

Investigating Investigation Methodologies

By Ludwig Benner Jr

© 2003 by Starline Software Ltd.

Good Morning.

Thank you for demonstrating your interest in Investigation Methodologies by being here.



Purpose

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

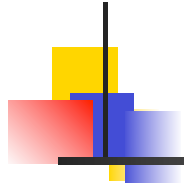
NOT AN EVALUATION OF CSB REPORT

My paper is a progress report. You can read the paper, so today I will just present some highlights of my inquiry. My purpose was to find a way to examine how investigation methodologies affect the investigation process, and report differences I find.

I want to emphasize that this is NOT an evaluation of the CSB report that I used.

Without reviewing all the investigator's notes, I have no way of knowing what data investigators may have developed that was excluded from the published report adopted by the agency managers.

I might also note that this work is not sponsored - I am just continuing a 30+ year personal search for better ways to conduct investigations.



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

Why bother? Past papers provide comparisons, but they use differing assessment criteria.

Reviewing them, I noticed one attribute of those works that was interesting – none appear to be based on direct observations of investigation tasks and their results outputs.

In my view, that meant there is at present no adequate objective basis for the investigation methodology selection decision and for predicting its consequences of that decision.



Approach:

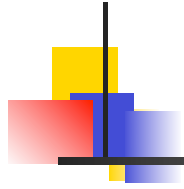
- Do investigations and document observable differences
- Would love to do competitive investigations of same accident but . . .
- Alternative: do a “table top” investigation simulation with one methodology using data from a report prepared with another methodology

What to do about that. Well, one way would be to do investigations using different methodologies, document the tasks and outputs, and report the observable differences.

Probably not practical - for a lot of reasons - duplication, conflicts, money, interference, etc

What options? Well, emergency responders and others do table top exercises for various purposes, so it seem reasonable to see if that might lead to defining the comparative effects.

So that is what I have tried to do.



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

I chose two methodologies that I was familiar with and that had been analyzed in prior studies. I have taught both MORT which has evolved into RCA, and MES.

Procedures for both are formalized in published documents, and both methodologies are in use. For the simulation I used a published report of an RCA based investigation as the data source - it is quite comprehensive - I use MES to drive the investigation tasks and outputs.



Methodology Attributes

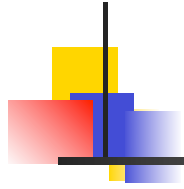
RCA

- 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

This is a summary of the major differences I observed in the ATTRIBUTES of the two methodologies, to give some perspective to what follows. The methodologies are quite different.



MES Investigation Drivers

MES investigation was driven by

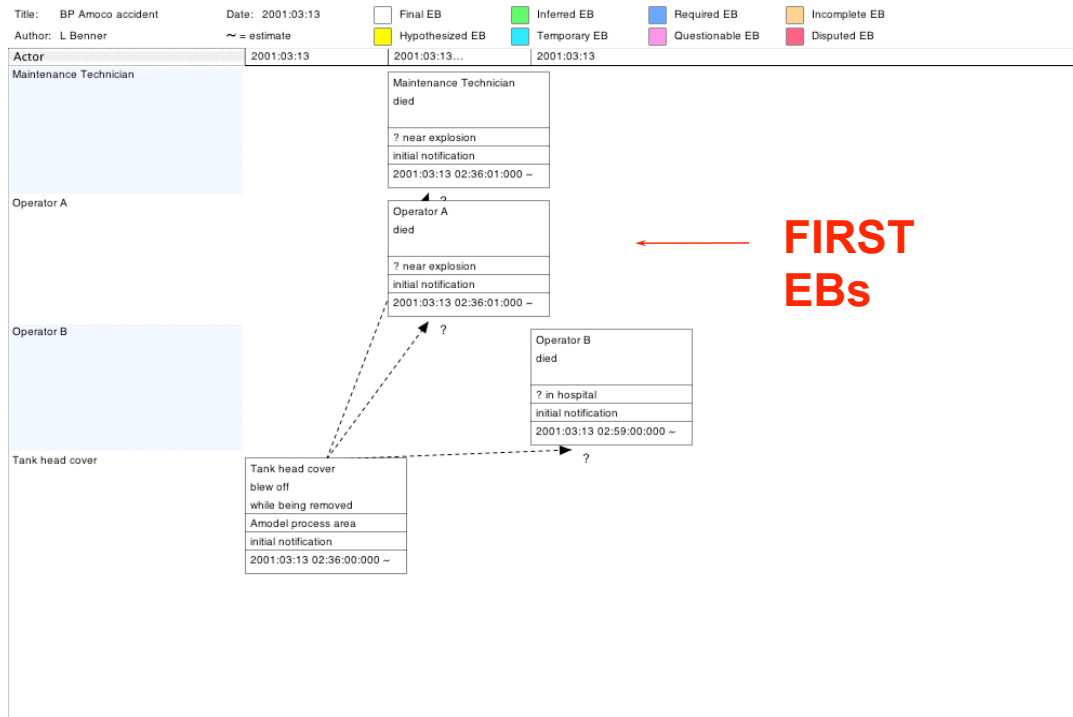
- Objective: understand behaviors
- Event Blocks to provide “data language”
- Matrix to structure data organization
- Links to couple related behaviors
- Problem tabs to drive recommendation development
- Source identification to constrain speculations, subjective judgments

MES has several key drivers: (read)

The main workhorses driving investigations are the Event Blocks and the Matrix.

You look for events, and you array them in a Matrix

Initiation of MES Matrix



© 2003 by Starline Software Ltd. 8

8

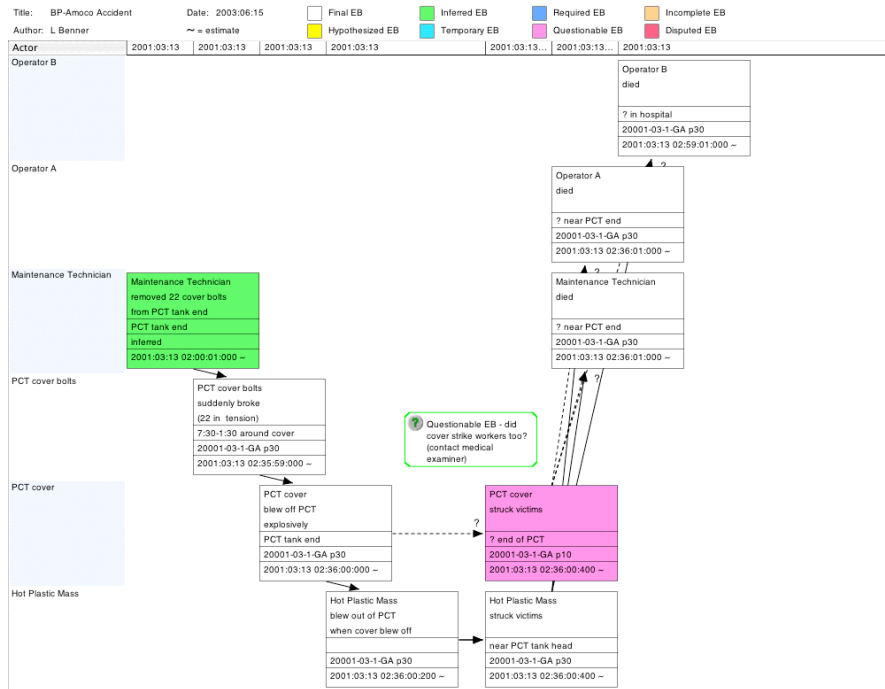
The Matrix guides the data search. You start with what you have and add to, update, or delete EBs as your investigation progresses.

The investigation proceeds from each EB that you have, to the next prior or subsequent EBs that you need to get. Logical reasoning shapes what questions to ask, and what data that requires.

In this case the investigation started with the information in the first notification, which is usually the report of the casualties. The first entries are the reported casualties.

Building the Matrix

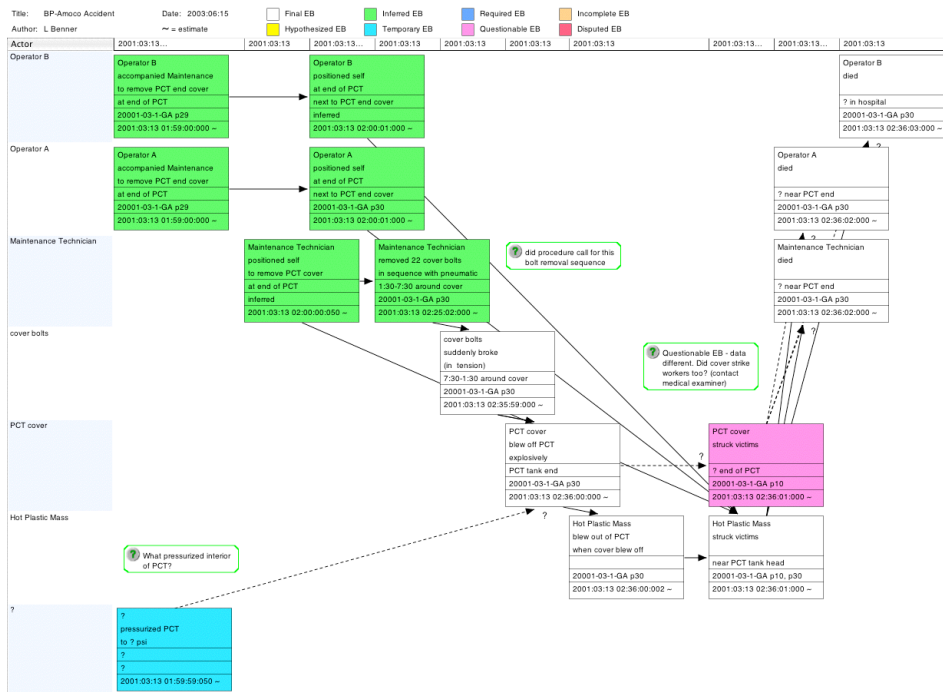
- Apply logic
- Add new EBs
- Add links
- Expose uncertain data
- Point to prior EBs needed



The investigation proceeds by applying logic, to develop one EB at a time as data become available and are added to the Matrix. This leads investigators to focus on concrete facts and observations, minimizing conjecture based prior experience and guesses.

Links are used to show cause-effect interactions as they are found. Unlinked EBs point directly to incomplete Investigation tasks, giving direction to the investigation -and exposing what might otherwise be unknown unknowns.

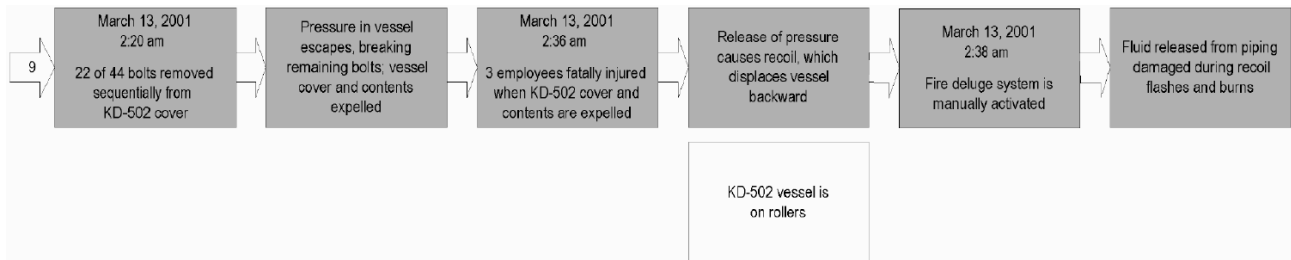
Add more EBs



As the if-then or why-because reasoning drives the search for new EBs the Matrix keeps growing until the origin EBs are identified.

In this example, the color coding indicates the current status of the various entries. Everyone working on the Matrix, can see what is known, inferred, questionable or unanswered, and what has to be developed.

Compare RCA Timeline



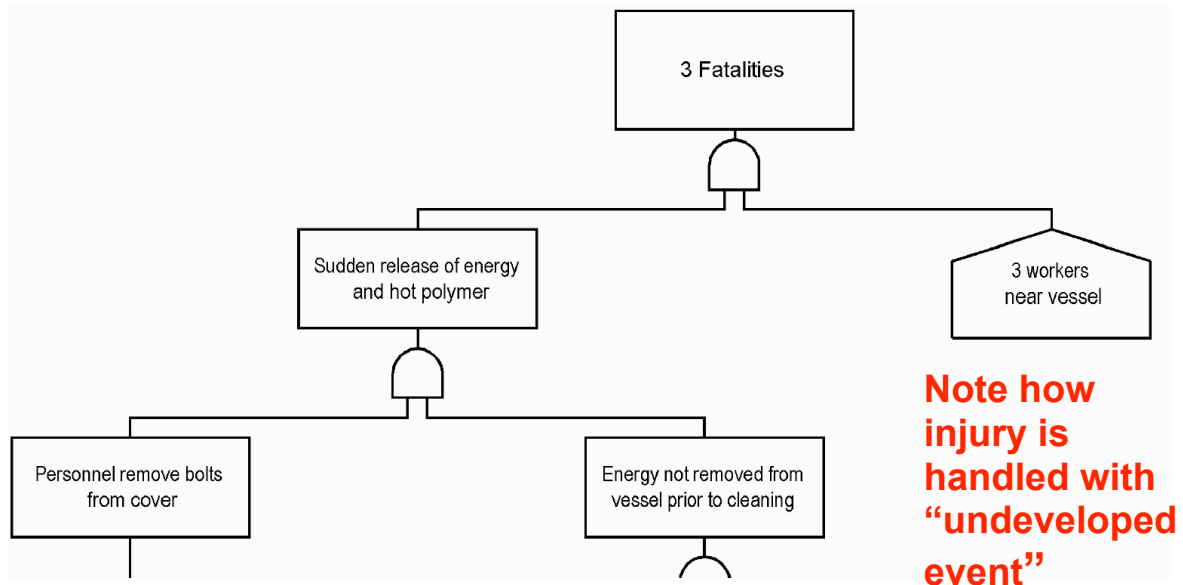
Note sequence in block 2, elapsed time between removal of bolt, and fatal injury, variance of block contents

This portion of the Timeline from the source report covers the same part of the incident as the previous MES Matrix you just saw.

RCA outputs contain some selected elements of the scenario, which may or may not be complete, as can be seen here. The criteria or rationale for the chart content selection are not evident. Apparently they depend on what the creator thinks was important.

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

RCA Logic tree of injuries



This is another example of the effect of the RCA methodology on investigations and investigators.

RCA uses logic trees to hypothesize scenarios. I call your attention to how injury is handled - or rather not handled - by this published RCA tree.

RCA Charting rules are very general and abstract, so investigators can make personal decisions about what to develop or omit, without demonstrating their rationale.

MES uses bounded logic trees - both the top and bottom events are defined.



Tasks - differences

RCA

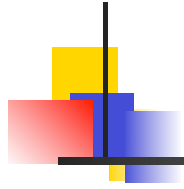
- Accommodated ambiguous unstructured inputs
- Used loosely defined charting tools
- Mixed events and conditions
- Emphasized experience-driven check lists, guides
- Required judgment-based categorization of causes

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

This gives you an abbreviated summary of the differences in the tasks resulting from use of the two different methods.

(Read them)



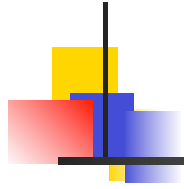
Results - similarities

Both led to

- Hazard analysis problems
- Deficiency correction problems
- Investigation problems

Despite the task differences, the two methodologies did produce some similar results.

Both disclosed hazard analysis problems, deficiency correction and 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

RCA and MES also produced significantly different results (READ THEM)

The major difference is that MES does not produce any statements of cause or characterize anything as a causal factor.

MES is aimed at process improvement through behavior changes rather than the determination of root or any other kinds of causal statements. Very different investigation objectives



MES prevented 5 problems

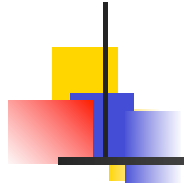
RCA investigators . . .

- 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*

Among the results that were observed are those listed here.

For those who must read and digest and LEARN from narrative reports, these problems can be very disorienting



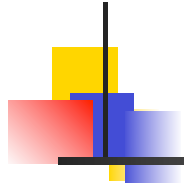
Differences. . .

- Handout has examples of unanswered questions that MES investigation raised

The development of the MES Matrix disclosed many questions that remained unanswered in the report. I have printed a list of those questions to illustrate this point.

Again, before you criticize the Report, remember that all the data developed by investigators may not have found its way into the report.

But that's a problem addressed by others. I was just looking at the effects of the methodology selection decision on the investigation tasks and their consequences.



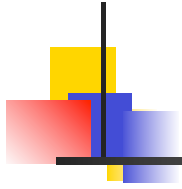
Continuing efforts

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

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

The work is continuing as time permits. Questions being addressed include

- how quality assurance can be implemented
- how efficient the investigation is in arriving at the deliverable products
- how reproducible the investigations outcomes are
- the utility of the outputs for users
- how well time and costs can be managed



Discussion . . .

lbennerj@gmu.edu

I hope others will pursue the identification of differences in tasks attributable to the methodology selection decision, and their consequences, by observations of the investigation process.

Please feel free to contact me if you care to engage in further dialog. I have the GMU mail box because I am affiliated with the GMU Learning In Retirement Institute, but that has no bearing on this research.

The software used for the MES slides is Investigation Catalyst, by Starline Software Ltd. At <http://www.starlinesw.com>

End here.



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

This is a supplemental slide with additional differences found if questions come up during the discussion.