Course Learning Outcomes for Unit V

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

2. Apply occupational safety and health concepts to workplace scenarios.
   2.1 Explain the steps required to perform a risk assessment of a mechanical hazard.
   2.2 Explain the steps required to perform a risk assessment of a fall hazard.

5. Evaluate common workplace hazards.
   5.1 Perform a risk assessment using a risk-assessment matrix or a risk-assessment decision tree.
   5.2 Evaluate the acceptability of risk after performing a risk assessment.

6. Formulate hazard abatement strategies for common workplace hazards.
   6.1 Recommend controls to reduce the risks associated with a mechanical hazard.
   6.2 Recommend controls to reduce the risks associated with a fall hazard.

Course/Unit Learning Outcomes	Learning Activity
2.1	Unit Lesson Chapter 14, pp. 307–326 Unit V Scholarly Activity
2.2	Unit Lesson Chapter 15, pp. 329–357 Unit V Scholarly Activity
5.1	Unit Lesson Chapter 14, pp. 307–326 Chapter 15, pp. 329–357 Unit V Scholarly Activity
5.2	Unit Lesson Chapter 14, pp. 307–326 Chapter 15, pp. 329–357 Unit V Scholarly Activity
6.1	Unit Lesson Chapter 14, pp. 307–326 Unit V Scholarly Activity
6.2	Unit Lesson Chapter 15, pp. 329–357 Unit V Scholarly Activity

Reading Assignment

Chapter 14: Mechanical Hazards and Machine Safeguarding, pp. 307–326

Chapter 15: Falling, Impact, Acceleration, and Vision Hazards with Appropriate PPE, pp. 329–357

Unit Lesson

So far in the course, we have discussed the history of safety, causation models for safety, how to perform an investigation, and the role of human factors in accidents. In this unit, we start to look at how those variables apply to some hazards that you might face in your safety job—specifically mechanical hazards and fall hazards.

Two important concepts that students must be familiar with in this course are *hazards* and *risks*. While at first glance, these terms appear to be relatively easy to understand, many students are easily confused, using the terms interchangeably. Hazard and risk are not identical variables. A *hazard* is anything that has the potential to cause harm. The harm can be to an individual, the environment, or physical property like a structure. There are several common definitions of *risk*, but the most common is the probability that the hazard will cause harm and the severity that would be associated with the harm.

Part of the safety professional's job is to identify hazards that are present at a workplace. There are multiple methods for the safety professional to identify hazards, commonly referred to as a *hazard analysis*. We will go into some specific hazard assessments in greater detail in Unit VII as they are associated with management programs. For this unit, we will look at risk assessment of some specific hazards that we have already identified.

If you are a safety professional working in an industrial manufacturing facility, you have most likely encountered some mechanical hazards. Machines are required for most modern manufacturing processes. In the early days of the Industrial Revolution, many machines were driven by either human or animal power. As scientific knowledge increased, steam power became much more prevalent. Finally, with the advent of electricity, human- and animal-powered machines became obsolete. Today, most machines are powered by electricity, hydraulics, pneumatics, or some combination of the three. Another increasingly common variable is the use of robotics in manufacturing processes. Each of these power sources represents a hazard in the workplace.

The questions that the safety professional must answer are: how likely are employees to be injured when interacting with these hazards? And, how seriously can they be injured? One concept that is important for you to understand deals with residual risk. Optimally, a safety professional would like to create a workplace where the risk of injury and illness was zero. This goal is unrealistic. Whenever a hazard is present in a workplace, some level of risk will always be present. In other words, you cannot have a hazard with zero risk. Therefore, the only way to get rid of all risk associated with a particular hazard is to remove the hazard completely from the workplace. In most cases, this is not possible because the hazard is necessary for the production process.

The realistic goal of the safety professional is to reduce the risk associated with a specific hazard to an acceptable level. First, there needs to be a method of assessing the risk associated with a hazard. Then, there needs to be a way to determine if the risk is acceptable. The concept of acceptable risk is very subjective. What some might consider an acceptable level of risk associated with a process, others might consider to be unacceptable. If you have a way to quantify the risk, say give it a number rating, the evaluation may be easier.

Fortunately, there are several risk assessment methods that have already been devised and are in common use in the safety field. One method, using a decision tree, is presented in Chapter 14 of the textbook (Goetsch, 2019). A very common method used currently by safety professionals is the risk assessment matrix. In this type of matrix, one axis addresses the likelihood of harm and the other axis addresses the severity. Matrices exist with three choices per axis (3 X 3 matrix), four choices per axis (4 X 4 matrix), and five choices per axis (5 X 5 matrix). An example of a 5 X 5 risk assessment matrix appears below.

Outcomes				Likelihood				
Severity Rating	Health	Property	Environment	Very Likely	Likely	Possible	Unlikely	Very Unlikely
				5	4	3	2	1
5	Death or Permanent Total Disability	Catastrophic Loss	Significant Impact, Irreversible	25	20	15	10	5
4	Permanent Partial Disability	Severe Damage	Significant Impact, Reversible	20	16	12	8	4
3	Injury or Illness With Lost Workdays	Significant Damage	Moderate Impact, Reversible	15	12	9	6	3
2	Injury or Illness With no Lost Workdays	Moderate Damage	Minimal Impact	10	8	6	4	2
1	First Aid Only or no Treatment	Light Damage	No Impact	5	4	3	2	1

Sample 5x5 risk assessment matrix

Looking at the matrix, you can see that the results are colored red, orange, yellow, or green. These colors represent the level of risk, with red being the highest risk and green being the lowest risk. You may decide that orange and red represent unacceptable levels of risk and require corrections, while yellow and green represent acceptable levels of risk and do not require corrections. Understand though, that there are no regulatory requirements as to which levels to rate as red, orange, yellow, or green (or even which colors to use in a matrix), or which levels are acceptable and unacceptable. The decisions are purely subjective.

The way most safety professionals use the risk assessment matrix is to complete a risk assessment on an identified hazard. Once the risk level is calculated, a decision is made as to whether the risk is acceptable or unacceptable. If the risk is unacceptable, corrective measures are implemented, and the risk assessment is repeated with the new control measures in place. This process is repeated until the residual risk has been reduced to an acceptable level.

Let's look at an example. Figure 14-8 (page 315) in the textbook shows a picture of a shearing machine (Goetsch, 2019). Obviously, this is a hazard in the workplace. If we performed a risk assessment using the 5 X 5 matrix above before any controls have been added, we would probably say the likelihood of injury would be very likely, and the severity would at least be permanent partial disability (or maybe the higher category of death). We can all agree that a level of risk of 20 or 25 would be unacceptable. We decide to install the controls that are shown in Figure 14-8, which require both the foot pedal and the hand button to be pushed at the same time for the shear to operate.

When we perform a second risk assessment with the controls in place, we might now rate the likelihood as unlikely since the operator would need to purposely place the free hand inside the machine while both pressing the hand button with his/her other hand and stepping on the foot pedal. However, the severity would still be the same if an accident did occur. This would reduce the risk to a score of 4, 5, 6, 8, or 10 (green, yellow, or orange), depending on which likelihood and severity you chose. We can agree that the level of risk has been significantly reduced. Some of you may still rate the risk as being unacceptable, and you may implement additional controls, like installing a light curtain of boxing in the shear. You would then perform another risk assessment after the new controls have been installed.

The primary task the safety professional would have in the above scenario would be choosing a control method that reduced the risk to an adequate risk level and convincing management that the controls were necessary. Using the results of a risk assessment is a good way to help convince management of the need for the expenditure. Chapter 14 contains some examples of controls that can be used for reducing risk associated with mechanical hazards (Goetsch, 2019).

Falls have become a major source of injuries and deaths in the United States, especially in the construction industry. Based on the lessons we learned in our first four units, we know that falls can be caused by unsafe conditions or unsafe behaviors (human factors). Because of the risk of injury from fall hazards, the Occupational Safety and Health Administration (OSHA) has implemented a regional emphasis program for falls in the construction industry. OSHA (2017) has also published multiple standards for fall hazards.

You can perform a risk assessment for fall hazards using the same procedures we illustrated for mechanical hazards. For example, if we were evaluating the fall hazard associated with a roofing crew working on a two-story residential building with no controls, we would probably rate the likelihood as very likely. This rating could be reached by reviewing the number of falls in residential roofing projects each year (information can be obtained on OSHA's website). The severity would probably be rated as death or permanent total disability based on the number of deaths and permanent disabilities from falls each year. The rating of 25 would definitely be unacceptable.

There are many control methods that are available for fall hazards. Some of the control methods are described in Chapter 15 of the textbook. A large problem for safety professionals is getting workers to actually use the controls. This can especially be difficult on construction projects. Most residential roofing projects you see while driving through neighborhoods either do not use any fall protection, or use controls that would only minimally reduce risk. For example, many workers on roofing projects use foam knee pads on which they kneel while working as their fall protection. You can see that a risk assessment of a roofing project using that control method would still end with a rating of 15-20, which would be unacceptable. For that reason, OSHA recently started requiring the use of approved fall protection methods instead of these alternate methods. Approved fall protection methods for roofing projects would be a fall protection system (think fall arrest harness) with an anchor point on the roof or a netting system around the roof. If we performed a risk assessment with one of these controls, the risk would be reduced significantly to a point that most of us would say is acceptable.

References

Goetsch, D. L. (2019). *Occupational safety and health for technologists, engineers, and managers* (9th ed.). Pearson.

Occupational Safety and Health Administration. (2017, June 13). *Regional emphasis program - Fall hazards in construction* (OSHA Directive No. 2018-01). United States Department of Labor. https://www.osha.gov/dep/leps/RegionII/reg2_fy2018_2018-01.pdf

Suggested Reading

In order to access the following resources, click the links below.

Reducing the risks associated with falls can be very complicated. The following presents some ideas about reducing risks for falls based on some common misuses of protective equipment.

Galecka, C., & Smith, S. (2018, June). Fall protection: Top 10 misuses & what to do about them. *Professional Safety, 63*(6), 52–56. https://search-proquest-com.libraryresources.columbiasouthern.edu/docview/2050595194?accountid=33337

Prevention through design is a fairly new concept that is being used to reduce the risk associated with hazards at the initial planning phase prior to actually being introduced into an occupational setting. The following article presents a way to use prevention through design for construction hazards.

Lyon, B. K., Popov, G, & Biddle, E. (2016, September). Prevention through design for hazards in construction. *Professional Safety, 61*(9), 37–44. http://search.ebscohost.com.libraryresources.columbiasouthern.edu/login.aspx?direct=true&db=a9h&AN=118015566&site=ehost-live&scope=site

Safety professionals need to know how to conduct risk assessments. Performing risk assessments is sometimes even called an art form. The following article describes some methods for performing effective risk assessments. The article contains some good forms that you could use.

Lyon, B. K., & Popov, G. (2016, March). The art of assessing risk: Selecting, modifying & combining methods to assess operational risks. *Professional Safety, 61*(3), 40–51. https://search-proquest-com.libraryresources.columbiasouthern.edu/docview/1771603941?accountid=33337

OSHA has allowed residential roofing companies to use alternate methods of protection for many years. The following PowerPoint presentation explains the current requirements for fall protection in residential roofing projects.

Occupational Safety and Health Administration. (1992). *Residential fall protection program update* [PowerPoint presentation]. United States Department of Labor. https://www.osha.gov/doc/residential_fall_protection/ppt/index.html

In this unit, we read about mechanical hazards. The following article looks at some of the common mechanical hazards you might find in a machine shop.

Reif, R. H., Lopes, D. S., & Medeiros, S. M. (2018, April). Machine shop safety: A look at the Woods Hole Oceanographic Institution program. *Professional Safety, 63*(4), 30–35. https://search-proquest-com.libraryresources.columbiasouthern.edu/docview/2023370569?accountid=33337

Learning Activities (Nongraded)

Nongraded 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.

OSHA has developed some training aids for safety professionals. One training aid is in the form of a game to help you understand hazard assessment and risk assessment. Click the link below, and play the game. What did you learn about hazards and risks from the game?

Occupational Safety and Health Administration. (n.d.). *Hazard identification training tool.* United States Department of Labor. https://www.osha.gov/hazfinder/index.html