found it practical for analyzing aerospace products.

THERP, a technique for human error prediction, developed by Sandia Corporation, provides a means for quantitatively evaluating the contribution of human error to the degradation of product quality It can be used for human components in systems and thus can be combined either with the failure mode and effect or the fault tree methods.

Cost-effectiveness. In the cost-effectiveness method, the cost of system changes made to increase safety are compared with either the decreased costs of fewer serious failures, or with the increased effectiveness of the system to perform its task, to determine the relative value of these changes Ultimately all system changes have to be costed, but this method makes such cost comparisons explicit Moreover, cost-effectiveness is frequently used to help make decisions concerning the choice of one of several systems which can perform the same task

In all of these analytical methods, the main point is to measure quantitatively the effects of various failures within a system In each case probability theory is an important element

Deviation caused by change

In any process or system, there is some risk When something *changes*, accompanied by an *error*, there is an *accident* The error can be either active or latent For example, in a highway crash, a dog might run across a highway (the change), the first driver slams on his brakes, but there was too little space between him and the car behind (a latent error) The deviation is a two-car accident The accident, a deviation, interrupted the task performance

When a safety change is planned, unwanted changes must be anticipated (*a*) An offsetting safety change can be made to channel unwanted change aside or get rid of it (*b*) Or the change can be kept from affecting the error situation (*c*) Or the error can be kept from resulting in an accident (*d*) If there is an accident, its adverse results can be minimized by providing personal protective equipment (*e*) If there is an injury, then it can be treated In some cases, a new and better way can be found to do the task, thus avoiding the trouble-spot entirely

The objective of a plan for safety changes must be to help task performance The objective of accident investigation (discussed in Chapter 7) is to determine the facts that produced the "change," and to take countermeasures to offset this change so that the desired task may be completed

Value of systems approach

The industrial safety professional might well ask what all this "systems analysis" has to do with him The answer to that question, and the major point of this discussion, is that anyone can use and profit from the systems approach to safety The systems approach helps to enlarge one's viewpoint Becoming oriented in terms of task performance and being forced to visualize the interrelationships of all the components of a system helps to bring most accident possibilities into consideration automatically and in an orderly manner

The systems approach to safety can help to change the safety profession from an art to a science by codifying much of our knowledge It helps change the application of safety from piece-meal problem solving (such as putting a pan under the leak) to a safely designed operation (avoiding the leak itself)

We can apply the question "what can happen if this component fails" to the various elements of the systems and come up with adequate safety answers *before* the accident occurs instead of after the damage has been done

The Critical Incident

The critical incident technique is a method for identifying human errors and unsafe conditions which contribute to both injury and no-injury accidents within a given plant group The technique can identify mechanical and human causes of potential accidents before a loss occurs

The technique involves selecting a random sample of participant-observers from various portions of a plant population These persons are selected from the major plant departments, in order to obtain a representative sample of workers exposed to various hazards