

Engineering Ethics and the Rebuilding of New Orleans After Katrina

Norma Jean Mattei, Ph.D., P.E.

University of New Orleans

Dept. of Civil and Environmental Engineering

Tulane Engineering Forum, May 2007

This presentation is dedicated to the employees of the U.S. Army Corps of Engineers, New Orleans District.

Format of Presentation

- How engineers rank, ethically
- Codes of conduct
- Engineers are human
- IPET Report issues
- Probability of successfully addressing IPET issues
- The profession's ethical responsibility

1990 Survey (Zinckgraf)

- 1000 Corporate Executives polled (forced choice)

<u>OCCUPATION</u>	<u>Which most ethical</u>
– Engineer	34%
– CPA	24%
– Doctor	17%
– Dentist	7%
– Lawyer	8%
– Other	10%

Engineering Ethics: Codes of Conduct

- ASCE
- NSPE
- ASME
- IEEE
- ASHRAE
- etc.....

Professional societies have similar codes of conduct

NSPE Code of Ethics
FUNDAMENTAL CANONS
RULES OF PRACTICE

#1

**Maintain safety, health & public
welfare**

NSPE Code of Ethics
FUNDAMENTAL CANONS
RULES OF PRACTICE

#2

**Perform services only in area of
competence**

NSPE Code of Ethics
FUNDAMENTAL CANONS
RULES OF PRACTICE

#3

**Public statements must be
objective and truthful**

NSPE Code of Ethics
FUNDAMENTAL CANONS
RULES OF PRACTICE

#4

**Be a faithful agent or trustee in
representing employer or client**

NSPE Code of Ethics
FUNDAMENTAL CANONS
RULES OF PRACTICE

#5

**Avoid deception in solicitation of
professional employment**

NSPE Code of Ethics
FUNDAMENTAL CANONS
RULES OF PRACTICE

#6

**Conduct oneself honorably,
responsibly, ethically, and
lawfully**

LAPELS Board

- Governed by two documents:
 - Law (LA Revised Statutes 37:681-37:703)
 - Rules of the Board (LA Administrative Code)
- Rules are legally binding on every licensee
- Rules include Professional Conduct (Chapter 25)
 - Licensees, services, conflicts of interest, improper solicitation, and conduct of advertising
- **Licensees shall hold paramount public safety**

The background is a dark blue gradient. A thin, light blue curved line starts from the top left and arcs across the middle. A larger, semi-transparent blue shape, resembling a spotlight or a lens flare, is positioned in the lower right quadrant, partially overlapping the text.

Do we always do the right
thing?

Unconscious Bias

- Psychological studies
 - Our desires powerfully influence the way we interpret information
 - Even if we try to be objective and impartial

Unconscious Bias

- Most of us think
 - We are better than average drivers
 - Our kids are smarter than average
 - We are not too drunk to drive
 - The storm will turn
- We erroneously conclude that our decisions are free from bias

Six aspects of human nature that leave an opening for bias

- AMBIGUITY

- Possibility of interpreting information in different ways
- Two design differing even if same requirements used

- ATTACHMENT

- Engineers have strong motivation to remain in a client's good graces

- APPROVAL

- CORPS: Vicksburg must ultimately reject or agree with the New Orleans District's levee design

Six aspects of human nature that leave an opening for bias

- **FAMILIARITY**

- People are more willing to harm strangers than people they know

- **DISCOUNTING**

- People are far more responsive to immediate consequences, rather than delayed, uncertain ones

- **ESCALATION**

- People may explain away minor oversights, sometimes without realizing it.
- Over time they build up and are recognized
- Sometimes people, instead of owning up, conceal the oversights

Other aspects of human nature

DENIAL

Other aspects: organizational culture and inertia

- The “Dilbert” Syndrome
 - Upper Management
 - Decisions based only on the bottom line
 - Money
 - Schedule
 - Historical precedence
 - The “worker bee” engineer
 - The “check the boxes” mentality
 - Won’t think outside of the box
 - Does not challenge existing rules

Other aspects: engineering as a profession

- Engineering defined as the application of math and science in service to humanity
- Engineering is a marriage of science and business
 - As engineers, we walk a tight rope
 - Safety on one side
 - Economy on the other

Other aspects: engineering education

- Present engineering curriculum is
 - Narrowly defined
 - Packed with technical courses
- Tomorrow's engineers must be educated
 - Think broadly in fundamental and integrative ways
 - To lead
- If we define engineering as the application of math and science in service to humanity, can we ignore the study of:
 - The human condition
 - The human experience
 - The human record

Is It Time to Shut Down Engineering Colleges? by Domenico Grasso

“The breach of the levees in New Orleans, which has unleashed a torrent of human suffering, came about not solely because engineers designed for a category 3, rather than a category 4, hurricane. It was caused by decades of engineering and technical hubris, which resulted in loss of wetlands and overbuilding on a grand scale. Would engineers who had studied economics, ecology, anthropology, or history have acted the same?”

CORPS of Engineers' s Mission

- To provide quality responsive engineering services to the nation
 - Planning, designing, building, and operating water resources and other civil works
 - Navigational
 - Flood control
 - Environmental protection
 - Disaster response

IPET Report

- Volume I: Executive Summary
- Volume II: Geodetic Vertical and Water Level Datum
- Volume III: The Hurricane Protection System
- Volume IV: The Storm
- Volume V: The Performance - Levees and Floodwalls
- Volume VI: The Performance - Interior Drainage and Pumping
- Volume VII: The Consequences
- Volume VIII: Engineering and Operational Risk and Reliability Analysis
- Volume IX: General Appendices

Not covered by IPET

Organizational and jurisdictional issues that impacted the effectiveness of the physical hurricane protection system

Issues identified by IPET

- 1. Vertical datum issues
 - Authorized relative to mean sea level (water level reference datum) but built relative to a terrestrial measure (geodetic vertical datum)
 - Subsidence caused some structures to be below authorized elevations
 - Sea level is rising
- 2. Insufficient soil borings
 - Spaced 350' – 650' where floodwalls were planned
 - Spaced 700' – 1500' in remote areas
 - Such spacings may have not disclosed problem soils

Issues identified by IPET

- 3. Use of 1960/1979 Standard Project Hurricane
 - No action to modify structures built using 1960 storm
 - Comparable to Lake Pontchartrain surge
 - Actual surge and wave periods much greater than predicted
 - Plaquemines Parish levees
 - Gulf Intracoastal Waterway
 - Mississippi River Gulf Outlet
- 4. I-wall design methodology
 - Failure after gap opened in ground on waterside of I-wall
 - Failure occurred before overtopping
 - Neglect existing CORPS data that indicated I-wall design issues preKatrina

Issues identified by IPET

- 5. Armoring inland side of floodwalls
 - Overtopping and erosion led to failure of some I-walls
 - T-walls inherently have erosion protection
- 6. Design methodology periodically reviewed by independent experts and updated
 - Review to ascertain if methods represent best practice and knowledge
 - Update storm based on probabilistic methods
 - Reevaluate designs based on recent research and experience

Issues identified by IPET

- 7. System design and system management
 - Consider resilience and redundancy (duplication of critical components for increased reliability)
 - Consider how each component depends upon and interacts with others
 - Periodically reassess level of protection and make timely modifications where needed
- 8. Quantify risks, determine level of risk acceptable
 - Clearly communicate how risk-cost-benefit tradeoffs impact performance and safety
 - Risk changes with time, depending on the natural and manmade environment

Issues identified by IPET

- 9. Communicate risk to public
 - Goal is to produce an adequately informed and engaged public
 - Without an effective risk communication program, people gradually forget risks
 - Sociologists estimate this takes two years
- 10. Ensure operation of pumps and safety of pump station operators during storm
 - Not just a Corps issue
 - Provide safe houses, design structures for Storm wind
 - Prevent reverse flow of water through pump system

Issues identified by IPET

- 11. Provide for emergency response needs beyond the capabilities of each parish
 - Not just a Corps issue
 - Plan for unwatering after a catastrophe, practice plan annually
- 12. Coordination of all agencies involved
 - Historic lack of coordination between agencies at all levels
 - Implement strong sustainable mechanisms for communication, cooperation, and coordination
 - Funding of system
 - Implementation of system
 - Inspection, repair, operation of system
 - Emergency response

Strock's 12 Actions for Change

The "New" USACE

1. Employ systems-based approach
2. Employ risk-based concepts
3. Continuously reassess
4. Employ independent review
5. Employ adaptive planning
6. Focus on sustainability

Strock's 12 Actions for Change

The "New" USACE

7. Inspect completed works
8. Assess and modify organizational behavior
9. Effectively communicate risk
10. Establish public involvement risk reduction strategies
11. Manage and enhance technical expertise and professionalism
12. Invest in research

Chance of Success

<u>Issue</u>	<u>Old</u>	<u>New</u>
1. Vertical datum issues	B	A
2. Insufficient soil borings	B	A
3. Project Hurricane	A	A
4. I-wall design methodology	B	A
5. Armoring inland side of floodwalls	B	A
6. Reviewed by independent experts	D	B

Chance of Success

<u>Issue</u>	<u>Old</u>	<u>New</u>
7. System design & management	D	B
8. Quantify risks, acceptable?	D	B
9. Communicate risk to public	D	B
10. Ensuring operation of pumps	C	B
11. Emergency response needs	C	A
12. Coordination of all agencies	D	B

Good Question:

What is the CORPS's chance of success in becoming Strock's envisioned organization?

NASA - 1986

- A government agency heavily reliant on science, technology, and engineering
- Funding issues: had to sell the public and political system the need for reusable space transportation
- Disaster: Challenger
 - Environmental: hardware failure (O-ring)
 - Human Factors: decision to launch was flawed
 - False sense of security after 24 successful launches
 - Risk is a player

NASA - 2003

- A government agency aware of its organizational problems and the risk from bad decisions
- Disaster: Columbia
 - Environmental: foam failure
 - Organizational causes
 - rooted in the program's history and culture
 - Compromises made to gain approval
 - Resource constraints
 - Fluctuating priorities
 - Schedule pressures
 - Lack of vision

CAIB Final Report

NASA's "IPET"

- Attributes for success:
 - Robust and independent program authority w/ complete control of specs and requirements
 - Independent safety assurance organization w/ line authority on safety issues
 - Organizational culture that reflects the best characteristics of a learning organization

Do we have an ethically
responsibility as engineers to
safeguard the public?

The Profession of Engineering

How can the profession help to ensure the success of the CORPS's make-over?

CORPS employees

- Upper management
 - Has power to make decisions
 - Will be required to make hard choices
- Design engineers
 - Think outside the box

Contracting Engineers

- If something should be done differently because it is unsafe, speak to the correct person in a manner that will ensure you a high probability that your point will be heard
 - Impact on the schedule does not supersede safety

Engineering Educators

- US engineers of the future need to be
 - Technical competent
 - Problem solvers
 - Conscious of the needs of the public that they serve (including the environment)
 - **LEADERS!**

Engineers as the Public

- Don't leave the rebuilding of New Orleans to the politicians and developers - become active in the rebuilding process

Questions?

RENEW ORLEANS!!