



# Multilinear Events Sequencing Investigation Technology

A brief description of  
the origins, nature and application of  
a research-based investigation technology,  
for the investigating of all kinds of phenomena

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# Multilinear Events Sequencing Technology for Investigation

## **INVESTIGATE:**

to examine  
systematically;

to observe or inquire  
into,  
usually some  
phenomenon.

The basic purpose of investigations is to gain understanding of some phenomenon. Sometimes investigations are undertaken simply for the sake of gaining new knowledge. Sometimes they are undertaken to be able to predict and control future or past phenomena. Sometimes they are undertaken to understand crimes. Whatever the reason, all investigations have a common thread: they seek to describe and explain some phenomenon, clearly, validly and consistently.

Investigations are conducted in many ways, ranging from casual single person efforts to elaborate international team investigations or judicial inquiries. Many investigation methods are used, with varying results.

## **WHAT IS MES?**

The Multilinear Events Sequencing-based investigation technology is an integrated set of concepts and techniques used to investigate occurrences before or after they happen.

The main elements were developed initially to improve the investigation of accidents, explosions, fire and injuries. It soon became apparent that the investigative system that emerged can help understand, predict and control other phenomena, such as equipment breakdowns, quality problems, physical trauma or even crimes. Functionally, it is used in the investigation of mishaps, development of operating procedures, safety reviews, hazard analyses, emergency response assessment, and - recently - research.

The Multilinear events sequencing- technology has led to several investigative breakthroughs. One of its most significant breakthroughs is its ability to function as a "research defining" investigation tool. It clearly identifies what one knows and doesn't know about a phenomenon as one applies the technology during data acquisition and analysis tasks.

A second breakthrough is the rigorous structuring of the problem discovery and definition process. The new technology helps investigators look into a phenomenon systematically and uniformly, to discover problem relationships among system interactions. Understanding these relationships invariably increases the number of choices for controlling the phenomenon, and estimating relative effectiveness of proposed changes.

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### WHY WAS MES TECHNOLOGY DEVELOPED?

This investigative technology was developed to overcome major shortcomings in traditional accident investigative processes. A standardized investigative methodology for comprehensive, efficient and useful investigations was needed to:

- provide a systematized and self guiding investigation process that was independent of the investigators' experiences with the system or its operation.
- Isolate and organize data relevant to the investigation as it is acquired so it guides subsequent data acquisition
- produce trustworthy, unambiguous descriptions and explanations of accidents.
- provide a systematic procedure to identify, document, evaluate, disseminate and implement risk-reducing control actions.
- Permit validation of proposed or implemented changes.
- enable objective quality control of investigation outputs.
- provide a process to resolve differences amicably among investigators or other interested parties.
- facilitate training of investigators in the better methods.

### WHAT DOES MES TECHNOLOGY DO?

The MES investigation technology provides investigation task guidance. Tasks addressed include investigation project planning; definition of data requirements; data acquisition transformation and documentation; data organization and integration, display, manipulation, coupling, analysis and relevance testing; transparent display and discovery of unknown unknowns and bounded hypothesis development for resolving them; problem search, identification and assessment; preventive action development and assessment; operational and regulatory performance evaluation metrics and procedures; preparation and presentation of investigation reports; objective investigation and work product quality assurance procedures; and evidence association, referral, retention and retrieval.

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## WHAT ARE THE MAIN MES COMPONENTS?

The main MES investigation technology components include

- A process framework for thinking about what is being investigated, and for its investigation,
- A rule-driven matrix to define, organize and analyze investigation data as it is acquired,
- Logical coupling of input-output interactions, describing what happened and why it happened,
- Structured steps to discover needs disclosed by coupled interactions, and to identify candidate control actions, and
- A focus on action or behavior sets to change and monitor in the future, to achieve improved performance..

Other components include numerous generic investigation models and investigation or analysis procedures; strategies for future control; a "mental movie" data acquisition guide and testing protocol; events pairing analytic and validation procedures, and data sets procedures for identifying common behavioral subsets.

## HOW IS MES TECHNOLOGY APPLIED?

The MES investigative technology is relatively simple in concept and practice. Its application consists of three main phases:

1. development of a description of the process or system operation being investigated, followed by
2. a problem or needs discovery, definition and control phase, followed by
3. the monitoring phase to verify the predicted performance after changes are made.

Its application was first described in a 1986 book Investigating Accidents with STEP, in which the MES technology implementation process was called the Sequentially Timed Events Plot or STEP process. Unfortunately that name seemed to have directed most attention to the preparation of the time-actor matrix, to the detriment of the valued other features of the investigation process.

### 1. Description phase.

Phase 1 focuses on developing a description of what happened and why it happened. The output is a display of coupled interactions describing and explaining the occurrence. Properly prepared and quality checked, this description can serve all users whose actions depend on understanding the occurrence. Its contents are tested for validity, completeness and input-output relationships with objective procedures. The MES display (or STEP plot) one key output generated during the investigation.

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2. Problem discovery, definition and control. After the description is completed, the MES system addresses the discovery, definition assessment and documentation of problems or needs.. The problem definition and control phase is based on examining interactions between each specific event pair in the description for undesired changes, and possible new changes. Candidate control actions at each event pair can be developed, using associated safety principles, strategies and techniques. Each option's future effects on the process can be considered and the reduction in risk evaluated by tracking the new changes on the displays to the anticipated new outcomes.
  
3. MES performance monitoring plan. The MES displays, with the new controls in place, are then used as a baseline to guide observations of the ongoing process to see how it compares with the predicted operation. This forms the feedback loop for a continuous improvement effort. ***This is a major benefit unique to MES.***

MES outputs can also guide investigation of anomalies or deviations from predicted performance, and guide the assessment of any changes to the process that are proposed or observed. MES work products provide a useful method to implement a change control system by providing the basis for documenting, analyzing and predicting effects of changes before they are introduced into a system or process.

### WHERE CAN I LEARN MORE ABOUT USING THE MES TECHNOLOGY?

Guidance for application of MES technology is available in 10 MES Investigation Task Guides published on the Internet as shareware at

[www.starlinesw.com/product/Guides/MESGuide00.html](http://www.starlinesw.com/product/Guides/MESGuide00.html)

Investigation support computer software offering assistance during investigations and guidance for investigators includes a detailed presentation and explanatino of MES technology implementation.

### ***The bottom line.***

It sounds complicated, but in practice MES provides simple objective procedures that are easily understood and used. It helps users avoid the differences in opinions and controversy that so often result from ambiguities, abstractions, or value judgments like inadequate or improper performance, causal factors, root causes, fault, or blame