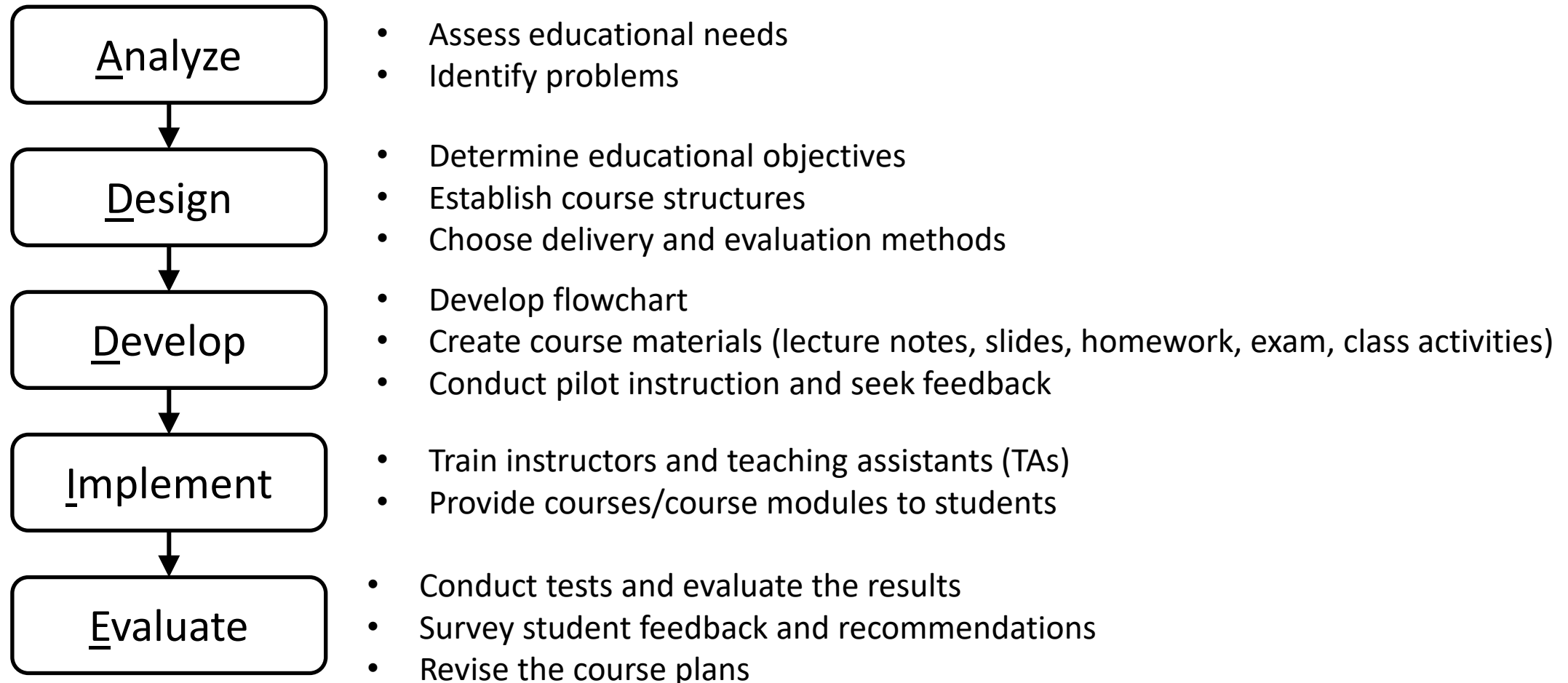
- Only 6.5% of over 5,300 US Higher Education Institutes offer emergency management programs.
- Existing safety courses in engineering departments are limited to **engineering and technical safety**:
 - ✓ Occupational safety
 - ✓ Chemical process safety
 - ✓ Construction safety
 - ✓ Industrial hygiene
 - ✓ Lab safety
- **Previous standards education efforts** were focused on teaching occupational safety and health standards such as ISO 14001 (environmental) and ISO 45001 (OSH).

■ Project objective

- To develop a publicly accessible and replicable education module/course on emergency, disaster, and crisis management (EDCM) standards for undergraduate and graduate engineering students.



■ Instructional Design – ‘ADDIE’ model



- **Semi-structured interviews with three stakeholder groups**
 - Engineering students recruited from Texas Tech, N=13 (grad and UG)
 - Faculty members recruited from multiple institutions, N=3
 - Public safety professionals recruited from public safety organizations (fire, EMS, emergency management), N=4
- ✓ Convenience sampling and snowball sampling methods
- ✓ In-person and virtual (e.g., Zoom, Teams) interviews

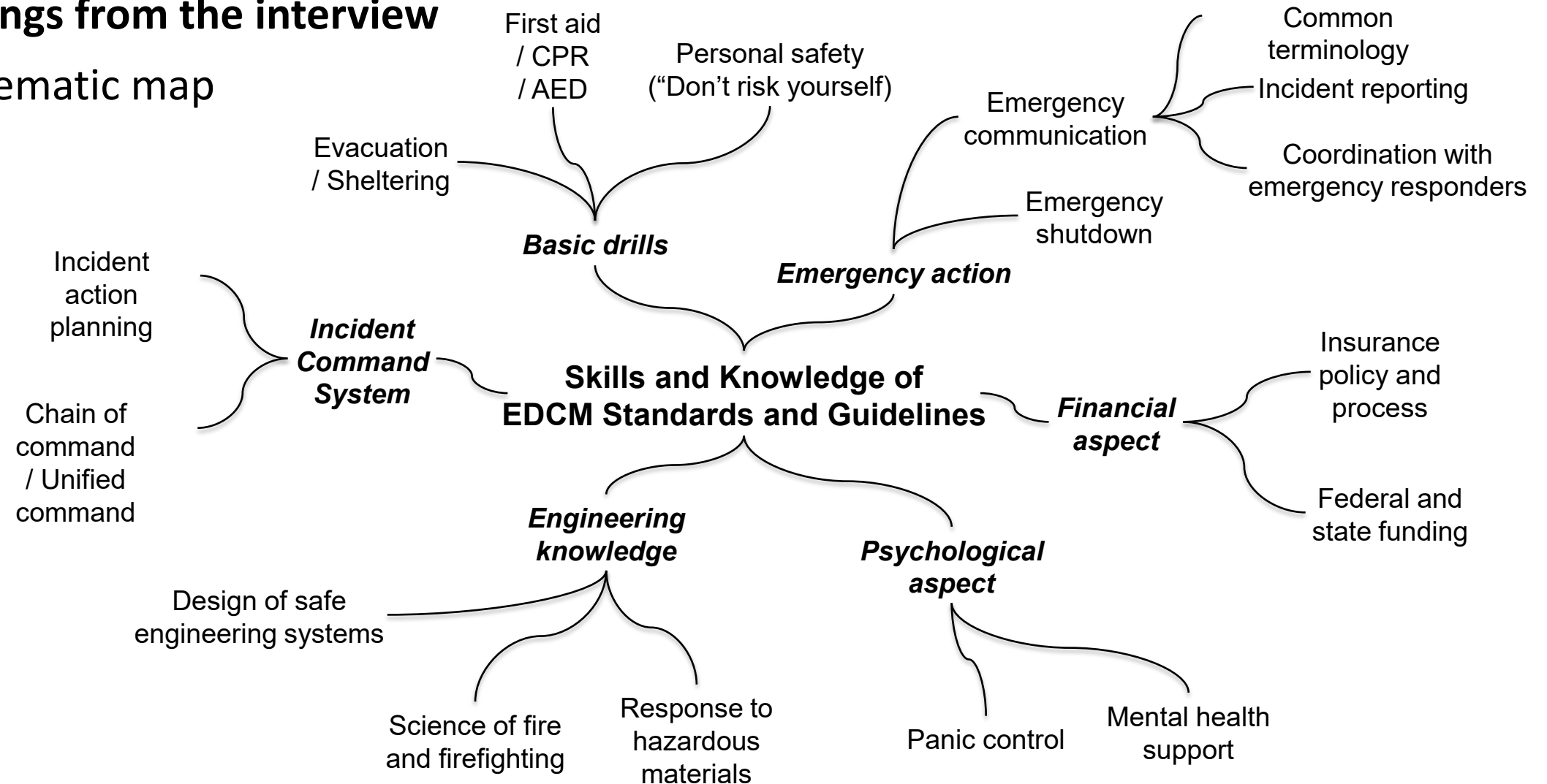
❖ **Texas Tech University IRB No. 2024-16**

- **Questions used in the interviews**
 - Importance, Asset, and Needs approach

Dimension	Questions
Importance	How important do you think it is to have an ability to manage emergency, disaster, and crisis as an engineer? Why do you think it is important? What emergency, disaster, or crisis made you think so?
Assets	How much knowledge do you have of emergency, disaster, and crisis management (EDCM)? What skills and knowledge of EDCM do you think engineering students (or engineers) are lacking? What courses provided any of EDCM standards and guidelines? What EDCM standards and guidelines did you learn (teach)?
Needs	What specific learning elements do you want to see from the future courses? What learning methods or learning environments do you think would be the best for the courses? What skills and knowledge do you expect of engineering students when they graduate?

Findings from the interview

- Thematic map



Advanced System Safety Engineering			Enrollment	Hours
3-week module (second iteration)	IE4306-001 (in-person, UG)	N=29	}	T/TH, 12:30am-1:50pm
	IE5306-001 (in-person, Grad)	N=16		
	IE5306-D01 (online, Grad)	N=12		
Emergency/disaster/crisis mgt principles & practices				
A full elective (first iteration)	IE4331-001 (in-person, UG)	N=1	}	T/TH, 9:30am-10:50am
	IE5331-001 (in-person, Grad)	N=2		
	IE5331-D01 (online, Grad)	N=1		

Spring 2025 IE4306/5306 Course Overview



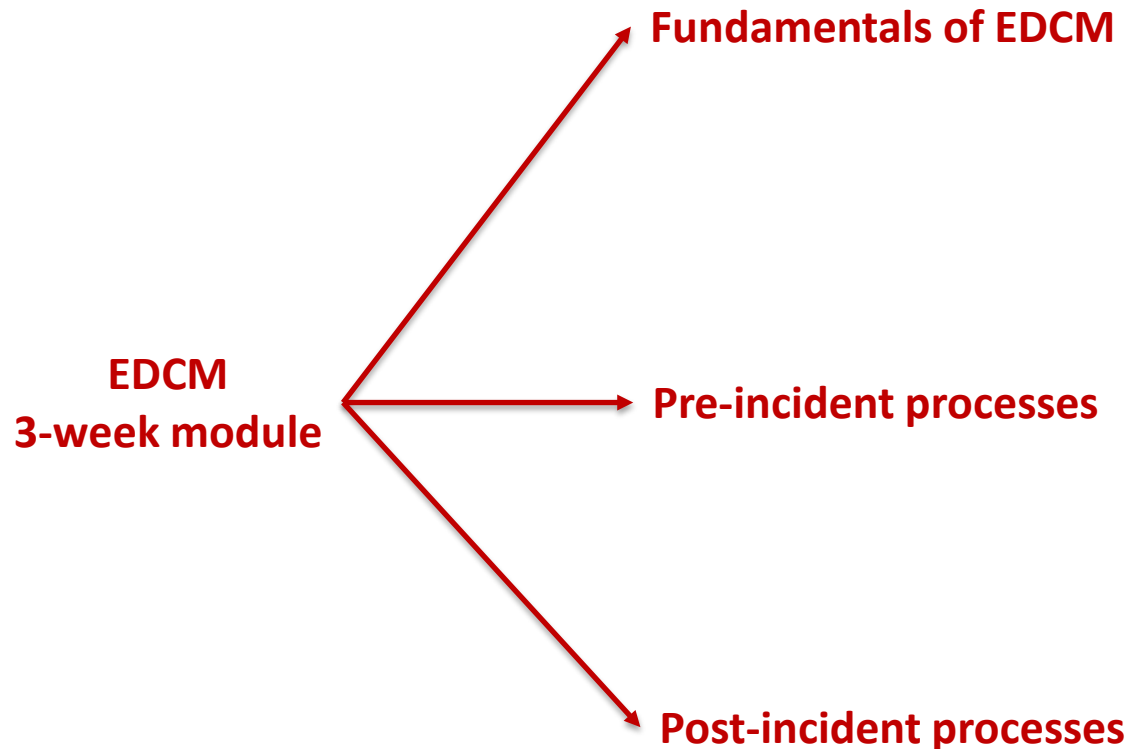
■ Course Overview

	Date	Topic(s) to be covered / Activity
Fundamentals of safety	Jan 15 (Thu)	1. Introduction and course overview
	Jan 20 (Tue)	2. Safety terms and definitions
	Jan 22 (Thu)	3. Systems safety process and safety management system
	Jan 27 (Tue)	4. Safety standards and regulations
	Jan 29 (Thu)	5. Safety indicators and incident statistics
Safety analysis methods	Feb 3 (Tue)	6. Hierarchy of control
	Feb 5 (Thu)	7. Major industrial incidents
	Feb 10 (Tue)	8. Preliminary Hazard Analysis
	Feb 12 (Thu)	9. Failure Mode and Effect Analysis (FMEA)
	Feb 17 (Tue)	10. Fault Tree Analysis (FTA)
	Feb 19 (Thu)	11. Event Tree Analysis (ETA)
	Feb 24 (Tue)	12. Bow-tie Analysis
	Feb 26 (Thu)	Midterm exam 1
	Mar 3 (Tue)	13. Process Safety Analysis – HAZOP/LOPA
	Mar 5 (Thu)	13. Process Safety Analysis – HAZOP/LOPA
EDCM 3-week module	Mar 10 (Tue)	14. Human Reliability Analysis (HRA)
	Mar 13 (Thu)	<i>Campus closure due to power outage</i>
	Mar 17 & 19	<i>Spring Break, No Class</i>
	Mar 24 (Tue)	14. Human Reliability Analysis (HRA)
	Mar 26 (Thu)	15. Emergency Management - A. Fundamentals
	Mar 31 (Tue)	15. Emergency Management - A. Fundamentals
	April 2 (Thu)	16. Emergency Management – B. Pre-incident Processes
	April 7 (Tue)	16. Emergency Management – B. Pre-incident Processes
	April 9 (Thu)	17. Emergency Management – C. Post-incident Processes
	April 14 (Tue)	17. Emergency Management – C. Post-incident Processes
Advanced safety concepts and methods	April 16 (Thu)	Midterm exam 2
	April 21 (Tue)	18. Safety-I and Safety-II Approaches
	April 23 (Thu)	19. Resilience Engineering
	April 28 (Tue)	19. Resilience Engineering
	April 30 (Thu)	20. Systems safety analysis method – AcciMap
	May 5 (Thu)	21. Systems safety analysis method – FRAM
	May 8 (Fri)	Final exam (comprehensive)
	7:30-10:00pm	

Spring 2025 IE4331/5331 Course Overview



■ Course Overview



Date	Topic(s) to be covered / Activity
Jan 15 (Thu)	1. Introduction and course overview
Jan 20 (Tue)	2. EDCM Terms and definitions
Jan 22 (Thu)	3. Different types of EDCs and their impacts
Jan 27 (Tue)	4. Major EDCs in the history
Jan 29 (Thu)	5. Importance and needs for emergency planning
Feb 3 (Tue)	6. Roles of an emergency planner
Feb 5 (Thu)	7. Ethics of EDCM
Feb 10 (Tue)	8. Politics and legal issues of EDCM
Feb 12 (Thu)	9. Critical infrastructure in EDCM
Feb 17 (Tue)	10. Economics and logistics of EDCM
Feb 19 (Thu)	Midterm exam 1
Feb 24 (Tue)	11. NRF: EDCM framework and guiding principles
Feb 26 (Thu)	11. NRF: EDCM framework and guiding principles
Mar 3 (Tue)	12. Critical community lifelines
Mar 5 (Thu)	13. Preparedness for EDCs
Mar 10 (Tue)	14. Developing emergency plans
Mar 13 (Thu)	14. Developing emergency plans
Mar 17 & 19	<i>Spring Break, No Class</i>
Mar 24 (Tue)	15. Emergency support functions
Mar 26 (Thu)	15. Emergency support functions
Mar 31 (Tue)	16. Emergent organizations during EDCs
April 2 (Thu)	Midterm exam 2
April 7 (Tue)	17. NIMS-Resource management
April 9 (Thu)	17. NIMS-Command and coordination
April 14 (Tue)	17. NIMS-Information and communication
April 16 (Thu)	18. NIMS case studies
April 21 (Tue)	19. Financial aspects of EDCM
April 23 (Thu)	20. Psychological aspects of EDCM
April 28 (Tue)	21. Training and exercise for EDCM
April 30 (Thu)	22. Course summary
May 8 (Fri)	Final exam (comprehensive)
1:30-4:00pm	

■ Description

Terms and definitions of emergency, disaster, and crisis management (EDCM), different types of EDCs, emergency planning, ethics in EDCM, political and legal aspects, critical infrastructure, economics and logistics of EDCM, National Response Framework (NRF), developing emergency plans, emergency support functions, and emergency organizations.

Course Objectives & Learning Outcomes



■ Objectives

This course aims to:

- Help students learn fundamental principles of emergency, disaster, and crisis management (EDCM)
- Help students understand the process of emergency planning and response.
- Help students apply the fundamental principles and processes of the EDCM to different incident contexts.
- Help students enhance skills and knowledge of managing emergency, disaster, and crisis.

■ Learning outcomes

After successfully completing this course, students will be able to:

- Identify and understand fundamental EDCM theory and standards,
- Understand basic terms, principles, and processes of EDCM,
- Apply the principles and processes of EDCM to real-world examples,
- Establish emergency plans for potential incidents.

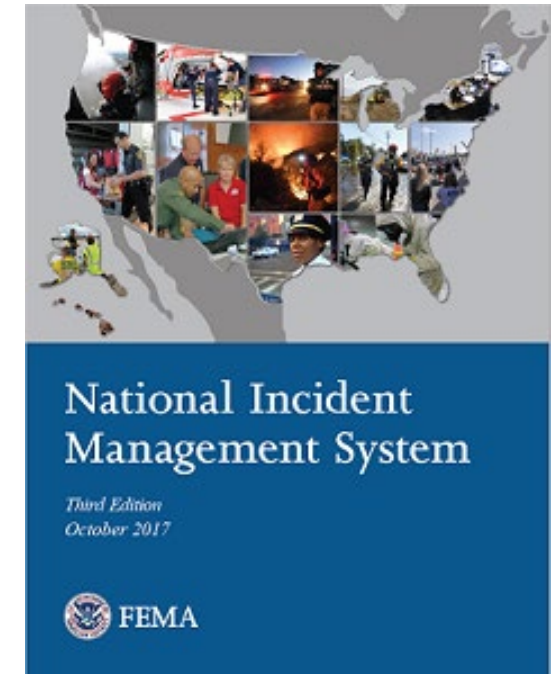
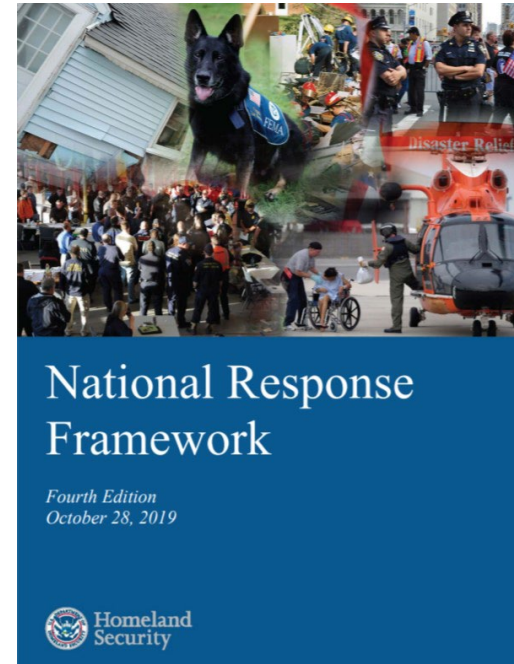
Major Teaching Components

■ Foundational Components

- Terms and definitions of EDCM
- Emergency planning
- National Response Framework (NRF)
- Emergency Support Functions (ESF)
- NIMS – Resource Management
- NIMS – Command and Coordination
- NIMS – Information and Communication

■ Other Essential Components

- Ethical aspects of EDCM
- Legal aspects of EDCM
- Economic aspects of EDCM
- Psychological aspects of EDCM
- Financial aspects of EDCM
- Training and education



From Lecture 4. Importance of Emergency Planning

Hospital's Response to Hurricane



Journal of Critical Infrastructure Policy • Volume 1, Number 1 • Spring/Summer 2020

Opportunities and Challenges for Resilient Hospital Incident Management: Case Study of a Hospital's Response to Hurricane Harvey

Changwon Son,¹ Ethan Larsen,² Farzan Sasangohar,^{1,2*} S. Camille Peres³

¹ Industrial and Systems Engineering, Texas A&M University

² Center for Outcomes Research, Houston Methodist Hospital

³ Environmental and Occupational Health, Texas A&M University

* Corresponding author: sasangohar@tamu.edu

“The general public’s access to medical facilities (e.g., local and regional healthcare providers) was severely limited due to road closure, and that most local clinics (e.g., dialysis providers) were closed for an extended period of time even after Harvey dissipated. As a result, the study hospital experienced a patient surge, including those who had to receive dialysis, especially in the ED.” (Son et al., 2020, p. 90)

Editor's Note: JCIP has established an ongoing relationship with the Resilience Week Symposium, the preeminent research conference on transforming the resilience of critical infrastructure systems and communities. Organized by the country's national laboratories and other partners, the conference sponsors an annual student research competition. Each year, JCIP will determine whether to invite an expanded paper from winners of the conference's Best Presentation Award. This article marks the first such publication, submitted by a 2019 Resilience Week Student Competition winner.

Using the instructor's own journal paper to help students understand the applicability of emergency planning process to private sectors such as healthcare.

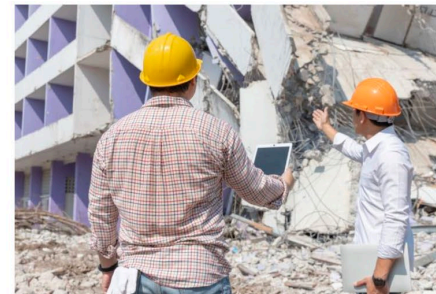
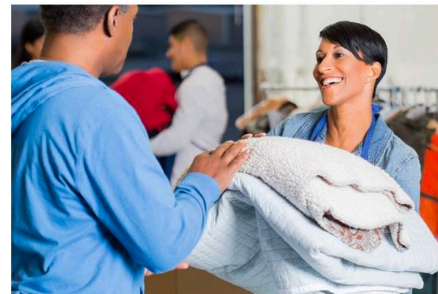
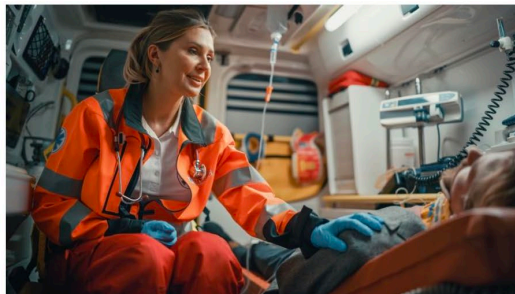
From Lecture 6. Ethical aspects of EDCM

IAEM's Code of Professional Conduct



Using the IAEM's Code of Professional Conduct to explain ethical conducts during disasters.

- The International Association of Emergency Managers (IAEM)
 - Professionalism
 - ✓ IAEM is an organization that actively promotes professionalism to ensure public confidence in emergency management.
 - ✓ Our reputations are built on the faithful discharge of our duties.
 - ✓ Our professionalism is founded on education, safety, and protection of life and property.



Selected Teaching Materials

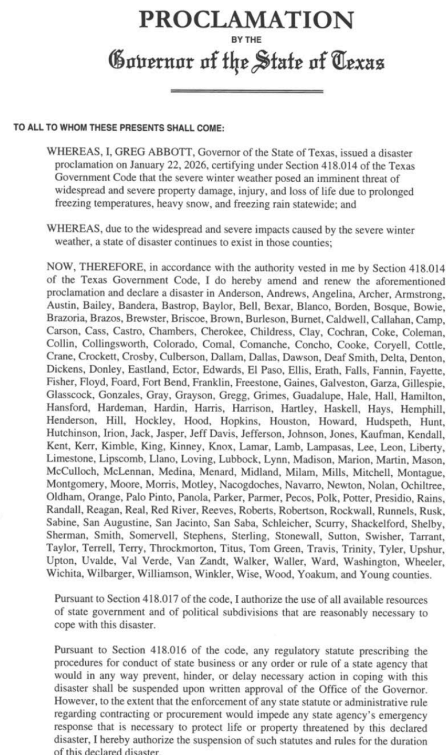
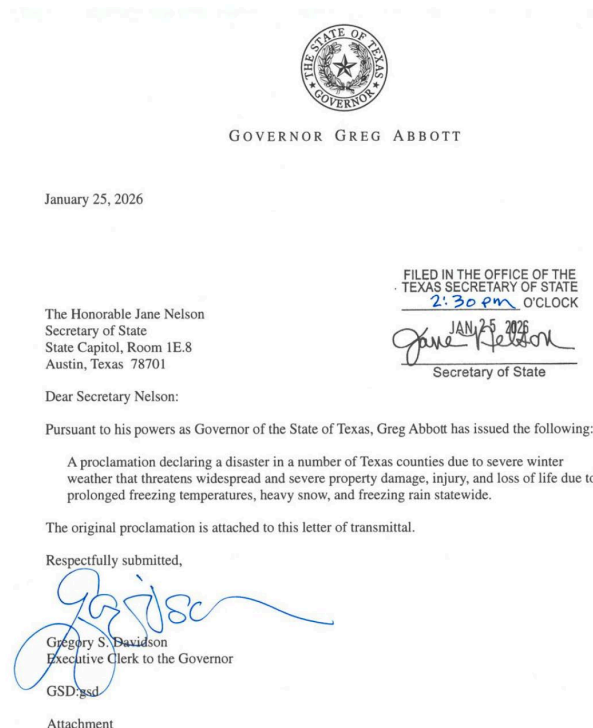
From Lecture 7. Legal aspects of EDCM

Disaster Declarations



- Example (Source: https://gov.texas.gov/uploads/files/press/DISASTER_January_winter_storm_IMAGE_01-25-2026_%281%29.pdf)

Real-world example of disaster declaration for extremely cold weather across the state of Texas in January 2026.



Governor Greg Abbott
January 25, 2026

Proclamation
Page 2

In accordance with the statutory requirements, copies of this proclamation shall be filed with the applicable authorities.



ATTESTED BY:

JANE NELSON
Secretary of State

IN TESTIMONY WHEREOF, I have hereunto signed my name and have officially caused the Seal of State to be affixed at my office in the City of Austin, Texas, this the 25th day of January, 2026.

GREG ABBOTT
Governor

From Lecture 17. NIMS Case Study – Hurricane Katrina

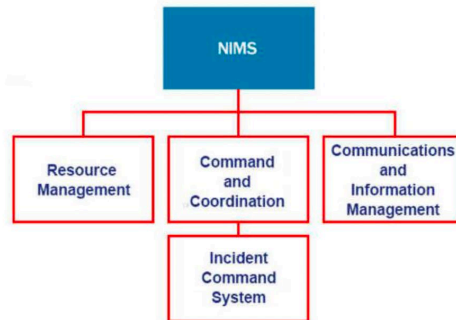
Communications and Coordination Problems



Crucial roles of disaster information and communication by taking an example of communication breakdown during Hurricane Katrina

❖ Information Breakdown

- **Situational awareness and command collapsed**
 - **Communication losses** prevented responders from quickly determining needs, conditions, resource status, and operational priorities across the disaster area.
 - A **command structure cannot function well without accurate, timely, and shared information** to support decisions and synchronize actions.



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Assessments in IE 4331/5306 Spring 2026



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Jan 20 (Tue)	2. Safety terms and definitions
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May 8 (Fri)	Final exam (comprehensive)
7:30-10:00pm	

← Pre-learning knowledge assessment

← Motivation survey

← Learning strategies survey

← Post-learning knowledge assessment

← Emotion survey

**EDCM
module**

■ Student Demographics

- The sample comprised **62 participants**: 42 male (67.74%) and 18 female (29.03%), and two students (3.23%) who did not report their gender.
- A total of **39 participants finished all surveys** which included pretest, SRL and Emotion questionnaires, and posttest.

Demography	Categories	Frequency	Percent
Gender	Male	25	64.10%
	Female	14	35.90%
Race	Asian or Asian American	13	33.33%
	Hispanic or Latino	11	28.21%
	White or Caucasian	10	25.64%
	Black or African American	5	12.82%
Education Level	Undergraduate	25	64.10%
	Graduate	14	35.90%

- **Knowledge gain on EDCM standards**
 - **A paired sample t-test** was carried out to identify the EDCM knowledge difference.
 - There was a **significant EDCM knowledge difference before** ($M = 7.23$, $SD = 2.26$) **and after** ($M = 10.18$, $SD = 1.86$, $p < 0.05$) the module was taught.
 - There were **no differences** in EDCM knowledge score, SRL (self-regulated learning), and emotional factors **by gender** ($p > .05$).
 - In terms of educational level, independent t-test result showed **graduate students** ($M = 19.81$, $SD = 2.52$) **had a significantly higher value component of motivation than undergraduate students** ($M = 17.69$, $SD = 2.11$, $p < .05$).

■ Association between measures

- Motivation, learning strategies, and emotion were not individually associated with knowledge gain.
 - Adaptive motivation: $r=.06$, $p=.743$
 - Overall learning strategies: $r=.12$, $p=.490$
 - Test anxiety: $r=-.17$, $p=.304$.
- The combined measures of motivation, learning strategies, and emotion did not meaningfully predict knowledge gain.
 - A joint model explained only 4.0% of gain variance.

- In Terms of Project Objectives

To develop a publicly accessible and replicable education module/course on emergency, disaster, and crisis management (EDCM) standards for undergraduate and graduate engineering students.



A 3-week module and a full elective course for EDCM standards have been developed and provided for both undergraduate and graduate engineering students.

- **Educational Needs**



Educational needs identified from students, faculty, and professionals have informed the course content and structure in both the 3-week module and a full elective course.

■ Research on Education

- Data was collected not only for knowledge gain but also other factors such as motivation and learning strategies. (credit : Dr. Mihwa Park, TTU College of Education)
- Future research should be focused on identifying strong predictors on student learning and knowledge gain.

Article

Self-Regulated Learning and Achievement Emotions in an Engineering Emergency Management Module

Mihwa Park ^{1,*}, Changwon Son ² and Sarah M. Fadillah ¹

¹ Department of Curriculum and Instruction, College of Education, Texas Tech University, Lubbock, TX 79409, USA; sfadilla@ttu.edu

² Department of Industrial Engineering, College of Engineering, Texas Tech University, Lubbock, TX 79409, USA; changwon.son@ttu.edu

* Correspondence: mihwa.park@ttu.edu

Abstract

This study examined engineering students' intrapersonal factors, self-regulated learning (SRL) and achievement emotions, and their prior emergency, disaster, and crisis management (EDCM) knowledge, within a three-week EDCM module embedded in an engineering course. We collected data at three points during the implementation of the EDCM module ($N = 53$). First, before the module began, students completed a demographic questionnaire, the SRL motivational orientation questionnaire, and an EDCM knowledge pretest. Second, during module implementation, students completed the SRL learning strategy questionnaire. Third, after the module was completed, students completed the achievement emotion questionnaire. We included 53 students' data and analyzed it using non-parametric statistics. Results showed no significant gender differences in learning strategies or achievement emotions; however, male students' motivation was significantly higher than that of female students. In addition, significant differences by race were found in motivational orientation, learning strategies, achievement emotions, and prior EDCM knowledge. Motivational orientation was positively associated with positive emotions, particularly enjoyment and pride, and negatively associated with negative emotions. Learning strategies, meanwhile, were primarily associated with positive emotions. Prior EDCM knowledge showed limited associations with intrapersonal factors. These findings highlight the importance of redesigning EDCM instruction in engineering education to be both effective and more responsive.

Keywords: achievement emotions; disaster education; emergency management; self-regulated learning

Park, M., Son, C., & Fadillah, S. M. (2026). Self-Regulated Learning and Achievement Emotions in an Engineering Emergency Management Module. *Education Sciences*, 16(7), 1146. <https://doi.org/10.3390/educsci16071146>

2026 ASEE ANNUAL CONFERENCE

June 21–24, 2026 | Charlotte Convention Center, NC

Host Sponsor UNC Charlotte



Paper ID #50550

Exploring Intrapersonal Factors in an Engineering Module on Emergency, Disaster, and Crisis Management: A Work-in-Progress Study

Dr. Mihwa Park, Texas Tech University

Dr. Mihwa Park is an Associate Professor of STEM education at Texas Tech University. Her research interests involve developing measurement instruments to assess students' understanding of scientific concepts and their emotions when learning science. She is also interested in teachers' emotions about teaching science and teacher identity.

Dr. Changwon Son, Texas Tech University

Dr. Changwon Son is an Assistant Professor in the Department of Industrial, Manufacturing, & Systems Engineering at Texas Tech University. Dr. Son is the principal investigator (PI) of a NIST-funded engineering education project that is focused on developing educational contents for emergency, disaster, and crisis management (EDCM) standards for engineering students. Dr. Son is the director of Safety, Human factors, And Resilience Engineering (SHARE) Lab at Texas Tech. He is the recipient of George T. and Gladys Abell-Hanger Faculty Award of Texas Tech University Whitacre College of Engineering.

Sarah Meilani Fadillah, Texas Tech University

Dr. Wesley Wehde, Texas Tech University

I am an Assistant Professor of Public Administration in the Department of Political Science at Texas Tech University. My research interests are broadly within the field of public policy. Substantively and specifically, I am interested in using cases from environmental and natural hazards policy and politics to contribute to developing theoretical approaches to the policy process, applied policy analyses, and public administration.

Park, M., & Son, C., & Fadillah, S. M., & Wehde, W. (2026, June), *Exploring Intrapersonal Factors in an Engineering Module on Emergency, Disaster, and Crisis Management: A Work-in-Progress Study* Paper presented at 2026 ASEE Annual Conference & Exposition, Charlotte, North Carolina. 10.18260/1-2--5976

Thanks!



Questions?

Changwon.son@ttu.edu