Human Error (HE) Precursors: They're everywhere!

"To err is human" Alexander Pope, ~1725

The purpose of this discussion is to describe a hierarchy of human error precursors and the mechanisms in which they can affect front-line worker performance and potentially limit improvement initiatives.

These results may help you better evaluate your specific operational risks and determine potential sources and levels of intervention.

Outline

- Why study human error precursors?
- A hierarchy of precursor influences
- Example precursors at each level
- Improvement limitations
- Risk homeostasis
- So where do you start?
- References

Why Study Human Error Precursors?

- "In accident reviews, human error is the determining factor in 70%-80% of the cases." Rasmussen.
  - Other estimates vary, 50%-100%, largely due to varying definitions of human error.
  - Recent EU MARS studies find that a high percentage of equipment failures were actually due to human error, support for the 80%. Nivolianitou
  - More recent research suggests that the HE % is increasing due to improved reliability of technology.
  - Some research also suggests that the average severity of HE is increasing because worker's have a weaker understanding of the technology.

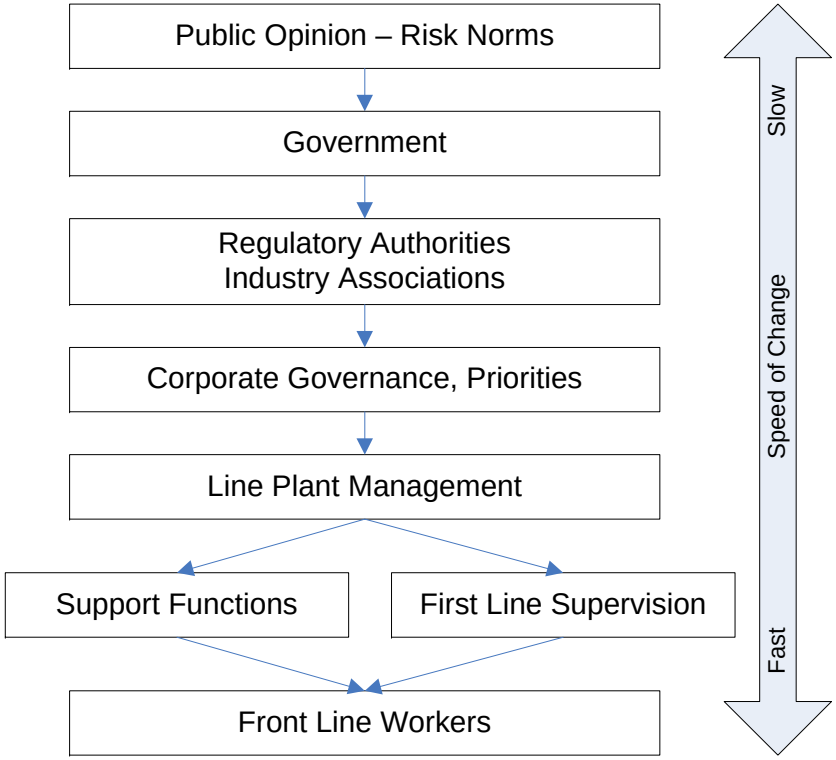
Why Study Human Error Precursors?

- Operations disasters are becoming more frequent, severe, and varied.
  - An enterprise sustainability issue: people, planet and profits.
  - Failure types receiving much more media and research attention: Environmental, supply-chain, financial, medical, food supply, and scientific failures.
    - 1980's and 1990's ~10 significant failures per year
    - Early 2000's ~20 per year
    - Late 2000's ~ 50-100 per year

Definitions

- Human Error- The mental or physical activities of individuals that fail to achieve their intended outcomes. Commonly classified: skill, rule, knowledge, and violation.
- Precursors = “conditions, events, and sequences that precede and lead up to accidents, the “building blocks” of accidents.” National Academy of Engineering
  - Not the same as causal factors of accidents. Accident causal factors were precursors before the accident, and a subset of the precursor factors which can’t be completely known.
  - The precursor challenge is to discover and discern what’s really important.
- Safety- The elimination of adverse consequences of technical breakdowns and human error.

Hierarchy of Precursor Influence: Reduced to Three Primary Levels



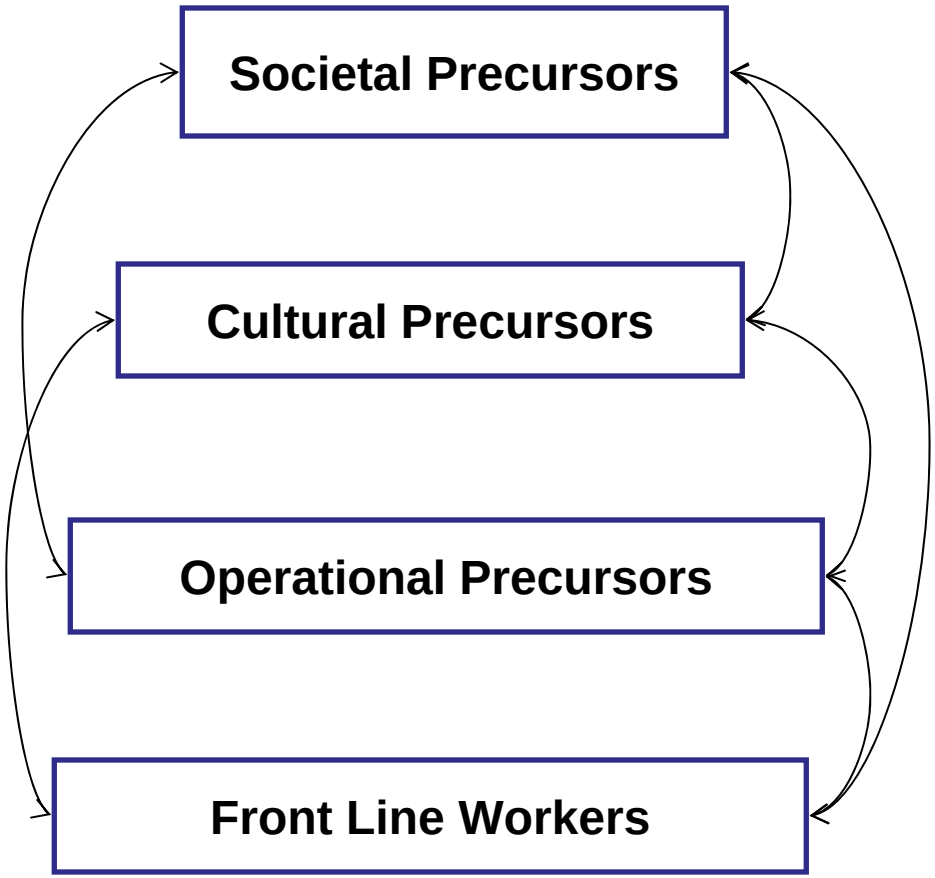
Societal Precursors

External to the firm
Internal to the firm

Cultural Precursors

Operational Precursors

Descriptions



Codified and informal standards based on risk norms shared by large groups.

Culture – "the way we do things around here"

Operational factors – Processes, tools, equipment, facilities, physical environment

Personal precursors: mental, physical, and emotional factors.

Examples of Operational Precursors

- DOE Occurrence Reporting and Processing System (ORPS)
  - Seven Primary factors: Engineering/Design, Equipment/Material, Human Performance, Management, Communications, Training, External Phenomena.
  - Similar findings with other joint reporting databases: EU Major Accident Reporting System (MARS), Institute of Nuclear Power Operators (INPO), National Response Center (NRC), EPA Risk Management Plan (RMP) Rule Reporting….

Culture

- Commonly accepted attributes of good culture:
  - Good organizational communications
  - Good organizational learning
  - Senior management and worker commitment to safety
  - Worker involvement
- Management leadership critical
- Measurement elusive, best captured by individual attitudes

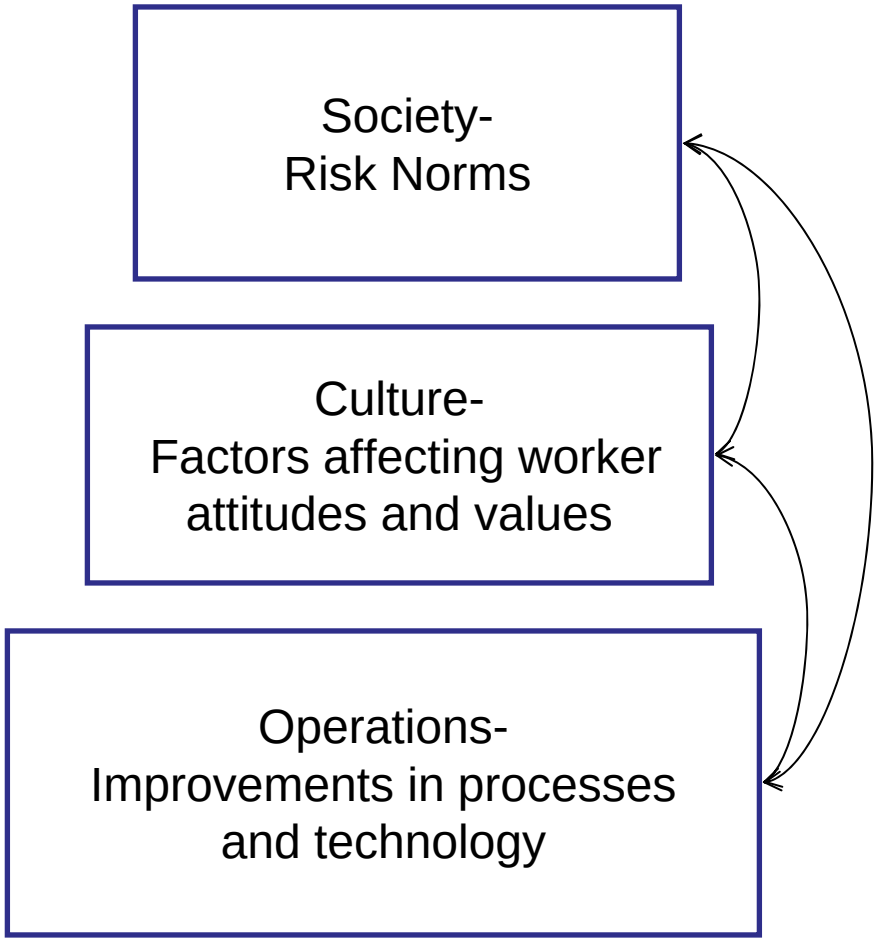
Examples of Cultural Precursors

- Safety Culture Assessments in British nuclear facilities, late 1990's, Terence Lee
  - Very detailed survey effort, ~6,000 workers involved
  - 19 attitudinal (indicators) predictors of accident likelihood identified
  - Top 8 in order of importance: "Job contentment, satisfaction with plant design, trust in the workforce, perceived source of safety actions (senior management initiative and support of safety improvement), personal interest in the job, personal caution over risks, confidence in safety procedures, personal understanding of safety rules.."

Societal Precursors: Risk Norms

- Societal risk norms often negatively affect the risk perception in the work environment and positively influence errors.
- Examples of different factors affecting risk norms
  - Location: Home versus Work, NSC/BLS
    - For every worker fatality on-the job, there are11 worker fatalities off-the-job.
    - For ever 2 injuries at work, there are 7 at home.
  - Industry type: TRC rates for Steel Foundries ~13, Mining ~3.9, Chemical mfg. ~2.5, Nuclear power ~.7
  - Activity: Traffic safety versus military safety

Improvement Limitations



"The general conclusion is that social control of risk perception may be the only factor that is capable of long-term reduction in the frequency and severity of accidents, while changes in other factors such as perceptual, decisional, and control skills will have only temporary influences." Rasmussen

"After a certain point technology (and process improvement) alone can not achieve further improvements. Organizational and cultural factors become more important." Dodsworth

Risk Homeostasis

- Theory that people like a certain level of risk in their lives, and if you eliminate one form of risk, people will tend to compensate by taking additional risks elsewhere to compensate and maintain “risk” equilibrium.
- Controversial, but gaining acceptance and validity
- The theory can apply to Individuals, groups, and society.
- Examples:
  - Investment, health, and dietary choices
  - Munich taxicabs study
  - Helmeted and non-helmeted bicyclists study
  - Overall vehicle safety improvements

Hierarchy Limitations

- The effectiveness of operational improvements (technology and processes) can be reduced or limited by cultural issues and differences in risk norms.
- Cultural improvements can be limited by differences in risk norms.
- Improvement at all levels can be limited by risk homeostasis within individuals, groups, and our society.

Human Error (HE) Precursors: They're everywhere! So where do you start?

1. Fix the obvious operational factors- processes, equipment, and materials issues.
   - Don't churn with change; change causes errors, excess change causes many errors!
2. Seek to improve the average culture, but especially look for variations and outliers in individual and group attitudes.
   - Outliers are the real risks! Only takes one.
3. Be mindful and manage societal differences in risk norms- group associations, past experiences.
   - Continually reinforce the correct risk norms and standards!

References

1. Accident Precursor Analysis and Management, Reducing Technological Risk Through Diligence. National Academy of Engineering. 2004
   - Good general, practical summary of the seven month Accident Precursors Project with many high quality contributors.
2. Risk Management in a Dynamic Society: a Modeling Problem, Jens Rasmussen, Safety Science, 1997. Vol 27, No. 3, (and almost any article by Jens Rasmussen.)
   - Difficult to read, but highly insightful regarding the complexity of factors affecting HE. Excellent behavioral psychologist credited with the skill, rule, knowledge framework.
3. Assessment of safety culture at a nuclear reprocessing plant. Terence Lee, Work and Stress 1998 Vol 12.3.
4. Assessing safety culture in nuclear power stations. T. Lee, 2000 Safety Science Vol 34.
5. The Dark Side of Organizations: Mistake, Misconduct, and Disaster, Vaughn. Annual Review of Sociology 1999. Vol 25.
   1. Highly academic and difficult to read, but integrates findings from four different research streams. Very insightful.