Author: Alwadai, Mesfer, M

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STUDENT: Mesfer Alwadai **DATE: 7/24/2013**

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Alwadai, Mesfer, Mohammed. ***Using Risk Assessment to Evaluate and Prioritize Emergency Events at University XYZ***

Abstract

Risks are associated with any job; they are impossible to eliminate, and employees are exposed to them each day. Therefore, each organization needs to determine the risk level of all possible emergencies that might occur. University XYZ has different types of potential emergency events that pose significant risks might impact organizational goals. The organization in this study is in need of determining the risk level of each event that might come from natural, technological, and human hazard and prioritize the emergencies around the university's campus area. Through observation and a questionnaire among of key emergency decision makers at the institution, the researcher was able to identify the most common events occurred and determine the severity and probability of each one which helped to categorize the events into high, medium, and low risks.. The emergency events were prioritized based on the emergency risk level. It is the conclusion of this study that the institute should pay more attention on the high risk events such as residential building fire, hazard material, water supply, academic building fire, high winds and public health emergency and having an immediate plan to reduce the level of risk of both high- and medium-risk emergencies. It is recommended that further research should be conducted to determine the future risk level for each emergency after implement improper controls in order to prevent future accidents and predict other emergencies that management might not otherwise take into consideration.

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Chapter I: Introduction

Each year, millions of people are injured in the workplace. According to an estimation by the Survey of Occupational Injuries and Illnesses (SOII) conducted by the U.S. Bureau of Labor Statistics, private industry employers indicated that there were about three million nonfatal workplace injuries and illnesses in 2011,which resulted in an incidence rate of 3.5 cases per 100 equal full-time workers. Thus, risk assessment is necessary to prevent injuries and reduce cost and to increase the employees' productivities. .

Risk assessment is a powerful tool that attempts to make the work environment a safer place. Reducing the level of risk to as low as reasonably practicable is one of an employers' responsibilities (Thompson, 2002). In fact, there are several reasons for increased interest in risk assessment: It helps identify more hazards and assists in devising better risk-reduction measures; risk assessment evaluates the risks to prioritize and select the proper action to increase the safety in the workplace; and risk assessment provides a competitive advantage by increasing profit and reducing time to market. Moreover, during the risk assessment process, 5-10% more hazards are be identified than when risk assessment is not conducted (Main, 2004).

Statement of the Problem

University XYZ has different types of potential emergency events that pose significant risks might impact organizational goals.

Purpose of the Study

The purpose of this investigation was to prioritize emergency events from natural, technological, and human hazards at University XYZ. Data will be gathered through observation during the Spring Semester of 2012. A questionnaire among of key emergency decision makers at the institution will be used to gather and identify the most common events occurred.

Goals of the Study:

The primary goals of this study were:

1. To utilize risk assessment tools to determine the probability and severity for each emergency event that results from natural, technological and human actions.
2. To use the Risk Assessment Matrix to indicate the appropriate risk level.
3. To prioritize the emergency events based on the level of risk.
4. To make recommendations on types of emergencies that needs more attention.
5. To make any other recommendations that help set future plans.

Background and Significance

University XYZ is an institution that provides an appropriate atmosphere for students, faculty and staff to gain knowledge and obtain opportunities to work and serve society. The University XYZ campus is located in the state of Wisconsin. The local area around the university has a population of roughly15,500.

University XYZ has had four colleges since it was built 121 years ago: The College of Arts, Humanities and Social Sciences; The College of Education, Health and Human Sciences; College of Management; and The College of Science, Technology, Engineering and Mathematics. University XYZ offers 44 undergraduate and 19 graduate degree programs.

University XYZ facilities are used daily by employees, students and visitors. 1,421 employees currently work at the university in different positions such as faculty, academic staff, graduate assistants, classified staff. etc. The number of students enrolled in Fall 2012 was 9,247.

University XYZ has approximately 36 buildings that serve different purposes. The university provides a variety of facilities and equipment to their faculty and staff to promote productivity and increase the students' ability to learn. These facilities consist of classrooms

buildings, labs, workshops, offices, and residence halls. There are potential hazards in these areas depending on the type of material that facilities have and the activities that they pursue.

University XYZ meets all safety requirements in order to provide a safe workplace environment such as emergency exits, evacuation plans and fire extinguishers that could help to minimize all losses. However, these requirements cannot eliminate the risk completely since there are risks are associated with any job.

In general, risk can be related to one or more areas of: people, property, environment and business operations. Indeed, University XYZ has different potential emergency events that cause risks and could impact the organization's goals. These risks could stem from natural events such as snowstorms, floods, and earthquakes, or human made events such as fires in labs or residential buildings, or from technological events such as power or system failures.

University XYZ safety department faces the difficult challenge of controlling all emergency events. They reported that they try to evaluate the level of risk that comes from each emergency to select the best technique that will eliminate the hazard and reduce the cost of loss cost. In fact, it is important to evaluate and prioritize the emergency events for the following reasons:

1. It helps to focus on the most common risks for them, and not devote more time to events that are not risky.
2. It helps to select and implement the best technique for controlling and minimizing risk.
3. It indicates risks for which the institution might not be prepared.
4. It dictates a plan for the future.

Assumptions of the Study

It was assumed that all data provided by the participating parties are accurate and correct

Definition of Terms

Hazard. " A potential source of physical harm to persons" (Main, 2004, p .443).

Probability. "The likelihood of specific outcome, measured by the ratio of specific events or outcomes to the total number of possible events or outcomes. Probability is expressed as a number between 0 and 1, with 0 indication an impossible event or outcome and 1 indicating an event or outcome is certain" (Main, 2004, p. 446).

Risk. "A combination of the probability of occurrence of harm and the severity of that harm" (Main, 2004, p. 10).

Risk level. "The level of risk calculated as a function of likelihood and consequence" (Main, 2004, p. 455)

Severity. "A measure of the possible consequences of a hazard" (Main, 2004, p. 459).

Chapter II: Literature Review

The literature reviewed in this chapter defines risk and its sources. It also defines risk assessment, its importance and its history; discusses emergency-response action plan; and describes the utilization of risk assessment tools to help in emergency planning.

Risks are associated with any job; they are impossible to eliminate, and employees are exposed to them each day. According to a report form the Census of Fatal Occupational Injuries (CFOI) program performed by the U.S. Bureau of Labor Statistics, 4,609 fatal work injuries were recorded in the United States in 2011. As a result, U.S. workers' rate of fatal work injury was 3.5 per 100,000 full-time worker compared with 2010 when the total of fatal work related injuries was 4,690 while the rate of fatal work injury was 3.6.

The goal of any industry should be maintain a corporate culture that makes safety and environment its a priories. In order to have a culture of safety, companies must assess and identify high-risk areas carefully and then improve plans for safety .In fact, employers are responsible for providing employees with a secure hazard- free work environment and must follow all the recommended and legal standards. The purpose of health and safety in the workplace is to prevent employees form any work job injuries and diseases, and to design a work environment that promotes welfare to everyone at the job (Princeton Energy Resources International, 2010).

Risk

Risks can take numerous forms that organizations should be a ware of in order to constitute a safe work environment. The definition of the term "risk" includes, those processes which lead to undesired results. Other meanings of risk include the fear of wrong decisions or uncertainty. The technical definition of risk comes from machine-tool industry, is "a combination

of the probability of occurrence of harm and the severity of that harm." Risks can be a threat to employees' health and an organization's objectives if it is not recognized (Main, 2004).

Sources of Risk

The sources of risk can be either external or internal to the target or system (Manuele, 2011). Risk can be related to one or more areas of people, property, environment and business operation. The related discussion and a risk assessment can address one or more sources. Before making a decision, participants need to be certain they consider the appropriate sources of risk are considered (Main, 2004).

Risk Assessment History

Industries have performed risk evaluation and reduction for several decades. After the Industrial Revolution, the process of evaluating and reducing risk emerged unofficially. In the early 1960s formal methods were devised for conducting risk and reliability assessment in the United State aerospace and missile programs. The systematic use of risk analysis in the U.S. aerospace program was utilized in the U.S. nuclear plant installations. Risk assessment then spread to the oil-production applications and chemical industries, then to the offshore industries. Successful application of risk assessment in the offshore industries led to its introduction into the civil engineering of transportation systems (Main, 2004).

In Europe, risk assessment gained visibility in 1995 with the publication of EN 1050: (Safety of machinery, principles for risk assessment) which presented the risk-assessment process generally. EN 1050 encouraged efforts to develop risk assessment in the U.S. Based on or the influenced by EN1050, fields such as robotics, the machine-tool industry, and semiconductor technology began to develop risk-assessment methods (Main, 2004).

Today, different risk-assessment methods exist and continue to improve. However, it has become challenging due to changes occurring in the assessment. Advanced developments need to be made in many industries combining experiences and knowledge (Main, 2004).

Risk Assessment

Risk assessment refers to the identification of the hazards in a workplace and the probable harm the hazards may inflict on employees (Kemshall & Pritchard, 1997). Risk assessment is one of the features of the systematic process of safety and health. All employers are mandated to carry out a risk assessment at their workplaces so as to ensure a healthy and safe working environment. However, the consent of the workers is equally important. The employer should incorporate employees' understanding and knowledge of the occupation into the process. This means that a risk assessment should comprise all the aspects of job operations, including the tasks of the employees and the probable risks in the workplace (Kemshall & Pritchard, 1997). The justification of risk assessment in a business is to provide the employer with an opportunity to rate and categorize the preventive and control mechanisms it deems necessary (Haimes, 2009). Employers are required by law to carry out risk assessments. The law does not demand that employers eliminate all risks; however, it necessitates that an employer protects its employees in a reasonable manner.

Importance of Risk Assessment

Performing a complete risk-assessment process helps a firm identify the potential risks it is susceptible to, and the degree of damage they can cause. This is performed to determine the relevant steps to control risks and possible damages (Blokdijk, 2007). Risk assessment gives an understanding of how the business will be affected by a risk occurrence. To this end, it helps rate and categorize the recovery plans on the basis of the importance of their functions. A crucial

function of the risk-assessment process is to identify the potential circumstances of a hazard, as well as the recovery steps to be followed by a firm to restore calm. It is a challenging task to list disasters. For the list to be comprehensive, it requires constant updating. To handle this effectively, an employer needs to use an all-inclusive tool that covers the types of hazards.

Additionally, risk assessment performs the role of thinking through losses. This means that it handles the destruction of the lifeline of a business (Blokdijk, 2007). Risk assessment assists the business in analyzing the degree of damage and determine the steps to be followed to minimize the risk.

Emergency

An emergency is any unexpected event that can cause human losses or serious injuries to customers, employees, or the public; shut the business down; disrupt operations; or cause physical or environmental damage. It can also be any situation that threatens a facility's financial standing or public image (Federal Emergency Management Agency, 1993).

Numerous events can be considered emergencies, and include:

- Fire
- Earthquake
- Hurricane
- Winter storm
- Tornado
- Flood
- Hazardous materials incident
- Communications failure
- Civil disturbance

- Radiological accident

In fact, the application of the term "disaster" might depend upon scale, since a nuisance to a large industrial facility could be a disaster to a small business (Federal Emergency Management Agency, 1993).

Emergency or Disaster?

It is essential to understand the different between emergency and disaster in order to possess a proper plan and effective response when necessary. Indeed, both tend to begin as unexpected occurrences which produce negative effects. However, each situation differs in terms of resources available, methods of response, and scope or impact (Vulpitta, 2002).

The goals of emergency and disaster response are similar: they aim to save people, protect property, and resume normal activities. Even though goals of response are similar, responses to emergencies and disasters require differ in terms of methods, scope, and impact. Emergency response uses local resources, while disaster response can initially be local but outside responders and/or resources are needed whenever the local resources become exhausted. In addition, unlike disasters, emergencies tend to affect contained areas and disrupt normal activities in particular communities or facilities (Vulpitta, 2002).

Emergency Preparedness and Response

According to the National Safety Council (NSC, 2002), two people will be killed and 390 will suffer a disabling injury every ten minutes in the United States. In an average year, 11 unintentional injury deaths and about 2,330 disabling injuries occur every hour. For those ages 1-38, unintentional injuries lead to the cause of the death while they are the fifth leading cause of death. Therefore, the emergency planner at a company must be an expert on every type of potential human emergency and natural disaster in order to establish plans to lower an event's

impact. Emergency planning is one of the elements of an effective workplace safety and health program (Vulpitta, 2002).

Effective preparation is important to organize thorough reaction in an emergency situation. The Occupational Safety and Health Administration (OSHA) clarifies the key elements of emergency preparedness and response:

Planning. OSHA standards require organizations with more than 10 employees to have a written emergency-action plan; they might communicate their plans orally. Effective emergency-action plans demand a commitment and involvement from the organization's members, with top management support.

After the plan is established, the employer should review it with employees and reevaluate and edit the plan periodically whenever there is a change in either employee responsibilities or the plan itself. In addition, certain emergency procedures govern the handling of any toxic chemicals, and include:

- Escape procedures and escape route assignments.
- Specific procedures for employees who are responsible to perform or shut down critical plant operations.
- Methods of accounting for all organization members after evacuation and for information about the plan.
- Providing medical care for employees who perform emergency-action plans.
- Means for reporting emergencies, such as fires.

Chain of Command. The employer should name an emergency response coordinator and employees should know who the coordinator is. Also, employer should designate a backup

coordinator to ensure that a trained person is always ready. In addition, coordinator and employer duties could include:

- Determining the emergencies that may occur and ensure that emergency procedures are developed to deal with each situation.
- Making sure that all outside emergency services are notified when needed.
- Guidance the shutdown the plant operations when necessary.

Emergency Response Teams. Emergency response team members should be totally trained to be capable to face the potential catastrophic and physically efficient to carryout their duties. Team member need knowledge about different workplace areas such as toxic hazard in order to decide when to evacuate or when to rely on outside help. One or more emergencies teams must be trained in the following areas:

- First aid, including cardiopulmonary resuscitation (CPR) and self-contained breathing apparatus (SCBA).
- Requirements of the OSHA blood borne pathogens standard.
- Search and emergency rescue procedures.
- Chemical spill control procedures.
- Shutdown procedures.
- Use of different types of fire extinguishers.
- Hazardous materials emergency response.

Response Activities. Effective emergency communication is important. The plan should be established an alternative zone for communications center other than management offices. In addition, duties of the emergency response coordinator should be performed form the communications center. Furthermore, emergency alarms should be provided by management

and employee should be informed how to report an emergency. Indeed, it is essential to maintain a list of key personal and off-duty telephone numbers.

It is crucial to account for personnel following evacuation. In case there are missing, police or emergency response teams should be notified by a person who is in the control center. Effective security procedures can keep vital records and equipment save form unauthorized access. However, documents and lists of employee relatives (to contact them in case of emergency) should be kept in other location instead of site.

Training. The emergency action plan details should be clear to all the organization's employees. The action plan details include types of potential emergencies, alarm systems, evacuation plans, reporting procedures for personnel, shutdown procedures. In addition, several hazards should be discussed with employee such as flammable material, toxic chemical and radioactive sources or water - reactive substances. Moreover, drills held irregular time, at least annually, and should include fire department and outside police.

There are several cases that training must be conducted. It must be performed a least annually, for the new employees and changes in the employee job. Furthermore, different conditions are needed to an additional training that might include:

- Utilize new equipment.
- Introduce a new material or processes.
- Change occurred in the layout or the design of facility.
- Update or revise procedures.
- Inadequate employee performance.

Personal Protection. Employer should provide a proper personal protective equipments to employees who are exposed to or near accidental chemical splashes, unknown atmospheres

with not enough oxygen or toxic gases, fires, live electrical wiring, falling objects, flying particles and/or similar emergencies.

Medical Assistance. First aid must be provided within 3 to 4minutes of an emergency. Worksites that need more than 4 minutes to reach a clinic, an infirmary or hospital required at least one person on-site trained in first aid, medical personnel readily available for advice and consultation and an efficient written emergency medical procedures. In addition, first aid equipments are important to be available to be used by the trained providers. Emergency phone numbers should be placed near telephones or in proper places. Also, ambulance service should be arranged in advance in case of emergency. However, it is might to be helpful to coordinate an emergency action plan with outsider responders such as the fire department, emergency medical service and local HAZMAT teams.

Risk assessment with Emergency Planning Process

One of the emergency operation plan basis is risk assessment. The assessment provides a lot of benefits to a planning team during the design stage. It's helps the team to decide which threat and hazard needs more attention, what situation must be plan for, and what recourses possibly to be needed (Federal Emergency Management Agency, 2010).

At the beginning of planning process, assessments should starts with a thorough assessment threat and evaluate risks in order to identify all potential threat to the organization (Schroll, 2005). The planning team is required to know risks that have occurred or could occur during the hazard and threat analysis process (Federal Emergency Management Agency, 2010). However, to increase efficiency, the process could include a small of key people to develop a list of risks that concern organization, which developed earlier in the planning process. It may be helpful to divide the list into categories such as technological (i.e., man made) and natural (flood)

(Schroll, 2005). The list of concern might include earthquake, hurricane, HAZMAT release, power failure, radiological release, civil disturbance, terrorist acts and sabotage (Federal Emergency Management Agency, 2010).

Two problems must planners keep in mind about hazard and threat lists. The first one is exclusion or omission. There are always a potential for unexpected or a new risk, so that's a part of the reason to maintain all-hazards and all-threats capability. The second problem is that such lists include grouping that could affect subsequent analysis. A list might indicate that threats or hazards are independent and not related to each other while the fact is they are some time related. For example, an earthquake may cause dam failure. Moreover, events that require a different type of response might be classified under a group that does not have the same causes and sequences in one category (Federal Emergency Management Agency, 2010).

The planning team requires comparing and prioritizing risk in order to determine which hazard or threat that need special attention in the planning. In order to develop a single indicator of the risk, the team needs to consider the frequency of the hazard or threat and the likelihood or severity potential of its consequences that could help sitting the priorities after perform the comparison. It may be helpful to have qualitative rating for different categories that used in the ranking system such as high, medium and low or index numbers to reduce quantitative information to 1-to-3, 1-to-5, or 1-to-10 scale based on definition of threat. Moreover, some approaches consider frequency and consequence as only two categories and treat them equally while others focus on consequences more than frequency. However, it is necessary that the magnitude involved have a sense. Indicators such as single indicator used in rank hazard or estimation of people affected are static. Some hazards might pose a risk to community but that is so limited which does not need to additional analysis while other threat may be dynamic such as

HAZMAT toxicity and transportation routs (Federal Emergency Management Agency, 2010)

Preliminary Hazard Analysis

It is one of risk assessment techniques that could to evaluate the risk during assessment the stage. A well-done Preliminary Hazard Analysis (PHA) will help to identify hazard and their potential consequences, assess risk to develop an expected loss rate, and guides cost-effective resource deployment. It is a line-item inventory of all system hazards and their risks. Also, it might be carried out at any point in the system life cycle. In addition, PHA provides the top management with a decision tool to effectively prioritize activities as well as assigning resources efficiently in order to bring all risks under acceptable (Mohr, 2002).

It is used to identify hazard and then determining the severity of consequences and probability of mishap. The hazard will be categorized into acceptable and non-acceptable levels after putting hazards a risk assessment matrix. The PHA provides controls to the identified hazards are well as the most effective countermeasure that could be utilized to reduce the risk into acceptable levels.

Chapter III: Methodology

This chapter includes information about the risk-assessment tools that utilized to evaluate and prioritize the emergency events at University XYZ in Wisconsin. The methods used during this investigation included: 1) utilizing risk-assessment tools to determine the probability and severity for each emergency event that occurs from natural, technological, and human causes; 2) administering a survey to the institution's key emergency-decision makers to identify the most commonly occurring events; 3) prioritizing the emergency events based on the level of risk; and 4) making recommendations on the types of emergencies that need more attention.

Subject Selection and Study

The subject of this study was the campus of University XYZ. It has approximately 36 buildings and 1,421 employees in different positions, such as faculty, academic staff, graduate assistants, classified staff, and others. The university had a total of 9,247 students enrolled in the fall of 2012. All emergency events around the campus were targeted to evaluate the level of risk in order to protect its people, property, and environment from any negative impact.

The decision makers at the university's safety and health department involved to help in determining the probability and severity for each emergency on campus. They utilized a questionnaire, provided by the researcher, which presents two questions about each emergency's probability and severity. These decision makers were chosen by the researcher because of their positions, knowledge, and experience dealing with emergencies during their employment period.

Data Sources and Data-Collection Procedures

The information for this study gathered from the university's safety department, in addition to the researcher's observations. The researcher was provided with a list of the

university's most common emergencies that cause a threat to its campus. The following is a list of the procedures that the researcher performed to obtain the needed data:

1. The researcher categorized emergencies into three groups according to their causes: Natural, Technological, and Human.
2. The researcher defined the targets made vulnerable by emergencies: people, property, productivity, and environment.
3. The researcher generated a survey to administer to the management, evaluating the emergencies at the present time.
4. The Risk-Assessment Survey (appendix E) distributed among the institution's decision makers, and the research analyzed the data gathered by the survey.
5. The researcher reviewed the loss-history record to recognize and evaluate the emergencies that have occurred most often.

Data Analysis

After identifying the emergencies at University XYZ, the probability and severity of each one needs to be categorized. The researcher used the probability of mishaps (Appendix A) to order emergencies according to how likely the occurrence of loss during each emergency would be over a 25-year period. There were factors that might increase or decrease probability, such as target population, exposure duration, and operational phases. However, records and accounts of near hits of the emergency might give an indication of a loss' future likelihood.

Severity of consequences (Appendix B) utilized to put emergencies into different levels of severity according to the targets' loss of personnel, equipment, productivity (downtime), and environmental quality. Severity was categorized according to four different levels ranging from catastrophic (where consequences include death, or damage that forces the closing of the

institution) to the lowest level (negligible emergencies that are forgotten after a short period of time). Between these two extremes were marginal and critical levels. These levels determined based on the survey administered to university management.

The Risk-Assessment Matrix (Appendix C) has three levels of risk that help prioritize emergency events at the University XYZ by indicating the emergencies that should be addressed first. It cross-references the probability and severity of mishaps and categorizes each emergency into a risk code of one, two, or three.

Preliminary-Hazard Analysis (Appendix D) used as a risk-assessment tool to put the information together and provide efficient countermeasures to reduce the risk of emergency. Preliminary-hazard analysis addressed emergencies and countermeasures in order to achieve a lower code on the Risk-Assessment Matrix.

Chapter IV: Results and Discussion

The purpose of this study was to prioritize emergency events from natural, technological, and human hazards at University XYZ. The objectives of this research were to indicate the appropriate risk level and prioritize the emergency events based on the level of risk. This chapter provides a discussion and results of the data collected used to achieve the research objectives.

Discussion Survey Questions and Data

Starting from the emergency events list provided to the researcher, the Risk Assessment Survey (Appendix E) was designed to evaluate the current status for each emergency. The intent of the survey was to detect the probability (likelihood) of each emergency's occurrence and the severity of the impact it would have on the organization's objectives. However, the final result of the survey indicates an insight about the present level of risk that could be a threat to the institution. The process of evaluating the present state of each emergency event began by assigning each emergency a risk code based on its probability and severity indicated by the survey respondent. The Risk Assessment Matrix (Appendeix C) was utilized to code every emergency by indicating its level of risk as a 1, 2, or 3 in order to define the needed action. The risk code 1 presented a high risk level; 2 presented a medium risk level, and 3 presented a low risk level.

Survey Participants

Survey participates served in various departments at University XYZ, such as Safety and Risk Management, Building Maintenance, Recreation, and the Physical Plant, in different positions in the organization's management structure. They held positions such as Executive Director of Health & Safety, Director of Safety and Risk Management, Chemical Hygiene Officer, Building & Grounds Superintendent, Adventure Coordinator, and Director of the

Physical Plant. The survey's data were resulted from six responses of twelve participants whom were asked to involved to this study.

Data

Since the participants served in different positions, their experiences with these emergency events might vary from each other, which led them to anticipate the probability and severity of each emergency differently. They gave dissimilar responses regarding the likelihoods and the impact of these events, but most likely gave responses that assigned similar amounts of risk to each event. After identifying the probability and severity of each event, the Risk Assessment Matrix (Appendix C) analyzed each emergency and indicated the current level of risk. Several emergencies were simultaneously classified as high- and medium-risk events at the by different respondents, as a result of their different perspectives.

Each one of the XYZ University's emergency events was assigned a percentage value according to how many respondents assigned it a given risk level (high, medium, low). Figure 1 presents bar graphs showing the percentage of respondents that assigned an emergency a high, medium, and low level of risk. The organization needs to pay more attention to emergencies that require actions to suppress high levels of risk, rather than emergencies whose level of risk was permissible for safe operation. The following are the emergencies that were classified as high-risk emergencies:

High-Risk Emergency Events. It is included:

- High winds
- Public health emergency
- Academic building fire
- Water supply emergency

- Residential building fire
- Hazardous material emergency

Medium-Risk Emergency Events. It is included:

- Academic building fire
- Radiological material emergency
- Wildfire
- Catastrophic earthquake
- High winds
- Power failure
- Telecommunications-system failure
- Residential building fire
- Sporting event emergency
- IT infrastructure emergency
- Biological agent emergency
- Severe winter blizzard/ice storm

As shown in Figure 1, emergencies such an academic building fire, a residential building fire, and high winds were assigned a risk code of 1 and considered high-risk-level events by some participants, but these same events were assigned a risk code of 2 by other respondents. Based on the rest of the survey questions, the University XYZ's loss-history data, and its priority of providing a save environment to all users, these emergencies were considered high-risk-level events. Also, emergencies that assigned a 2 and 3 by an equal number of respondents were considered medium-risk-level events.

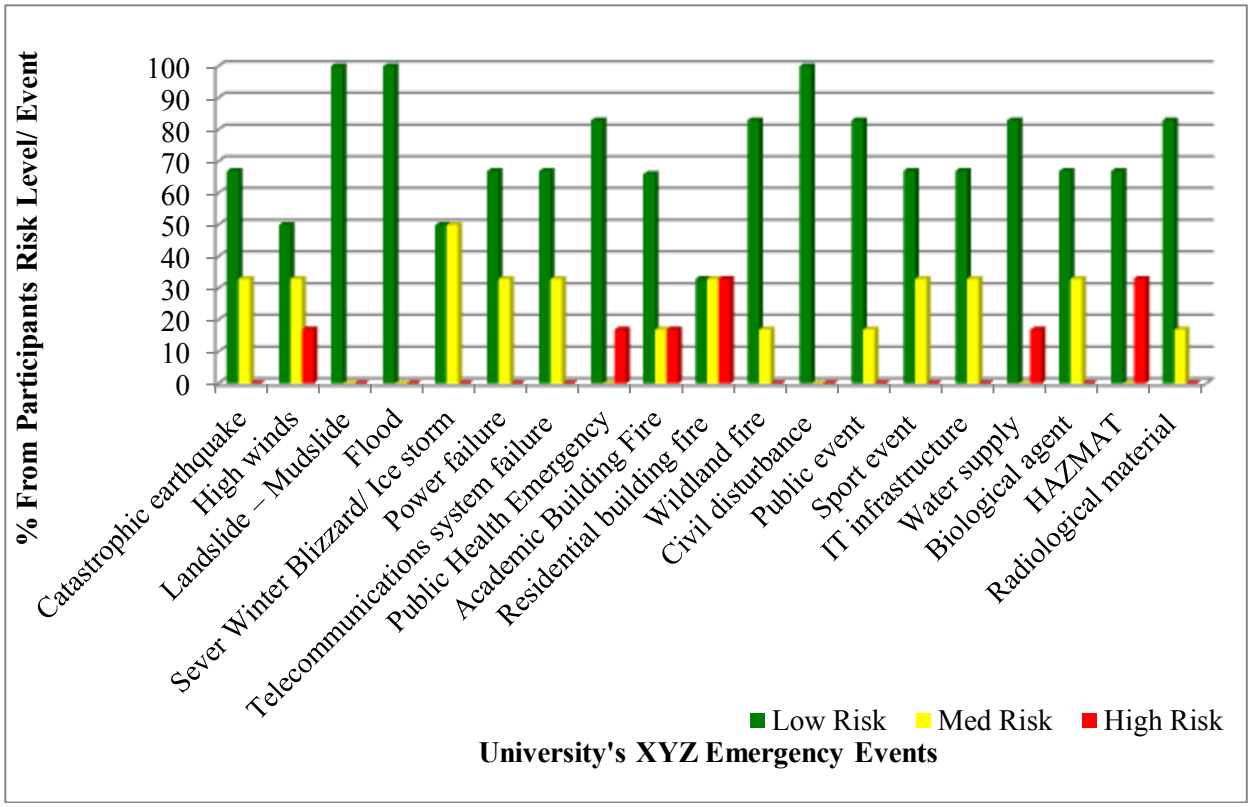

Figure 1. University XYZ's emergency events risk-level percentage.

Prioritizing Emergency Events

After evaluating the current state of these events, the next research objective was to prioritize the emergencies in order of which events post the highest risk and demand the most attention. High- and medium-risk emergencies were prioritized based on the percentage of respondents who indicated these events as high- and medium-risk-level events.

High-Risk Emergency Events

Six emergencies were indicated as high risk levels and grouped as one category of the survey results. They were divided into percentages based on how many respondents classified each event as high-risk. Furthermore, two of the six emergencies were assigned identical risk levels by an equal number of respondents. In other words, they were assigned the same priority for addressing the risk. The highest-risk events were the residential building fire and hazardous material events.

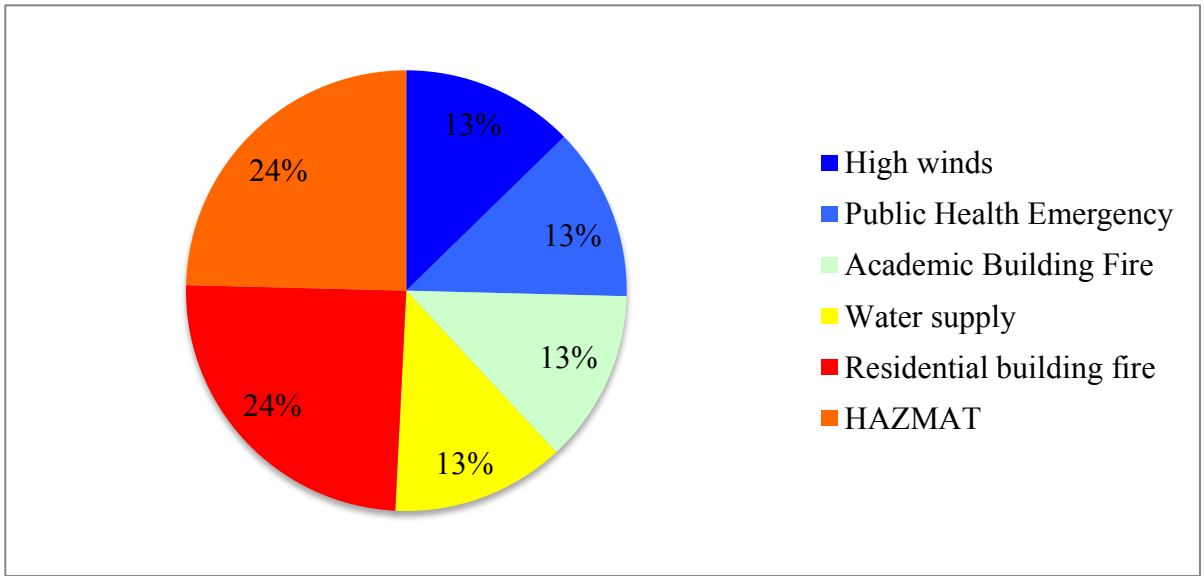

Figure 2. Percentage of respondents indicating high risk levels for events.

Figure 2 shows the proportion of emergencies that respondents indicted as high-risk-level events. 24% of participants indicted high risk levels for residential building fire and hazardous materials, respectively, and therefore presented the greatest risk. Emergencies were then prioritized from the most to least critical:

1. Residential building fire
2. Hazard material
3. Water supply
4. Academic building fire
5. High winds
6. Public health emergency

Medium-Risk Emergency Events

There were nine emergencies emergency events that were reported indicated by participants as having medium risk level at the campus area of the university XYZ levels. They were categories as the most one to occur to the less presented. 18 % of the participants whom indicated the medium risk events reported that a severe winter blizzard/ ice storm were as the

most events occurred which event that might be a the greatest threat of to the campus area. Emergencies Events such as biological agent emergencies, IT infrastructure emergencies, sporting-emergencies, events and telecommunications- system failure were presented indicated by 12% of the management participants. As shown on Figure 3 shows the percentage of respondents who assigned medium risk levels to these nine events. Each emergency had a mentioned percentage from the total participants

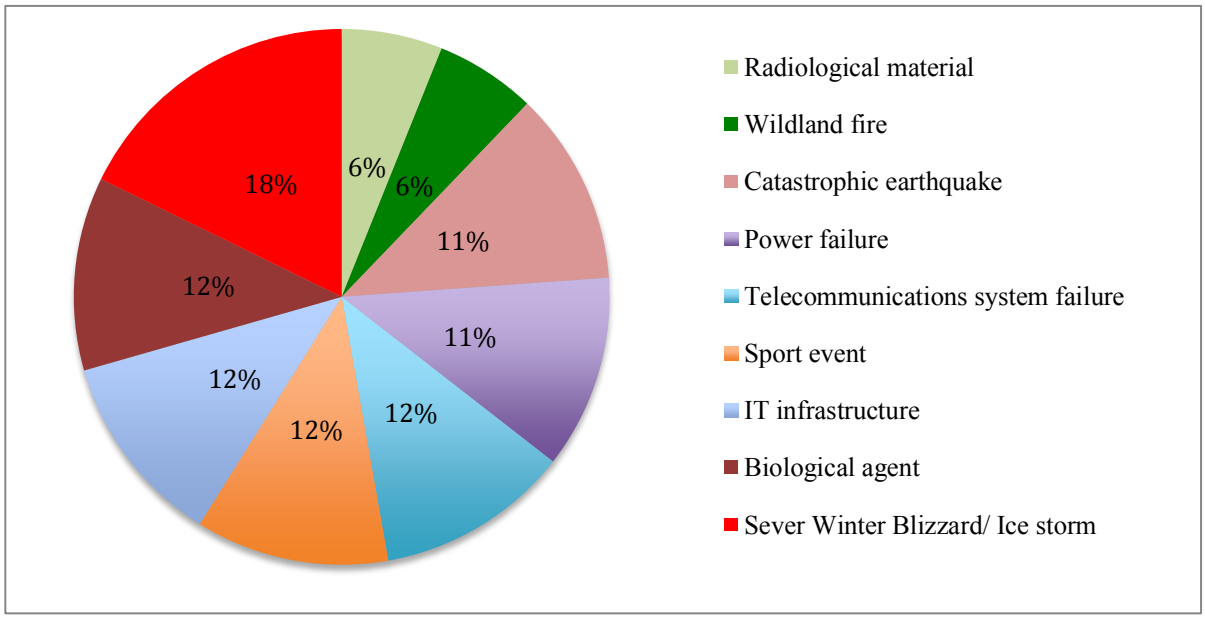

Figure 3. Percentage of respondents indicating medium risk levels for events.

The proportion of respondents identifying each event as a medium-risk emergency helps prioritize them from most to least critical. The following were the order of priority for medium-risk-level events:

1. Severe winter blizzard/ice storm
2. Biological agent emergency
3. IT infrastructure emergency
4. Sporting event emergency
5. Telecommunications-system failure

6. Power failure
7. Catastrophic earthquake
8. Radiological material emergency
9. Wildfire.

Top Five Emergencies

At the end of the survey, participants indicated the vents they considered the top five emergencies at University XYZ. The emergencies most frequently indicated were a residential building fire, an academic building fire, high winds, and water supply emergencies. However, these emergencies were assigned high risk levels after the risk matrix coded their probabilities and severities as risk-level 1. Several emergencies appeared on this part of the survey but the frequency of their mention was negligible; these emergencies included public-events disturbance, power failure, and ice/snow storms. Moreover, these emergencies were not at high risk levels, so they were not top priority.

Other Emergencies

Since there might be additional emergencies that could occur on the University XYZ campus area, the researcher added this section to the survey to give respondents an opportunity to mention them. One such emergency event mentioned was off-campus incidents involving students and automobiles. This emergency was assigned a medium risk level, which required lowering the risk level.

Loss-History Data

Looking at the organization's loss-history record helped identify the loss caused by the most common emergencies. University's XYZ property and liability claim incident losses of 2008 – 2009 indicated that most loss was caused by frozen pipes. Water damage and power-

outage emergencies caused the most loss in 2009 – 2010. In 2010 – 2011, academic-building fire emergencies contributed to about 70% of the organization's total losses. High winds caused the most losses in 2011 – 2012, while water-supply emergencies and academic- and residential-building fires caused the most losses in 2012 – 2012. The loss-history records for this five-year period showed a correlation between the emergencies that causes the most losses and the events considered high-risk emergencies by this research, and helps prioritize the emergencies that post the greatest risk.

Chapter V: Conclusions and Recommendations

The purpose of this study was to prioritize emergency events from natural, technological, and human hazards at University XYZ. The objectives of this research were to use the Risk-Assessment Matrix to indicate the appropriate risk level for each emergency, prioritize the emergency events based on the level of risk they present, make recommendations on the types of emergencies that needs more attention, and make any other recommendations that help determine future plans. Chapter IV also provided the study results and discussion. This chapter contains the major conclusions found in the investigation and offers some recommendations into possible areas of improvement.

Conclusion

Based on the data collected from the survey results and the last five years' loss-history record, the following conclusions can be made, given the current risk level of University XYZ's emergency events:

Emergencies can be caused by one or more of the events: natural events such as catastrophic earthquakes, high winds, landslides, mudslides, floods, or severe winter blizzard/ice storms; technological sources such power failures or telecommunications-system failure and human sources such as fire, disturbance, disruption, or the release of chemicals. Moreover, based on the risk codes derived from the Risk Assessment Matrix, each emergency was categorized according to three levels of risk: high, medium, and low.

After evaluating each emergency, several factors were taken into consideration before emergencies were prioritized. These factors included; obtaining a high level of safety, a survey of results by decision makers; the proportion of survey participants that indicated the level of risk for each emergency and the institute's loss-history record over the past five years.

As discussed in Chapter IV, emergencies evaluated and prioritized at a high risk level were: high winds, public-health emergencies, academic-building fires, water-supply emergencies, residential-building fires and Hazardous-material emergencies. Also, chapter IV has reported that the emergencies evaluated and prioritized at a medium risk level include radiological material emergencies, wildfires, catastrophic earthquakes, high winds, power failures, telecommunications-system failures, residential-building fires, sporting-event emergencies, IT-infrastructure emergencies, biological-agent emergencies and severe winter blizzard/ice storms. Moreover, public-disturbance events, civil-disturbance events, landslides/ mudslides and floods are emergencies evaluated and prioritized as low-risk-level events. Furthermore, participants designated one other emergency in University XYZ's campus area which is off-campus incidents involving students and automobiles—as a medium-risk event.

Recommendations

Based on the data that was gathered and the conclusions stated, the following recommendations would help obtain an acceptable risk level and maintain University XYZ's objectives. These measures intend to reduce the probability or severity of potential emergencies, and include:

- An immediate plan to reduce the level of risk of both high- and medium-risk emergencies must be developed by the management of the safety department. This plan should focus on high-risk emergencies first, to ensure that more operations are performed at a lower risk level. Furthermore, both high- and medium-risk emergencies were prioritized as events that might pose more risk to the campus area, so controls for those emergencies should be set sequentially.

- An assessment of high-risk events should be conducted that assesses specific areas in urgent need of control, to lower the level of risk and ensure users are in a safe environment.
- Since residential- and academic-building fires were considered high-risk emergencies, the following recommendations that might promote safety by sequentially reducing the risk level:
  A. Install advanced sprinkle and detector systems;
  B. Isolate the chemicals that could react together to cause fire;
  C. Train users on evacuation plans of the buildings;
  D. Connect the building with the fire department; and
  E. Provide special areas for smokers.
- To reduce the risk of hazardous-material emergencies, the following recommendations might help obtain the target risk level:
  A. Proper hazardous-material transmission;
  B. Efficient and proper containers; and
  C. Proper isolation for areas that contain hazardous materials.
- Natural-emergency events, such as high winds and ice storms, were classified at either a high- or medium-risk level. The following steps might reduce risk:
  A. Send notification and warning emails to faculty and students;
  B. Train users on building-evacuation plans;
  C. Cooperate with weather forecasting and the local fire department;
  D. Clear of sidewalks immediately; and
  E. Provide psychological barriers.

- Programs should be established that would increase awareness of the evacuation plans surrounding activities that might cause a threat to the whole campus area. These programs could be offered at the beginning of each semester or could be instructions sent via email to all campus users.
- Water-pipe damage requires more attention, so a maintenance program should be developed to help indicate weak pipes and replace them before emergencies occur. The employees could be a part of the program improvement which will enhance their level of a awareness to report the damage and keep the maintenance department updated.
- Off-campus incidents involving students and automobiles haven't yet been taken into account, and should be considered during the development of future emergency plans.
- Emergencies such as public- or civil-disturbance events, landslides, and floods are not sufficiently risky to require more preparation than is already in place, since they were classified as low-risk events.
- Further research should be conducted to determine the future risk level for each emergency after implement improper controls.

Recommendations for Further Research

The scope of this study focused on evaluating and prioritizing emergency events that might be a threat to University XYZ's campus area. The following areas should be researched further to determine areas that pose significant risk and develop plans for the future:

- Replicating this study periodically over time will help address major areas of risk, prepare for any type of emergency, and measure performance to prepare for emergencies that have been classified as high- or medium-risk-level events.

- Repeating this study will help explore and predict other emergencies that management might not otherwise take into consideration.
- The institution's loss-history record should be compared to assessment results to determine if there is any correlation between the occurrence of incidents and their risk-level, to help decide whether they need further action.

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Appendix A (Mohr, 2002): Probability of Mishap (25 years)

Level	Description	Definition
A	Impossible	Physically impossible
B	Improbable	Occurrence may not be experienced
C	Remote	Not likely to occur in system life cycle, but possible
D	Occasional	Likely to occur sometimes in system life cycle
E	Usually	Likely to occur several times in system life cycle
F	Frequent	Likely to occur repeatedly in system life cycle

Appendix B (Mohr, 2002): Severity of consequences

Category	Personnel Illness/Injury P	Equipment loss ($) E	Productivity loss (Downtime) T	Environmental loss N
I CATASTROPHIC	Death	> 1 M	> 4 Months	Long-term (>5 yrs) environmental damage, or requiring >$1M to correct and/or in penalties
II CRITICAL	Severe injury or Severe occupational illness	250K - 1 M	2 weeks - 4 months	Medium-term (1-5 yrs) environmental damage or requiring $250K-1M to correct and/or in penalties
III MARGINAL	Minor injury or minor occupational illness	1K to 250K	1 day - 2 weeks	Short-term (<1 yr) environmental damage or requiring $1K-$250K to correct and/or in penalties
IV NEGLIGIBLE	No injury or illness	< 1 K	< 1 Day	Minor environmental damage, readily repaired and/or requiring <$1K to correct and/or in penalties

Appendix C (Mohr, 2002): Risk-Assessment Matrix

Severity of consequences	Probability of Mishap					
	A Impossible	B Improbable	C Remote	D occasionally	E Usually	F Frequent
I Catastrophic					**1**	
II Critical				**2**		
III Marginal			**3**			
IV Negligible						

Risk Code/ Action	**1.** Imperative to suppress risk to lower levels	**2.** Operation requires to lower levels written, time-limited waiver, endorsed by management	**3.** Operation permissible

Appendix D (Mohr, 2002): Preliminary Hazard Analysis

Brief Descriptive Title (Portion of system/sub-system/Operational Phases covered by this analysis):										
Probability Interval:	Date:	Risk Before				**Description of Countermeasures**	Risk After			
System Number:	Analysis: ☐ Initial ☐ Revision ☐ Addition	Hazard Target	Severity	Probability	Risk Code	Identify countermeasures by appropriate code letter(s): D = Design Alteration E = Engineered Safety Feature S = Safety Device W = Warning Device P = Procedures/Training	Severity	Probability	Risk Code	
Hazard No. / Description										
Prepared by/Date:	*Target Codes: P- Personnel E - Equipment T - Downtime R - Product V - Environment						Approved by/Date:			

Appendix E: Risk-Assessment Survey

This survey is a part of the research " Using risk assessment to evaluate and prioritize the emergency events at University XYZ"

Your Name:

Your Position:

Instructions:

The following are eighteen emergencies that could be the most one might be a threat to the university campus area and cause harm and/or loss to the institution objectives. They are categorized to three groups which are 1-Natural, 2-Technological and 3-Human emergencies, under each group there are several emergencies, each one has two questions.

- **Please refer to the appendix A while you answering to the first question for each emergency in order to classify the probability (likelihood) from A to F.**
- **Please refer to the appendix B while you answering to the second question for each emergency in order to classify the severity from I to IV.**

Note:

Personnel (illnesses/ injury), equipment loss ($), productivity (down time) and environment are the targets for this investigation so the judge of probability and severity should be based on that. Also, the probability (appendix A) is the likely a loss would occur over a 25-year period.

Appendix A (Mohr, 2002): Probability of Mishap (25 years)

A Impossible	B Improbable	C Remote	D Occasionally	E Usually	F Frequent
Physically Impossible	Occurrence may not be experienced	Not likely to occur in system life cycle but possible to occur	Likely to occur sometimes in system life cycle	Likely to occur Severityal times in system life cycle	Likely to occur repeatedly in system life cycle

Appendix B (Mohr, 2002): Severity of consequences

Category *Descriptive Word*	Personnel Illnesses/ injury P	Equipment loss ($) E	Productivity (Down time) T	Environment N
I CATASTROPHIC	Death	> 1 M	> 4 Months	Long-term 5 yrs or greater environmental Damage or requiring >$1M to correct And/or in penalties
II CRITICAL	Severe Injury or Severe Occupational illness	250K to 1 M	2 Weeks to 4 Months	Medium-term (1-5 yrs) environmental damage or requiring $250K-1M to correct and/or in penalties
III MARGINAL	Minor Injury or Minor Occupational Illness	1K to 250K	1 Day to 2 Weeks	Short-term (<1 yr) environmental damage or requiring$1K-$250K to correct and/or in penalties
IV NEGLIGIBLE	No Injury or Illness	< 1 K	< 1 Day	Minor environmental damage, readily repaired and/or requiring <$1K to correct and/or in penalties

1- Natural Emergencies

Catastrophic earthquake	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
High winds	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Landslide – Mudslide	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Flood	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Severe Winter Blizzard / Ice storm	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

2-Technological Emergencies

Power failure	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Telecommunications system failure	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

3- Human Emergencies

3-1:Emergency

Public Health Emergency	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

3-2: Fire

Academic Building Fire	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Residential building fire	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Wildland fire	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

3-3: Disturbance

Civil disturbance	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Public event	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Sports event	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

3-4: Disruption

IT infrastructure	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Water supply	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

3-5:Releases

Biological agent	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
HAZMAT	

What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV
Radiological material	
What would you classify the **Probability** of this emergency to occur?	A B C D E F
How **Severely** would this emergency impact the organization?	I II III IV

I-Please name the top five emergencies that are most occur and/or cause more lost on the campus area:

1.
2.
3.
4.
5.

II-Any other Emergencies that should be taken in consideration:

Emergency #1:

Probability:

Severity:

Emergency #2:

Probability:

Severity:

Emergency #3:

Probability:

Severity: