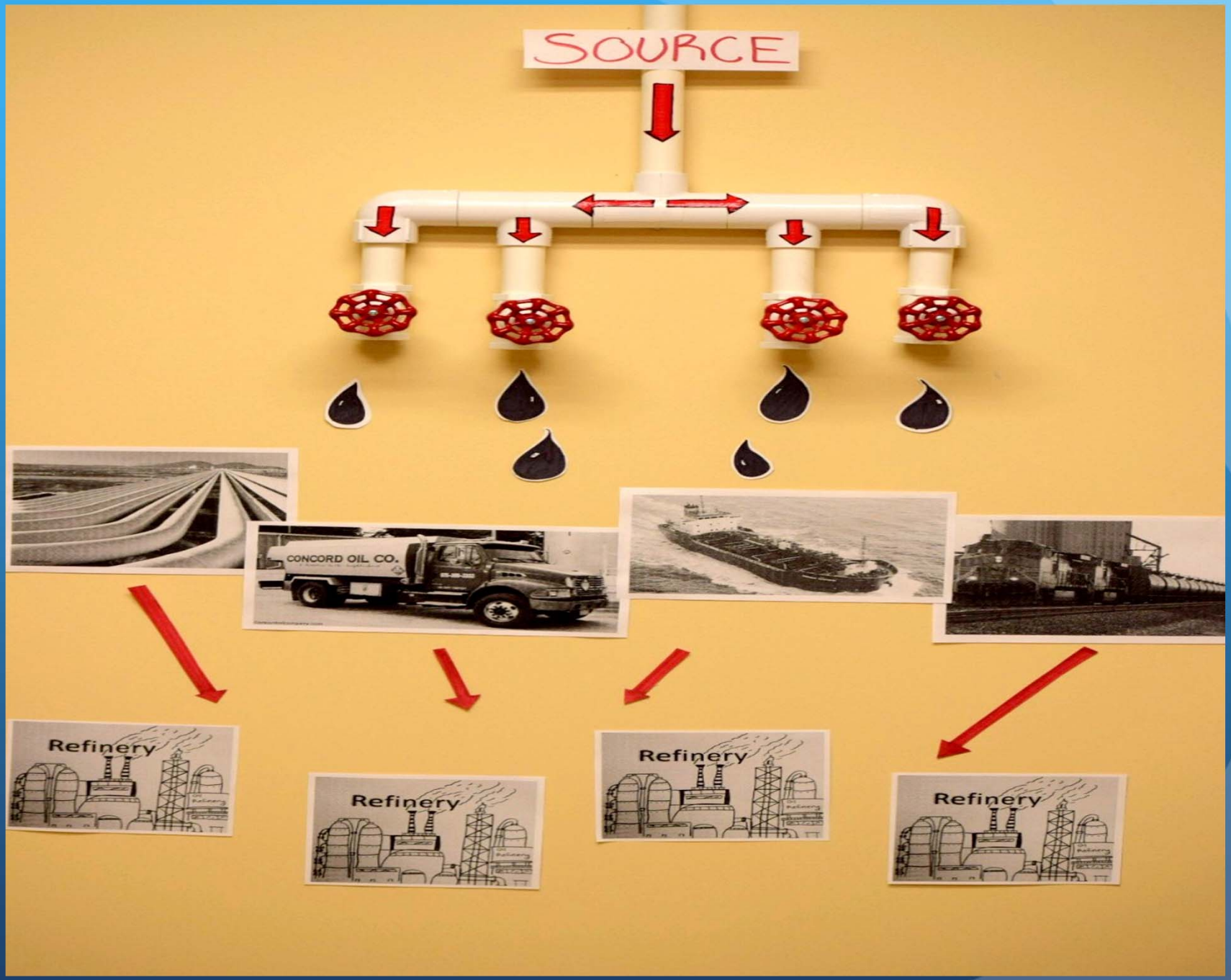
Understanding the Nature of Hazards, Risks:

Health, Safety, Economic and Environmental Impacts

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Sea Grant
Minnesota


SOURCE
CONCORD OIL CO.
Refinery
Refinery
Refinery
Refinery

Recap…

Previous Webinar:

- Crude Oil Movement in the Great Lakes Basin: Physical Properties, Geographic Pathways, Modes of Transport

Our current effort…

- How individuals and agencies perceive and evaluate "Hazards & Risk" to the social, economic and environmental good…
  - How We "Think" about Problems…
  - The Need to Define Terms across Disciplines
  - Evaluating & Linking Competing Goals of Stakeholders
  - Moving Forward: Systems Thinking and "Multi-Criteria Decision Analysis"

Embracing "Wicked Problems"

Some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them.

---*Laurence J. Peter*

Make every problem as simple as it can be…but no simpler.

---*Albert Einstein*

"Reductionist thinking" is not appropriate for the scale and complexity of 21st Century Problems…we need "Systems thinking."

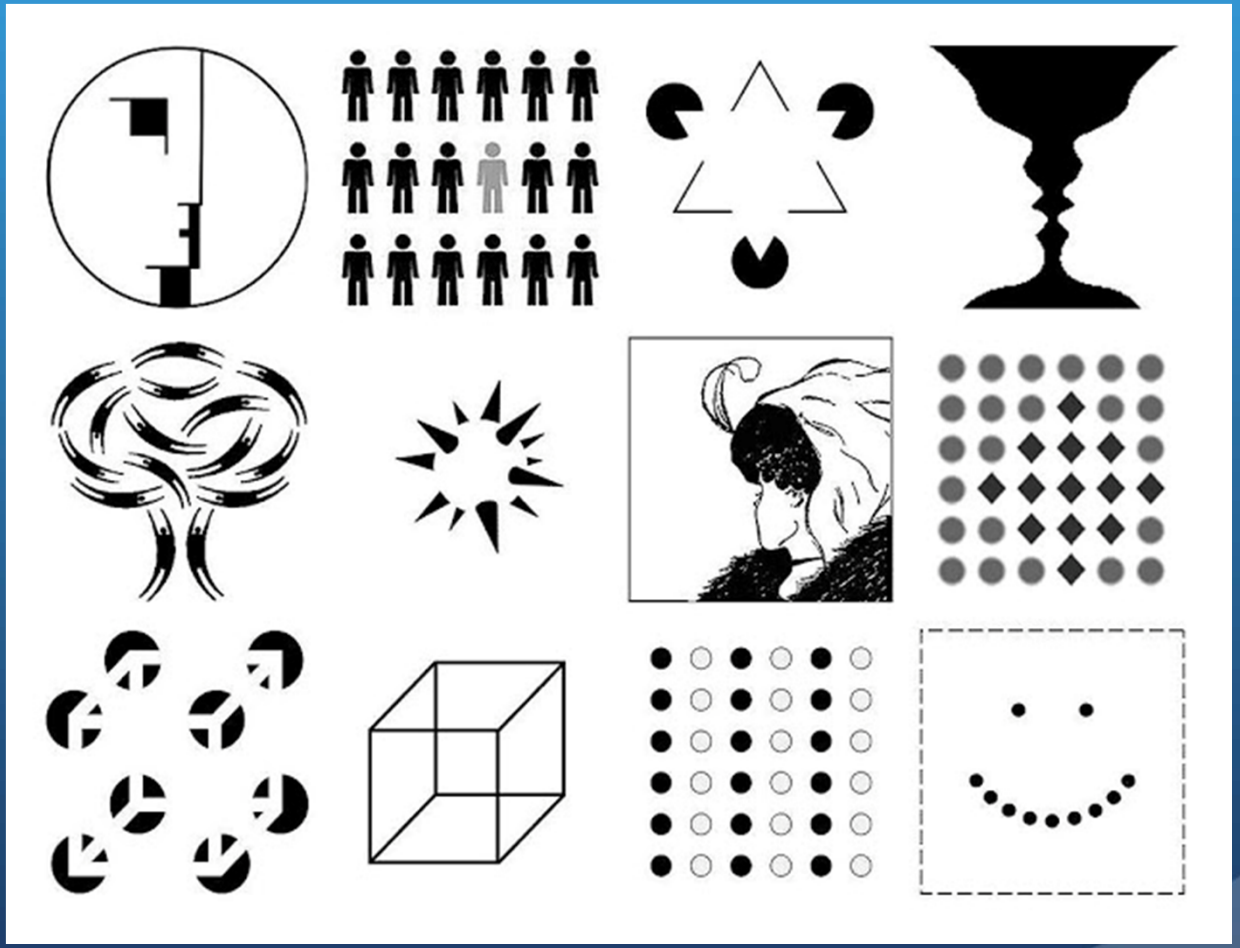
How we perceive and process information maters…

We cannot have a fruitful discussion of options and impacts unless we have a shared lexicon.

- What are the critical terms & how will we define them?
- How will we frame our question(s)?
- How do we create a transparent and full discussion?
- How do we include all “value-perspectives”?

Focus defines interpretation…

**Gestalt Theory of Perception:* *Tries to understand the laws of our ability to acquire and maintain meaningful perceptions in an apparently chaotic world.*
Focus/Awareness/Interpretation



Key Terms to Discuss Crude Oil Movement in the Great Lakes

- *Hazard, Risk, Security, Impact…*

Different specialists (and/or interests groups) will define these terms in very different ways; yet in a discussion, we tend to assume a common usage and understanding.

Economics, Transportation Logistics, Shipping, Spill Response, Hazardous Material Handling, Urban Planning, Environmental Science, Actuarial Science & Insurance, Human Health, Philosophy, etc.

There are different definitions of "Risk" for different applications across different specialties; its widely inconsistent and ambiguous use, creates conflict in efforts of "Risk Identification and Risk Management."



**Who (or what) we believe bears a particular risk, dramatically impacts our "risk tolerance." How do we view the "Terms of the Deal" between benefit, risk, and liability…?*

Hazards & Risk: What is the difference?

- Hazard is a known danger. However the presence of a Hazard does not necessarily constitute a Risk.
- Risk is the "known, or objective probability" of harm to people, property, or the environment.
- Relative Risk is comparative evaluation of probability between given choices. *This is an important consideration in understanding how transportation choices are made as we seek to move crude oil.*

Special Problem:

Uncertainty is unknown, or subjective probability-- which always exists.


We use oil for...
Mobility
Agriculture
Chemicals
Making Stuff



- *"The Congress finds that the movement of hazardous materials in commerce is necessary and desirable to maintain economic vitality and meet consumer demands, and shall be conducted in a safe and efficient manner. (HMTUSA; 49 App. U.S.C. 1801)."*

- *Regulatory Goal: "Satisfying the needs of our highly competitive industrialized society, while maintaining an acceptable level of safety at a reasonable cost…"*

PHMSA: Regulates all Hazardous Material transportation within the territories of the U.S. (synchronized with Transport Canada)

(this includes all Crude Oil Movements by all modes of transportation)

<http://www.phmsa.dot.gov/>


RADSAFE
In An Incident Ring
0800 834 153
Site Code___
1.4
G
1
EXPLOSIVE
1
NON FLAMMABLE GAS
2
Low
Hazard
6
COMPRESSED GAS
2
FLAMMABLE GAS
2
CORROSIVE
8
9
POISON
6
SPONTANEOUSLY
COMBUSTIBLE
4
RADIOACTIVE
7
ORGANIC PEROXIDE
5.2
1.3G
1
TOXIC GAS
2
OXIDIZING AGENT
5.1
AEROSOL
FLAMMABLE LIQUID
3
DANGEROUS WHEN WET
4
TOXIC
6
1.4
S
1
FLAMMABLE SOLID
4

Not everyone understands the system…



Hazard Labels for:

handling, transport, storage, incident response, etc.

The 9 Classes of Dangerous Goods: all present properties of potential hazard to human health and safety, the environment, or infrastructure.

- Class 1 - Explosives
- Class 2 - Gases
- Class 3 - Flammable Liquids
- Class 4 - Flammable Solids
- Class 5 - Oxidizing Substances
- Class 6 - Toxic and Infectious Substances
- Class 7 - Radioactive Material
- Class 8 - Corrosives
- Class 9 - And Miscellaneous Dangerous Goods

Elements of Transportation Risk

- Properties of the material (handling, storage, transfer, spill response, environmental persistence, toxicity etc.)
- Magnitude of the operation (size maters…)
- Physical strengths and weaknesses of Mode & Route Choice
  - Reliability
  - Velocity (total time, speed)
  - Security (potential loss of containment, theft, terrorism, incident)
  - Cost per Ton/miles (dry bulk); or MMbbl/day (crude oil, liquid fuels, etc.)
  - Fuel efficiency and carbon footprint (mode and length of route)
  - Exposure to Population Centers
  - Movement through Distinctive Environmental Features
  - Movement through Built Environment/Cultural Features
  - Total "life-cycle cost" and carbon footprint (not well understood or used…very complex)
  - Human Dimensions (are complex, subjective/emotional…but very important)

Risk Assessment…

Traditionally, the process of using quantitative and qualitative measures of risk level, and assigning the distribution of risks among specific people and places.

- *Technological advances allow us to use more sophisticated spatial modeling and geographic information.*
- *Potential Impacts and benefits can be projected more specifically to a broader range of interests.*

Triple Bottom-Line: *Social, Environmental, Economic*

Multi-Criteria Decision Analysis (MCDA) for Wicked Risk Problems…

MCDA: If not a Roman Numeral, then What?

- MCDA reflects characteristics of "Wicked Problems"
  - Scope and scale is not immediately obvious
  - Possible solutions are changed by expanding questions
  - No single unique optimal solution
  - Non-dominated "cluster of options"
    - Any "single issue focus" will distort outcomes in one or more other areas of concern or interest

Complex Assessments & Decisions

Need tested and recognized decision analysis tools & methodologies to…

- Integrate and Compare BOTH performance measures and decision criteria, with stakeholder and decision-maker values *Multi-Criteria Decision Analysis (MCDA)*
- Provide a neutral means of communicating and comparing trade-offs for management, planning and issue research, to expand understanding and options

GOAL: *Assure that our efforts are coordinated across "scales," our assumptions are transparent, and our thinking is aligned to optimize our choices.*

Some resources and perspectives…

- http://www.phmsa.dot.gov/
- http://onlinepubs.trb.org/onlinepubs/hmcrp/hmcrp_rpt_012.pdf
- http://glc.org/projects/water-quality/oil-transport/
- http://www.seagrant.umn.edu/newsletter/2015/06/crude_work_understanding_how_crude_oil_moves_within_the_great_lakes_basin.html
- https://www.fas.org/sgp/crs/misc/R43653.pdf
- http://www.brookings.edu/blogs/the-avenue/posts/2014/12/03-keystone-xl-america-oil-kane-puentes-tomer