

Engineering Event Investigation—The Role of Violations

Presented by

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Outline of Presentation

- ✚ Definition of errors and violations
- ✚ Maintenance Error Decision Aid (MEDA)
- ✚ New MEDA model, which includes violations



Definitions

- ✚ An **error** is a human action (behavior) that unintentionally departs from the expected action (behavior).
- ✚ A **violation** is a human action (behavior) that intentionally departs from the expected action (behavior).



Errors and Violations

- ✚ Errors have been the focus of research, so we have more theories of why errors occur than theories of why violations occur.
- ✚ However, errors and violations often occur together to produce an unwanted outcome. Data from the U.S. Navy suggest that
 - 60%-80% of unwanted outcomes (events) are caused by an error and a violation and
 - Only 20%-40% are due to “pure” error.



Some Ineffective Norms We Have Seen

- ❖ Memorizing tasks instead of using manuals/cards
- ❖ Troubleshooting through experience, instead of using the Fault Isolation Manual (FIM)
- ❖ Deviating from maintenance manual procedures
- ❖ Not using torque wrenches



Some Ineffective Norms We Have Seen

- ❖ Failing to attach “Do Not Use” tags when pulling circuit breakers and switches
- ❖ Skipping functional or operational tests
- ❖ Signing off for tasks not seen nor checked
- ❖ Providing minimum information in shift handover log
- ❖ Failing to document work not specified in the manual (e.g., loosening a clamp on a wire bundle)



Violations

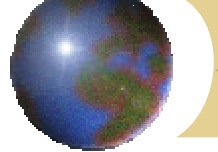
- ✚ Violations are often made by well-intentioned staff trying to finish a job, not staff who are trying to increase comfort or reduce their work load.
- ✚ There are several types of violations
 - ▣ Routine
 - ▣ Situational
 - ▣ Exceptional

Based on research by Patrick Hudson



Violation Definitions

- ✚ Routine—These are “common practice.” Often occur with such regularity that they are automatic. Violating this rule has become a group norm. Often occur when the existing procedure does not lead to the intended outcome.
- ✚ Who is culpable for these violations?



Violation Definitions (contd.)

✿ Situational—Occur as a result of factors dictated by the employee's immediate work area or environment. Due to such things as...

- ▣ Time pressure
- ▣ Lack of supervision
- ▣ Unavailability of equipment, tools, or parts
- ▣ Insufficient staff

✿ Who is culpable for these violations? 9



Violation Definitions (contd.)

- ✚ Exceptional—Rare and tend to happen only in very unusual circumstances, like an emergency or recovering from equipment failure. E.g., enter a fuel cell to rescue a fallen colleague, despite rules that forbid such a rescue attempt.
- ✚ Who is culpable for these violations?



Staff Likelihood of Violation

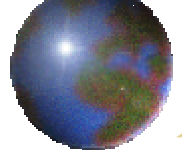
- ✿ Study done by Patrick Hudson in the oil industry—self reports
 - ▣ 22%--do not violate and would feel badly if they did
 - ▣ 14%--recently had a violation, but feel badly about having done it
 - ▣ 34% had not recently violated, but would not feel badly if they did violate
 - ▣ 30% recently violated and do not feel badly that they violated



What Is MEDA?

MEDA is a process that is used to investigate the causes of maintenance error.

- ✚ Errors result from contributing factors in the work place.
- ✚ Most of the contributing factors are under management control.
- ✚ Therefore, improvements can be made so that these factors do not contribute to future errors.
- ✚ Engineering must be viewed as a system, where the engineer is one part of the system.



Contributing Factors to Maintenance Error

Engineer
Knowledge
Skills
Abilities
Other characteristics

Immediate Environment

Facilities
Weather
Aircraft design/configuration
Component design
Equipment/tools/parts
Maintenance manuals
Tasks
Time pressure
Teamwork
On-the-Job training
Communication

Supervision

Planning
Organizing
Prioritizing
Delegating
Instructing
Feedback
Performance
Management
Team
Building

Organization

Philosophy
Other M & E
Organizations
Policies
Procedures
Processes
Selection
Training
Continuous
Quality
Improvement



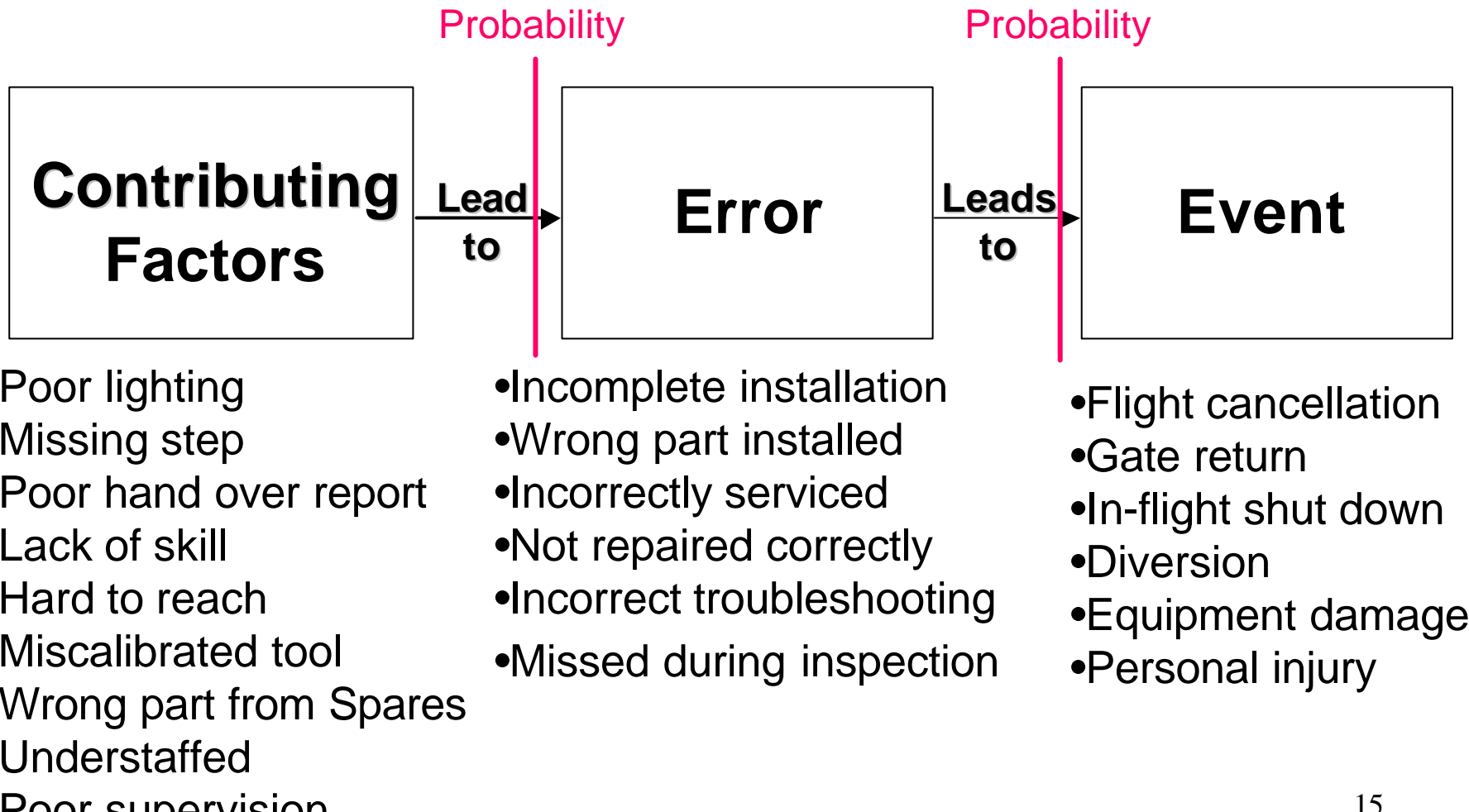
Levels of Causation

Two levels of causation

- ❖ Cause-in-Fact: If “A” exists (occurred), then “B” will occur.
- ❖ Probabilistic: If “A” exists (occurred), then the likelihood of “B” increases.
- ❖ The most common level of causation in error investigation is **probabilistic**

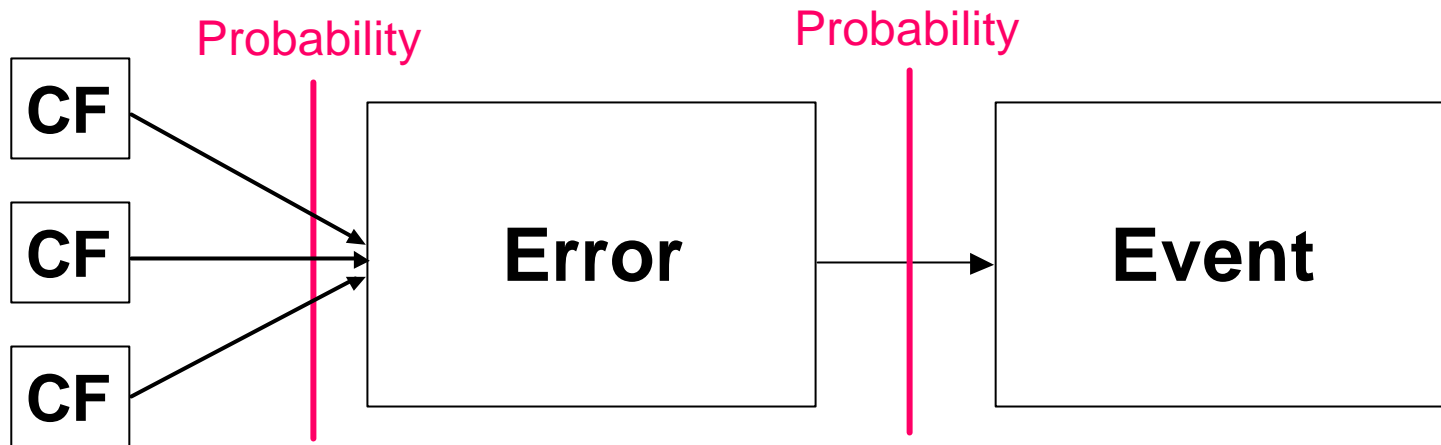


MEDA Error Model





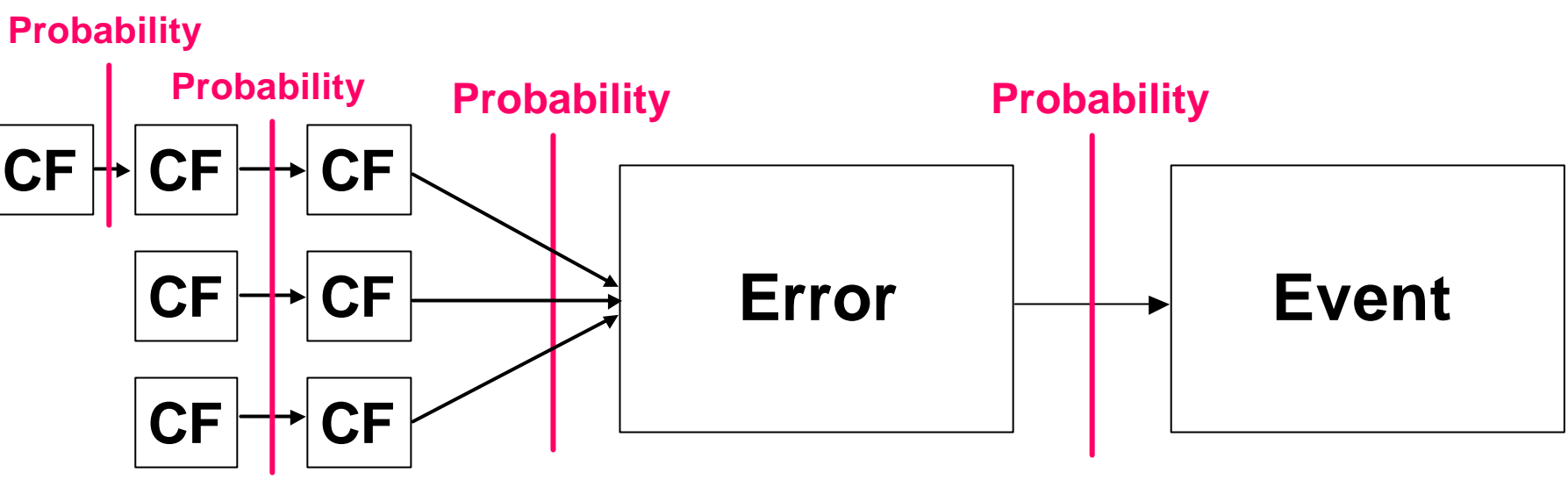
MEDA Error Model



**Experience has shown that
there is an average of 3 to 4
contributing factors to each error.**



MEDA Error Model

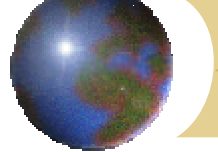


Also, there are contributing factors to the contributing factors.

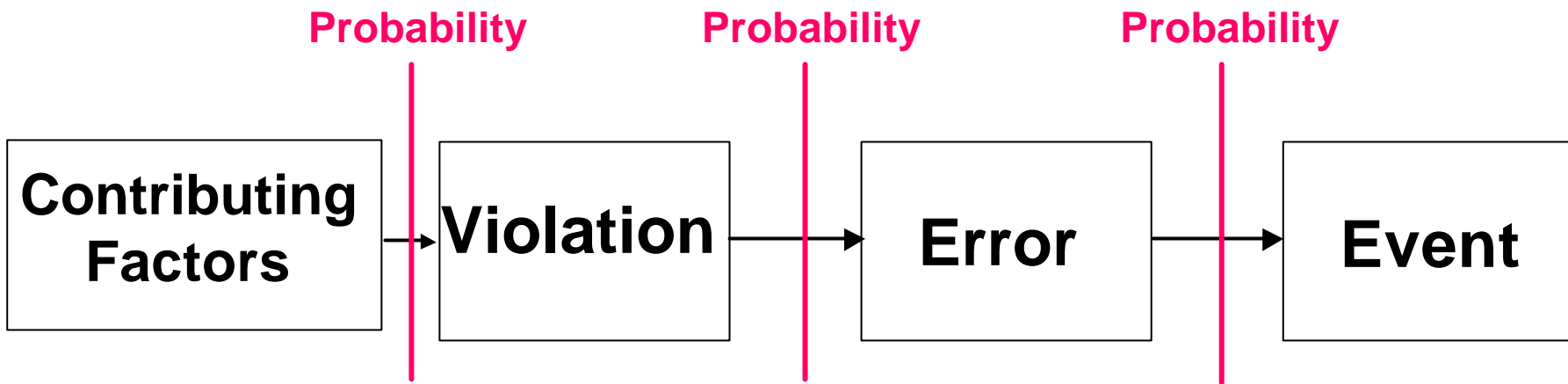


Errors and Violations

- ✚ Now that we know that errors and violations often occur together to produce an event, let's look at the ways that violations can contribute to errors and events.



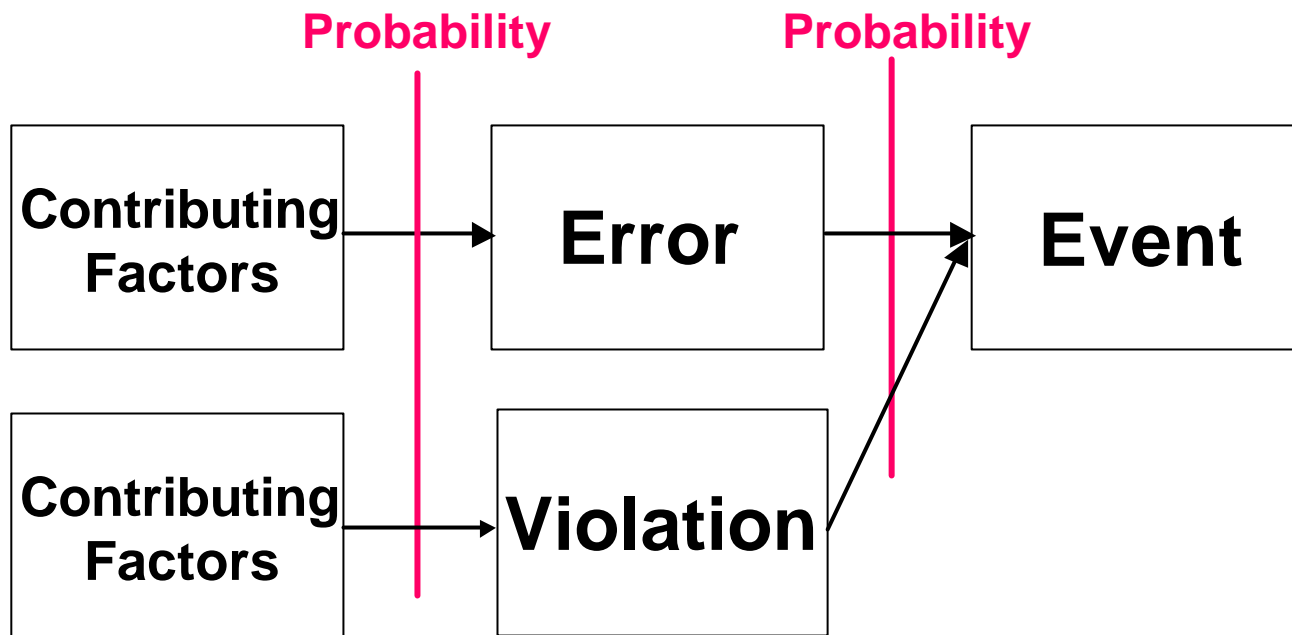
Error and Violation Model 1



- Engineer does not use a torque wrench (violation),
- which contributes to an incorrect installation (error) because of an under torqued bolt.
- This leads to an in-flight shutdown (event).
- There are reasons why (contributing factors) the violation occurred (e.g., torque wrench not available in time to do task or work group norm is not to use a torque wrench).



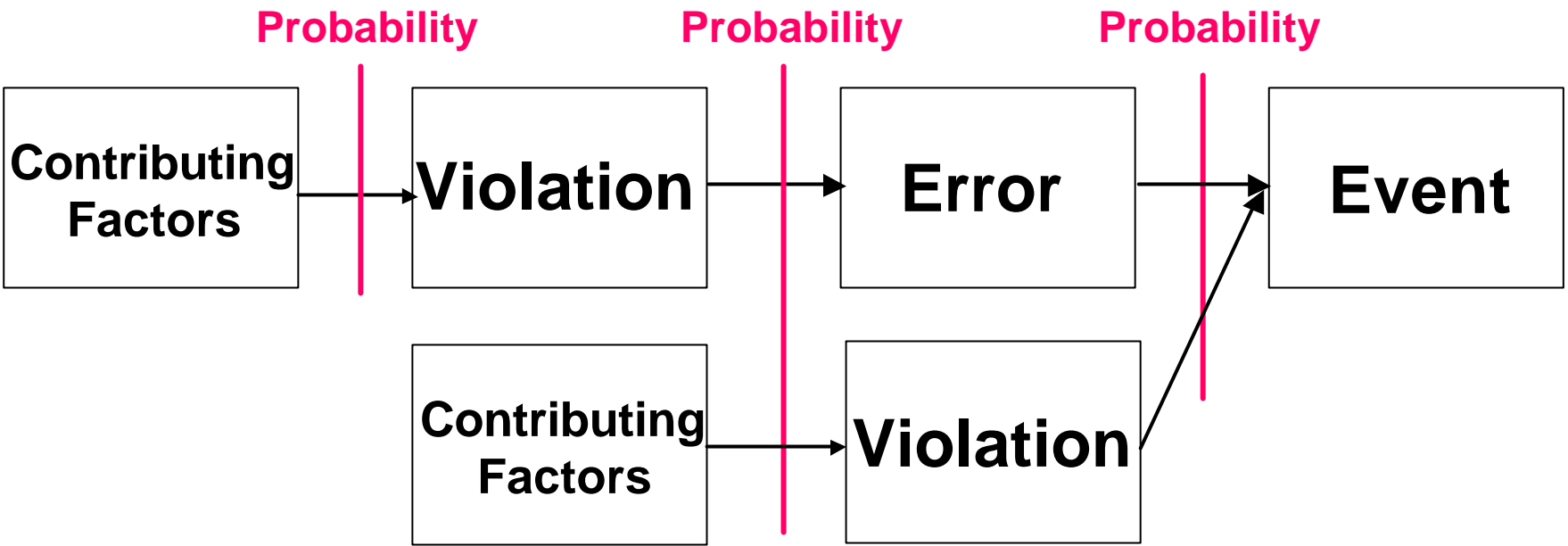
Error and Violation Model 2



- The engineer unintentionally misses a step in the maintenance manual (contributing factor),
- which leads to an incomplete installation (error).
- The engineer intentionally does not to carry out the operational check (violation), thereby missing the fact that the task was not done correctly.
- Because an error was made and this was not caught by the operational check, an in-flight shutdown (event) occurs.



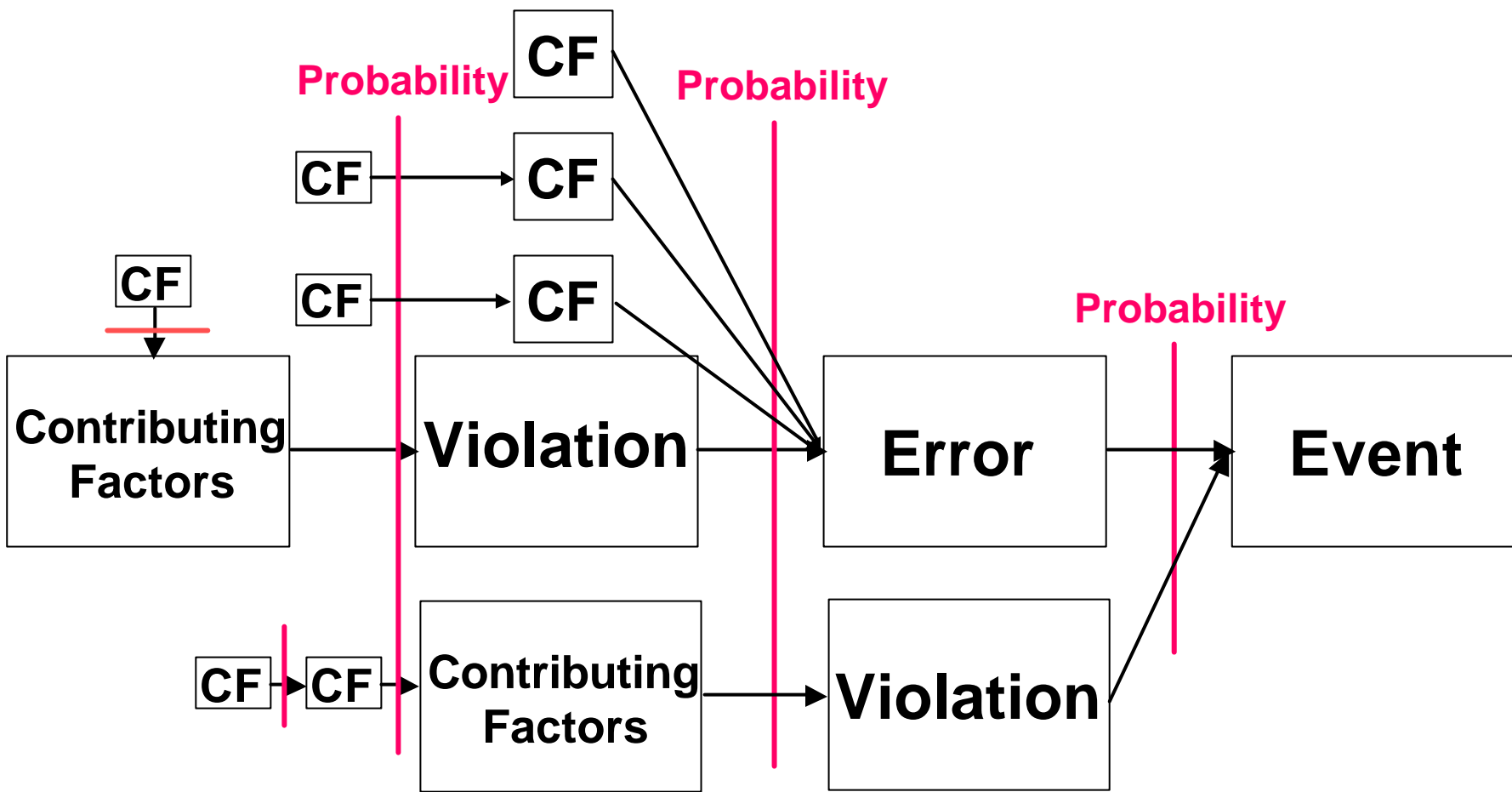
Combined Violation Model



- The engineer does not use a torque wrench (violation)
- which leads to an incomplete installation (error).
- The engineer intentionally skips the operational check (violation), thereby missing the fact that the task was not done correctly.
- Because an error was made and this was not caught by the operational check, an in-flight shutdown (event) occurs



Final Error and Violation Model





Impact of Including Violations

- ✚ Positive—More realistic investigation.
All of the facts are collected
- ✚ Negative—Managers may “stop” at the violation and not consider the contributing factors



MEDA Results Form

- ✿ Will the MEDA Results Form change as a result of including violations?
- ✿ Probably not
 - ▣ Most contributing factor areas where violations could occur include a “did not use” category, which could be considered the violation
 - ▣ “Organizational” category includes a “process/procedure not followed”



Summary

- ✚ Violations can contribute to engineering events in two ways
 - ▣ Can be a contributing factor to an error
 - ▣ Can cause a failure to “catch” an error
- ✚ Thus, engineering event investigations need to include the investigation of violations
- ✚ MEDA model has been changed to include violations
- ✚ This new event model can be used as a part of maintenance HF training