The Error Chain

A concept that describes human error accidents as the result of a sequence of events that culminate in mishap.

There is seldom an overpowering cause, but rather a number of contributing factors or errors, hence the term “Error Chain.” The links of these Error Chains are identifiable by means of eleven clues divided into operational and human factors. Breaking any one link in the chain might potentially break the entire Error Chain and prevent a mishap.

More than thirty accidents or incidents have been examined in testing the concept of Error Chains. Each was considered from the following perspective: “If this flight crew had been trained to recognize links in Error Chains and been proficient in doing so, were links present which, if found, might have caused a different response and outcome?”

In each event considered, the answer was “YES.” The fewest links discovered in any one accident was four; the average seven. Yet, recognizing and responding to only one link is all that is necessary to change an outcome. The presence of more than one serves to enhance the potential for timely recognition of an Error Chain.

While an Error Chain might be relatively easy to reconstruct during accident investigation, the presence of one may be difficult for a pilot to detect as it occurs. Familiarizing pilots with the concept of the Error Chain corrects this.
There are eleven clues to identifying links in an Error Chain. They are broken into operational and human factors. The presence of any one, or more, does not mean that an accident will occur. Rather, it indicates rising risk in the operation of an aircraft and that the pilot must maintain control through proper management of resources.

1. **FAILURE TO MEET TARGETS**
   Failure of the flight or pilot to attain and/or maintain identified targets. Targets include plans, procedures, or any other goals established by or for the pilot.

2. **USE OF AN UNDOCUMENTED PROCEDURE**
   The use of a procedure or procedures to deal with abnormal or emergency conditions that are not prescribed in approved flight manuals or checklists.

3. **DEPARTURE FROM STANDARD OPERATION PROCEDURES (SOP)**
   Intent to depart or inadvertent departure from prescribed standard operating procedure. Well defined sops are the result of a synergistic approach to problem solving with the influence of time removed. As a result, in difficult situations, standard operating procedures represent an effective means of problem resolution without the sacrifice of time, which is often not available.

   This is not to suggest that SOP’s will resolve all problems. However, they are an effective starting point. Failure to follow sop constitutes a link in the error chain and is an appropriate indicator of rising risk.

4. **VIOLATING MINIMUMS OR LIMITATIONS**
   Intent to violate or actual violation of defined minimum operating conditions or specifications either intentionally or unintentionally, as prescribed by regulations of more restrictive flight operations manuals or directives. This includes weather conditions, operating limitations, Rest or Duty Time Limitations, System Limitations, etc.

5. **NO ONE FLYING THE AIRCRAFT**
   No one monitoring the current state of progress of the flight. Flying the aircraft is the highest priority for the flight crew. If it is not being attended to, perhaps other important tasks are being overlooked as well.

6. **NO ONE LOOKING OUT OF THE AIRCRAFT**
   Again, this is a matter of priority. Mid-air collisions are a result of the crew not maintaining a heads up discipline. With today’s sophisticated electronic and flight management systems, it is easy to be tempted to keep one’s head in the cockpit rather than maintaining a careful eye outside. Failure to scan your flight direction and left and right through common conflict angles leads to a lack of situational awareness and rising risk.
7. **INCOMPLETE COMMUNICATIONS**
Incomplete communications are the result of withheld information, ideas, opinions, suggestions, or questions and failure to seek resolution of misunderstandings, confusion, or disagreements. For example, if a crewmember withholds information or fails to question another crewmember about an area of concern, a link in the error chain exists.

8. **AMBIGUITY**
Ambiguity exists any time two or more independent sources of information do not agree. This can include instruments, gauges, people, manuals, senses, control that do not correspond with associated indicators, etc.

9. **UNRESOLVED DISCREPANCIES**
Failure to resolve conflicts of opinion, information, or changes in conditions.

10. **PREOCCUPATION OR DISTRACTION**
The focus of attention on any one item or event to the exclusion of all others. This may include any number of distractions that can draw attention away from the progress of a flight. Distractions can be the result of high workload brought about by the demands of flight within high-density traffic areas, inclement weather, or abnormal and emergency conditions. Distraction can also be the result of personal problems, inattention, complacency, or fatigue.

11. **CONFUSION OR EMPTY FEELING**
A sense of uncertainty, anxiety, or bafflement about a particular situation. It may be the result of falling behind the aircraft or lack of knowledge or experience. Perhaps it is caused by being pushed to the limit of one's ability or such as a throbbing temple, headache, stomach discomfort, or nervous habit. Researchers suggest that these signals are symptomatic of uneasiness and should be trusted as indicators that all may not be right.

The presence of one or more of these clues means that an error chain might be in progress and that appropriate caution is advised. Recognition of the presence of error chain links provides a flight crew with the tools to appropriately manage risks associated with flight.

It is important to point out that identifying the presence of an error chain does not, in and of itself, eliminate the risk of a mishap. Instead, it serves as a warning to the crew that they must take appropriate action to manage the progress of the flight in the face of rising risk.

**OPERATIONAL CLUES**
1. Failure to Meet Targets
2. Undocumented Procedure
3. Departure from SOP
4. Violating Minimums or Violations
5. No One Flying the Aircraft
6. No One Looking Out for the Aircraft (Basket)

**HUMAN CLUES**
7. Communications
8. Ambiguity
9. Unresolved Discrepancies
10. Preoccupation or Distraction
11. Confusion of Empty Feeling
In addition to the eleven clues of the error chain, we need to consider several other factors that are involved in the investigation of an accident. These factors are not considered part of the error chain, but are contributory to the causes of accidents. They can be used in conjunction with the error chain to help determine some of the additional human or operational factors involved in an accident. In addition there are the five hazardous attitudes that we often find during accident investigation. These attitudes and their antidotes are important when considering the human side of flying.

**ADDITIONAL FACTORS INVOLVED IN ACCIDENT**

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<tr>
<td>COMPLACENCY</td>
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<td>EXPERIENCE</td>
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<td>PEER PRESSURE</td>
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**THE FIVE HAZARDOUS ATTITUDES**

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<th>Attitude</th>
<th>Characteristics</th>
<th>Antidote</th>
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<tr>
<td>Anti-Authority</td>
<td>“Don’t tell me what to do”</td>
<td>Obey the rules</td>
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<td>Impulsivity</td>
<td>“Do something quickly”</td>
<td>Not so fast</td>
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<td>Invulnerability</td>
<td>“It won’t happen to me”</td>
<td>It can and will happen to you</td>
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<td>Macho</td>
<td>“I can do anything”</td>
<td>You do not have super powers</td>
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<tr>
<td>Resignation</td>
<td>“What’s the use”</td>
<td>Continue to work the problem</td>
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In the evaluation of any accident or incident, you should use all of the factors contained in the error chain and consider them in concert with the additional factors and the five hazardous attitudes.