1. Describe in detail the eight-step risk assessment methodology.

The eight-step risk assessment provides a framework for effectively identifying, controlling, and managing risk in systems and processes. This structure provides a means for developing comprehensive risk assessments, including financial, perceptive, and safety-related risks (Bahr, 2015). Risk assessment eight-steps has three main domains: defining parameters, conducting risk-analysis, and evaluating and managing risk (Bahr, 2015). These eight steps are as follows Define Objectives, Define System, Develop Initiating Events for Scenarios, Develop Event Trees, Quantify Scenarios, Determine consequences, Evaluate Risks, and Manage Risks (Bahr, 2015).

An efficient and effective risk assessment requires well-defined objectives. Like managing projects, if the scope and purpose are vague, the project tends to creep and become unfocused. Discussing and determining what the assessment covers, what damages are of concern, and the purpose for performing ensures every stakeholder and team member is on the same page with a formal understanding (Bahr, 2015). Well-defined objectives assist other interest parties in understanding the what and why of an assessment which is vital for public and leadership entities (Bahr, 2015). Involved in this step is addressing risk perception by those stakeholders to help provide a base for further development later in the project (Bahr, 2015). Damages included in the scope and concern may include catastrophic, critical, major, and minor, and the effects of perception in this realm should be considered (Bahr, 2015).

Defining the system is key to understand that the process itself encompasses more than equipment and materials. The people, processes, technology, and infrastructure all require consideration (Bahr, 2015). People interact and are affected by a work system. Understanding their roles and ability to affect or be affected by a system is essential in risk assessments. Regulations, operations, opposition, and utilization by humans greatly impact outcomes and risks (Bahr, 2015). Processes are commonly focused on in these assessments as operating procedures and actions become considered. Still, other impacts in the process should be considered, such as the organization's business plan and interference in the process (Bahr, 2015). Involved in the detailed breakdown of the system includes technological impacts such as monitoring, system control, or recordkeeping may be involved throughout the system. Inclusion of facility is equally critical as the interactions and housing for work systems are integrated throughout the entire cycle (Bahr, 2015).

Initiating events are the key focus and sets the stage for risk analysis within the assessment. Initiating events are the events in which hazards present themselves. Inadequately identifying these events fails to find causes, Hazards, and controls throughout the assessment. Utilizing tools such as Fault Trees and FMEA provide an ability to assess the event and determine causes, potential effects, and underlying causes for these events of concern. This also provides a means to assess probability and provide a means to begin quantifying the assessment (Bahr, 2015).

Determining consequences assesses resulting outcomes, damages, and loss. These can include measurable impacts such as financial impact, public approval ratings, injuries and illness cases, lives lost, environmental damages, and other measurable outcomes (Bahr, 2015). Initially, these consequences can be qualitative as in what impacts are assessed (Bahr, 2015). Then these can be quantified in terms of measurable loss, impact, or variation.

Risk evaluation provides a means to understand better and compare risks associated with the system. This point of the process assists in decision-making for risk management (Bahr, 2015). This step intends to develop a quantitative understanding of risk. These quantitative measures provide a way to understand the inherent risk of a hazard and, therefore, allow for comparison and prioritization (Bahr, 2015). Risk profiles allow for identifying and labeling those events that pose greater risks within the system (Bahr, 2015).

Managing risk uses the profiles developed in risk evaluation to develop appropriate plans. Risk management considers how to approach risks and how to handle public communications and reporting protocols (Bahr, 2015. In this step, coordinating efforts and resources to reduce the impact and likelihood associated with the scenario is performed (ISO, NA). Public perception and expectation heavily sway the impact portion of the risk, as poor communication and involvement likely create significantly greater impacts. Communication plans, dialogue, and inclusion assist the management plan. This process is a formal component of safety management systems and provides a means to handle better and identify risks and hazards (Bahr, 2015).

References

Bahr, N. J. (2015). System safety engineering and risk assessment: A practical approach (2nded.). Boca Raton, FL: CRC Press.

1. Discuss in detail the quantitative risk evaluation technique, including both cut-set probabilities of system failure and the economics management theory equation of expected values.

Risk evaluation aims to develop effective decision-making when coming to risk events. Quantitative risk evaluations aim to develop probabilities of risks (Bahr, 2015). These quantifiable numbers allow for comparing and evaluating multiple risks through a system and classifying the varying risks presented (Bahr, 2015). The consideration of multiple events and their associated consequences is integral to risk evaluation. There are multiple techniques to perform quantitative risk evaluation effectively.

Event trees study each initiating event and the associated barriers, damages, and consequences (Bahr, 2015). Initiating event probability of occurrence and the likelihood of reaching each barrier are included in the evaluation. The damage states associated with the event can be qualitatively categorized with catastrophic, critical, or other classifications. The consequences utilize a quantitative cost or damage leading to the calculation of risk costs if the damage state occurs (Bahr, 2015).

Probabilities for initiating events can be obtained from Fault Tree analysis probabilities and FMEA (Bahr, 2015). Each barrier has an associated multiplying factor for if the barrier controls the initiating event appropriately or fails, resulting in the identified damage state (Bahr, 2015). An initiating event occurring but the first barrier able to keep normal operations would result in a minimal risk to the system. Consequence analysis is performed in the event tree to determine risk expectation values presenting the total risk of an event (Bahr, 2015).

As event trees can quickly pile up, dropping or cutting out lower-risk scenarios allows for fewer events to focus on (Bahr, 2015). As called by Bahr (2015) “pruning,” these scenarios at the event tree stage provide a best practice to ensure no significant risk scenarios are overlooked (Bahr, 2015). These cut-sets present events which result in the consequence streamlining the analysis processes to those of interest (Bahr, 2015).

Using the probabilities for reaching each barrier and damage state allows for calculating probabilities of occurrence (Bahr, 2015). Each event and damage state can be assigned a dollar value if the event occurs. Multiplying the probability of occurrence and the cost of that occurrence can calculate the Risk expectation value for each event and each event path.

To determine the appropriate cost across multiple scenarios the economics management theory equation of expected values can be used (Bahr, 2015).. This equation helps to derive expected values through comprehensive approaches accurately. This equation better reflects true costs and creates more accurate costs for determining consequences. The expected value theory takes into account the values of each scenario and the probability (Bahr, 2015). Using this theory provides a means to value the safety cost with multiple scenarios to better the decision-making process and convey quantifiable figures to leadership (Bahr, 2015). The combination of these quantitative tools provides strong risk evaluation and ultimately risk assessment.

References

Bahr, N. J. (2015). System safety engineering and risk assessment: A practical approach (2nded.). Boca Raton, FL: CRC Press.