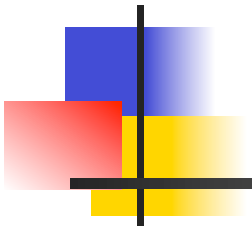


Investigating Investigation Methodologies

By Ludwig Benner Jr

Purpose

- Examine how investigation methodology affects investigation tasks and outputs
- Look for differences among methodologies and document them

NOT AN EVALUATION OF CSB REPORT

Why needed?

- Past works offer comparisons
- Use differing assessment criteria
- None seem to be based on direct observations of effects on investigation tasks and outputs
- Thus no reported objective basis for methodology selection decision

Approach:

- Do investigations and document observable differences
- Would love to do competitive investigations of same accident but . . .
- Alternative: do a “table top” investigation simulation with one methodology using data from a report prepared with another methodology

Methodologies compared:

- Root Cause Analysis (RCA) CSB variant
- RCA analyzed in prior studies
- Used as source of data for investigation
- Multilinear Events Sequence-based system (MES)
- MES analyzed in prior studies
- Used to do the simulation

Methodology Attributes

RCA

- Experience-driven
- Evolved from Navy nuclear program, MORT research
- Goal is finding, fixing root causes, causal factors
- Uses teams, charts, cause trees, guidelines
- Extensive categorization
- Extensive training

MES

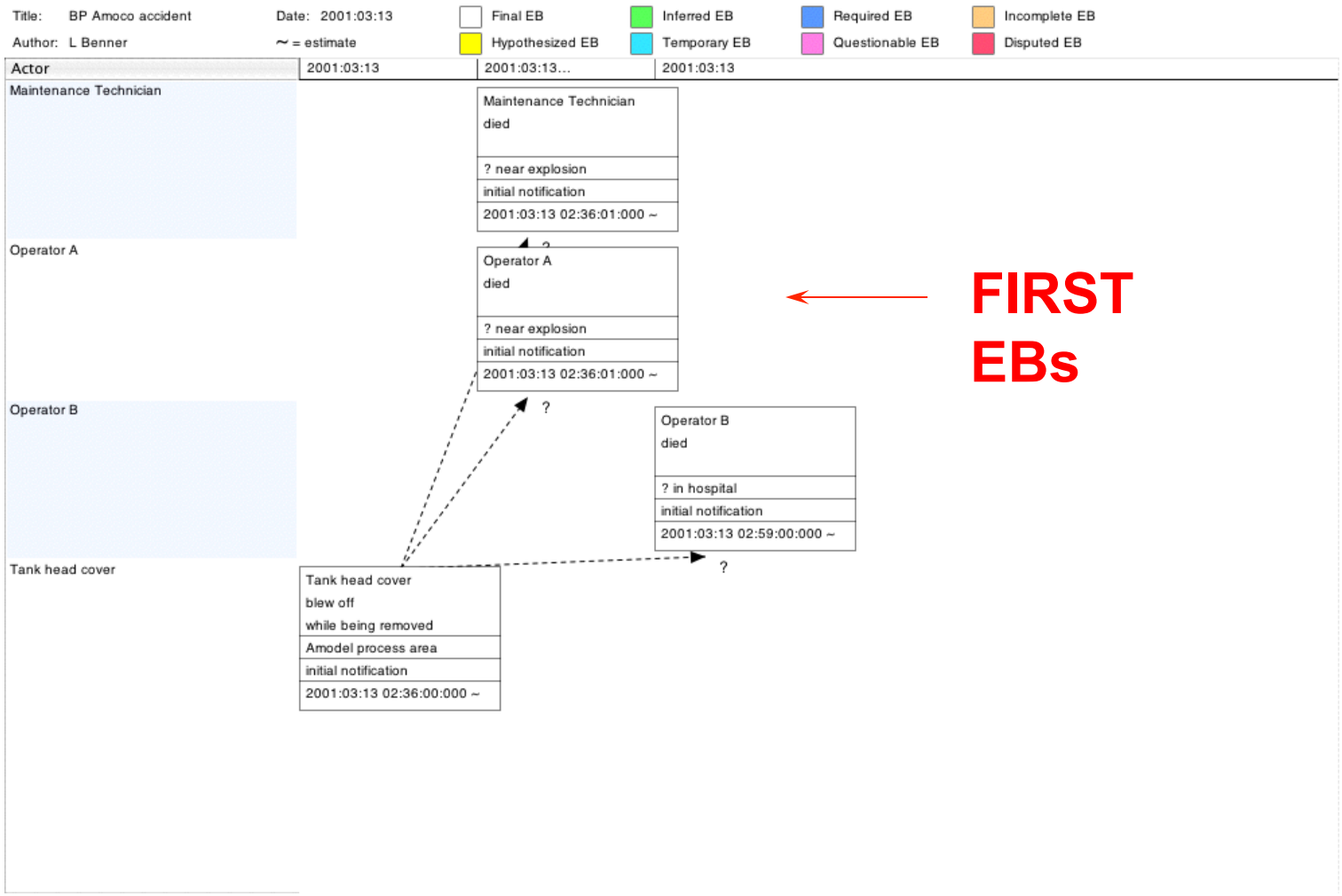
- Logic driven
- Evolved from investigation process research
- Goal is continuous improvement by finding and changing undesired behaviors
- Uses matrixes, rules, guides
- Minimal categorization
- Self-guiding

MES Investigation Drivers

MES investigation was driven by

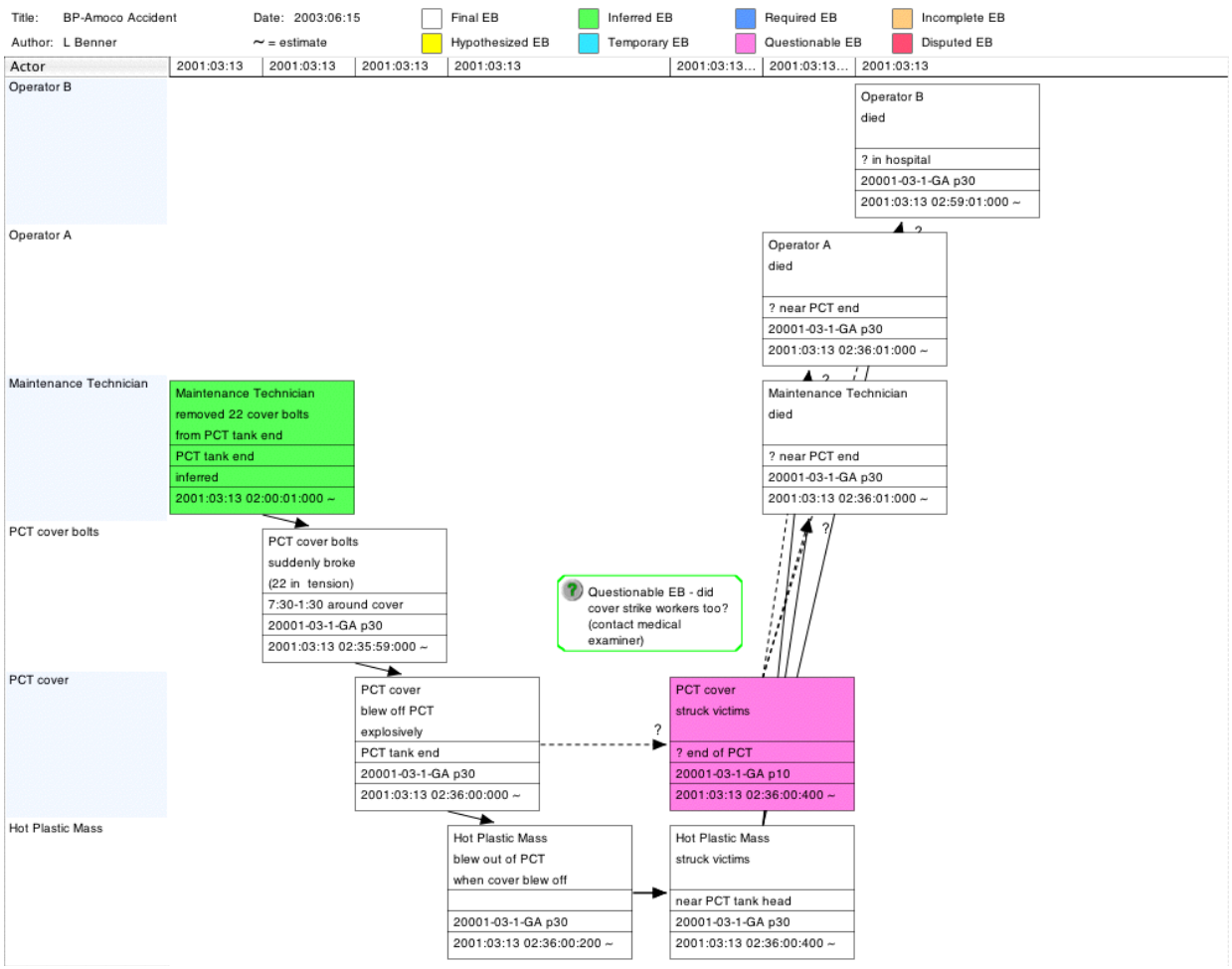
- Objective: understand behaviors
- Event Blocks to provide “data language”
- Matrix to structure data organization
- Links to couple related behaviors
- Problem tabs to drive recommendation development
- Source identification to constrain speculations, subjective judgments

Initiation of MES Matrix

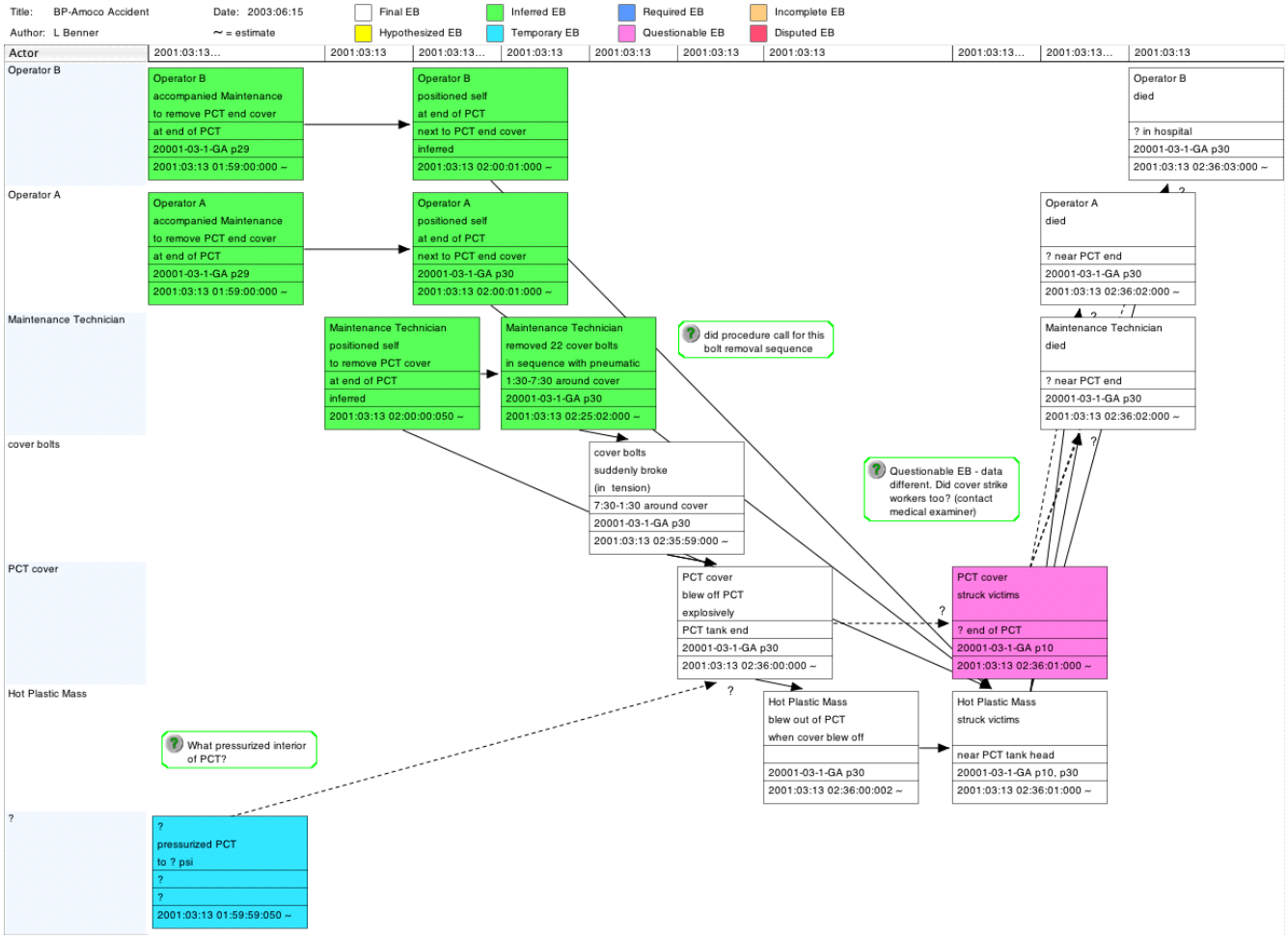


Building the Matrix

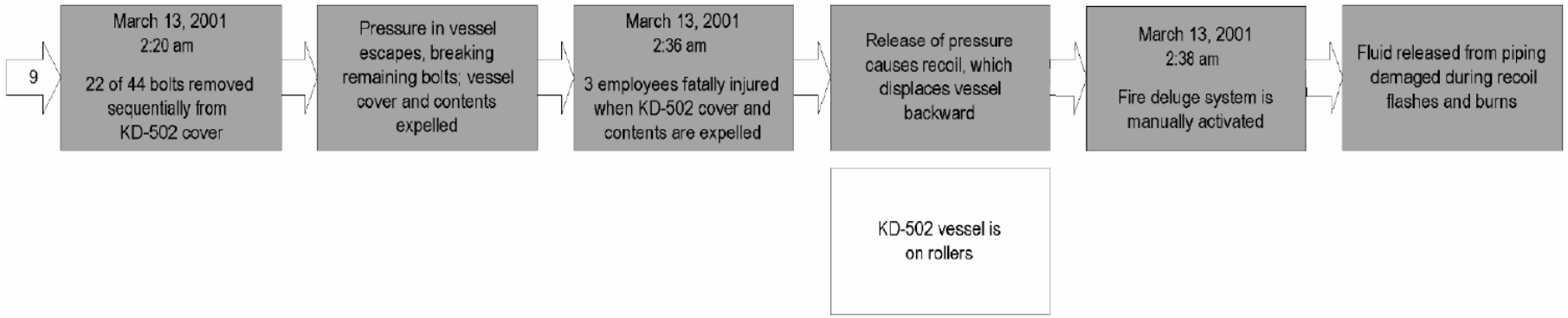
- **Apply logic**
- **Add new EBs**
- **Add links**
- **Expose uncertain data**
- **Point to prior EBs needed**



Add more EBs

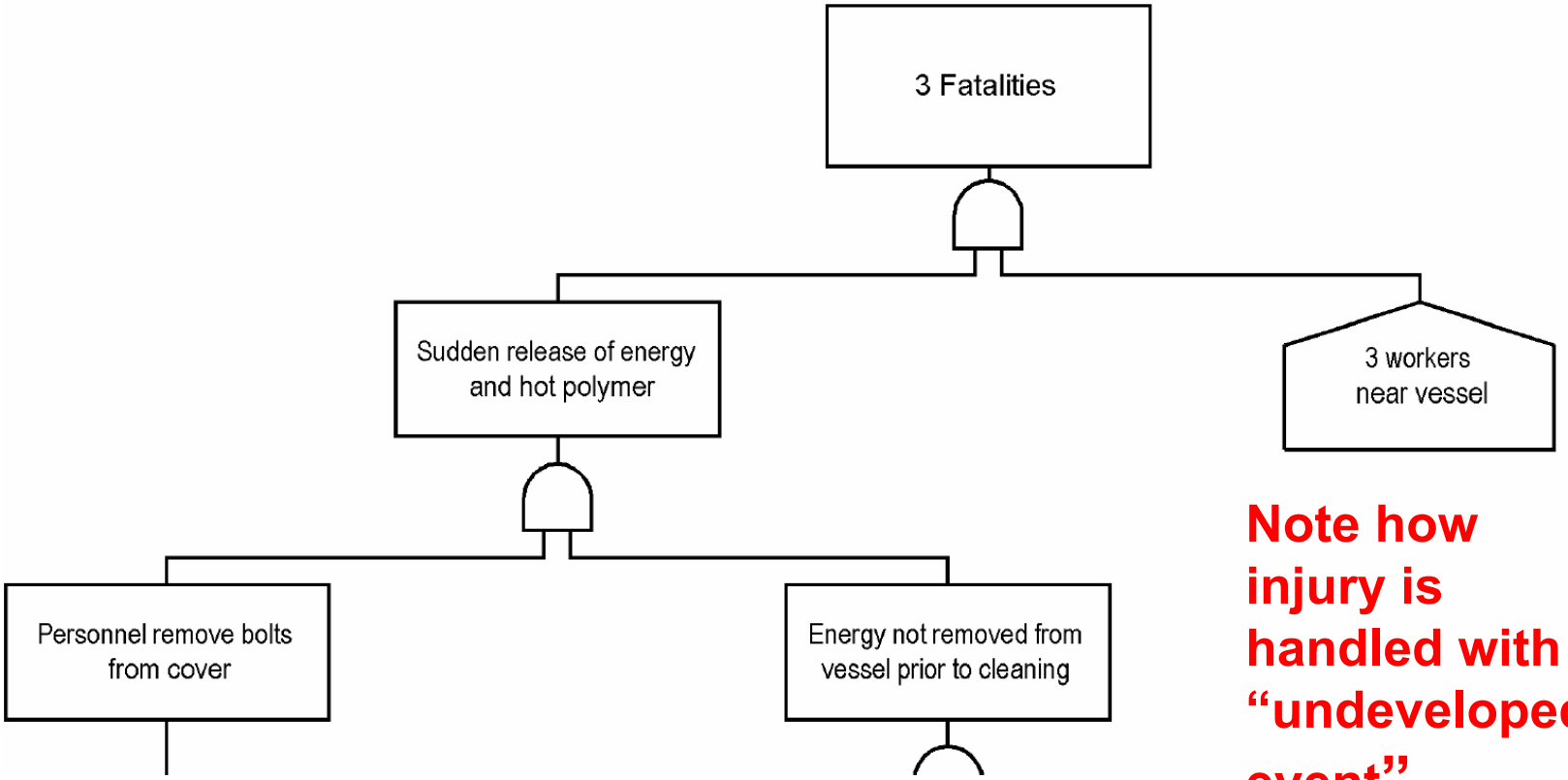


Compare RCA Timeline



Note sequence in block 2, elapsed time between removal of bolt, and fatal injury, variance of block contents

RCA Logic tree of injuries



Note how injury is handled with "undeveloped event"

Tasks - differences

RCA

- Accommodated ambiguous unstructured inputs
- Used loosely defined charting tools
- Mixed events and conditions
- Emphasized experience-driven check lists, guides
- Required judgment-based categorization of causes

MES

- Required structured data inputs
- Used matrix-based data organization tools
- Focused on behaviors and relationships
- Emphasized orderly, reason-driven inquiry
- Used a systematic problem discovery process

Results - similarities

Both led to

- Hazard analysis problems
- Deficiency correction problems
- Investigation problems

Results - differences

RCA led to

- 3 root causes with 8 subsets
- 4 contributing causes with 5 subsets
- 10 recommendations

MES leading to

- Many unanswered questions
- More and different options for changes,
- NO characterizations of cause or blame

MES prevented 5 problems

RCA investigators . . .

- Used more than one name for people or objects, confusing description
- Used ambiguous names, masking actions
- Used passive voice, obscuring who did what
- Introduced unsupported assumptions*
- Left relevant behaviors remain unaddressed

* *Found since paper was written*

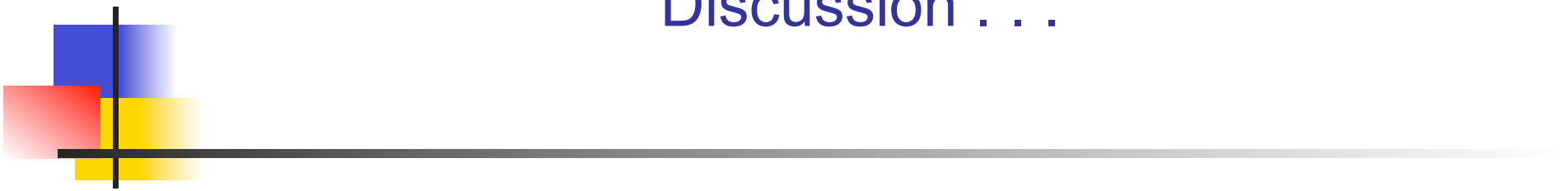
Differences. . .

- Handout has examples of unanswered questions that MES investigation raised

Continuing efforts

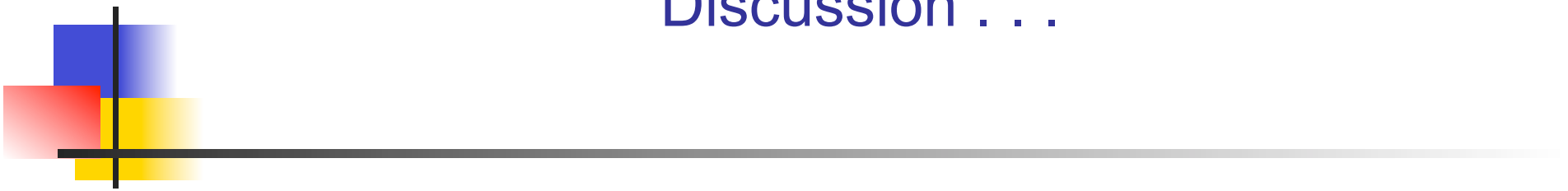
I am still working on comparisons of the influences of methodologies on investigations, including

- Quality assurance
- Efficiency
- Reproducibility
- Utility
- Time and cost control



Discussion . . .

lbennerj@gmu.edu



Discussion . . .

Results - differences

RCA led to

- Unintended chemical reactions
- Hazard reviews
- MSDS revision
- Incident investigation and reviews for trends and root causes
- Revalidate hazard analyses
- Revise lock-out/tag-out procedure
- Apply management of change to operational and procedural mods

MES led to

- Unanswered questions about what happened
- HAZOPs method or application problems
- equipment design concepts
- procedures development and updates
- problem diagnostic skills
- normalization of deviance,
- Investigation processes