Course Learning Outcomes for Unit II

Upon completion of this unit, students should be able to:

5. Compare various accident causation theories and models.
   5.1 Relate accident causation theories and models to accident scenarios.

Reading Assignment

Chapter 3:
A Short History of Accident Theory

In order to access the resource below, you must first log into the myCSU Student Portal and access the Business Source Complete database within the CSU Online Library.


The following work can be found on the Internet by typing the title into a search engine or clicking on the link provided:


Unit Lesson

Why do accidents happen? What needs to be done to prevent accidents from happening? These two questions are at the heart of any organization’s accident prevention efforts. Unfortunately, there is no simple answer. Some may even say that there is no answer at all. Remember that the various definitions of an accident include words like “unplanned” and “unanticipated.” Can we really identify ways to prevent something from happening that we cannot (or did not) anticipate? The accident investigation process gives us the opportunity to learn what went wrong. The worldwide body of knowledge related to accident causation has been a significant contributor to accident prevention efforts.

Before an attempt is made to investigate an accident, it is helpful to have a better understanding of how—not why—accidents happen. Analysis of accidents over the last century has led to a number of theories and models of accident causation. One the earliest theories came from H. W. Heinrich in the 1930s (Oakley, 2012; Toft, Dell, Klockner, & Hutton, 2012b). Heinrich postulated that accidents are caused by unsafe acts, unsafe conditions, or some combination of these. According to Heinrich, unsafe acts represented 80% of the causal factors, and unsafe conditions represented 20% (Oakley, 2012). More than 80 years later, this theory is still applied by many safety practitioners. Indeed, you can see it reflected in the way the Occupational Safety and Health Administration (OSHA) addresses workplace safety: OSHA standards contain prescriptive guidelines to control workplace hazards (unsafe conditions). OSHA standards also contain training and operational guidelines to modify or control worker behavior (unsafe acts). In the latter part of the 20th century, the behavior-based safety (BBS) movement further increased focus on controlling unsafe acts.

Heinrich expanded on his unsafe acts/unsafe conditions theory and incorporated it into a representation, or model, of the accident sequence. He described the accident sequence as a series of dominos. If one domino (causal factor) is removed, the accident will not happen. Heinrich’s domino theory has been updated and modified over the years, but its use remains pervasive. Undoubtedly, its use has resulted in many improvements to the accident investigation process.
The domino theory is an example of a simple linear model of accident causation (Toft et al., 2012b). It is simple, in that it is a single series of events, and linear, in that the events happen in sequence. It has been shown, however, that there are often multiple linear events that converge, resulting in an accident. In response, several complex linear models have been developed, such as the time sequence model, the epidemiologic model, and the energy damage model.

In the 1990s, the focus of accident modeling shifted from unsafe acts and unsafe conditions to a broader approach, which involves the interactions among people, their equipment, work processes, and organizational management (Toft et al., 2012b). It was recognized that failures in the system played a significant role in worker error, which resulted in accidents. The human element has not been removed from the accident causation theory; rather, we are beginning to better understand how the system in which the employee works contributes to decisions and behaviors that may lead to accidents.

Another contribution to accident theory made by Heinrich is the accident ratio study (also recognized as the accident pyramid or the accident triangle). This theory has been updated and modified over the years, but the premise remains the same: For every serious injury that happens, there will be a larger number of minor injuries, an even larger number of property damage incidents, and an even greater amount of close calls or near misses. The most common ratios used are 1-10-30-600 (Oakley, 2012). The numbers are arranged in a pyramid to indicate that the 600 close calls provide the foundation for all of the other levels of the pyramid. If we eliminate one or more of the levels, we weaken the foundation for the more serious levels above. In theory, if we eliminate all of the close calls, we would eliminate all of the incidents above them in the pyramid. The accident ratio theory has been widely accepted for many years and is often the driving force behind many accident investigation processes.

In recent years, however, some safety professionals have questioned the validity of the accident ratio (Manuele, 2013). While some minor incidents can be precursors to more serious incidents, there is very little data to support the idea that reducing injury frequency will reduce injury severity. Research has shown that in order for the ratios to be valid, the injuries at the various levels would need to have the same causal factors. This is certainly contrary to the multiple causation theory, and even a brief study of mishap causes would reveal the flaw.

Nonetheless, current-day safety practitioners continue to focus on near-miss reporting while possibly missing the true causes of serious injuries. That does not mean the accident ratio should be ignored. It needs to be looked at critically for what it is, which is a theory—not an immutable law of physics.

What are the benefits of understanding and using accident causation theories and models? Hovden et al. (as cited in Toft et al., 2012b) offer these thoughts on accident causation theories and models:

- They create a common understanding of accident phenomena through a shared, simplified representation of real-life accidents.
- They help structure and communicate risk problems.
• They help prevent personal biases regarding accident causation and provide an opening for a wider range of preventative measures.
• They guide investigations regarding data collection and accident analyses.
• They help analyze interrelations between factors and conditions.
• Different accident models highlight different aspects of processes, conditions, and causes.

As research into accident causation continues, we can expect to see new and more complex theories and models emerge. The safety practitioner is not limited to using one theory or model in the accident investigation process. Simple accidents—if there really are such things—may be well served by simpler models. Time and resources available to conduct an investigation may also dictate the complexity of the model used. Using multiple models can help balance the weaknesses of any single model.

The domino theory and its many variations are perhaps the most common models in use today (Oakley, 2012). While this course focuses more on these linear time-sequence models, the student is encouraged to learn more about the newer, emerging theories through independent research and study.

References


Suggested Reading

The most common approach to safety involves a defensive strategy; most organizations focus on barriers that reduce risk. This article looks at a new model of accident prevention; the article explores more of a systems approach.

In order to access the resources below, you must first log into the myCSU Student Portal and access the Business Source Complete database within the CSU Online Library.


This article focuses on a specific accident model—the entropy model. Take a few minutes to read this article if you are interested in learning more about this model.


Learning Activities (Non-Graded)

Bird and Germain’s accident ratio study (accident pyramid) is often cited as a reason to investigate minor accidents and near misses. Their work builds on research done in the 1930s by H. W. Heinrich, who is often considered as a pioneer in accident causation theory. In recent years, however, the accident pyramid has been criticized as being non-scientific and misleading.
Research the safety literature for recent articles that discuss the accident pyramid controversy. Summarize what you found, and provide your own conclusions as to whether or not safety practitioners should continue to rely on the accident pyramid to drive accident investigation efforts.

Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.