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TECHNOLOGY SIMULATIONS TRAINING AND APPS: THE USE OF TECHNOLOGY IN DISASTER PREPAREDNESS AND RESPONSE

MURPHY, JESSICA

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

INDUSTRIAL SYSTEMS & ENGINEERING

JACKSON STATE UNIVERSITY

JACKSON, MISSISSIPPI

Dr. Jessica Murphy

Department of Civil & Environmental Engineering and Industrial Systems & Engineering
Jackson State University
Jackson, Mississippi

Abstract

It has been projected that there will be an increase in disasters (i.e., man-made and natural) as time progresses. Social Science researcher, Quarentelli asserted that research findings denote consistent incidental patterns deeming the influx of disaster to be inevitable (Philips, Neal, & Webb, 2016). Considering this assertion, there must be measures in place to assist both current and the next generation of emergency and disaster professionals with contemporary training opportunities to further enhance problem-solving and decision-making for emergency response. Technology simulation in emergency and disaster management and response provides such training opportunities for planning, rehearsing, assessing, and increasing the competencies of emergency and disaster management professionals with the mission of preservation at the vanguard.

Technology simulations complement the mission to preserve life and property. In this mission, technology simulation training helps to improve the effectiveness and efficiency of situations in which the impact of potential disasters may be mitigated. Such simulations can be provided in a virtual reality platform presenting real-world scenarios of disastrous incidents. In addition to enhancing the competencies of current emergency and disaster management professionals, Technology simulations make the connection between formal education and training and live exercises. In this safe and repeatable environment, this will help to further fulfill the emergency management functions of mitigation, preparedness, response, and recovery.

Keywords: Emergency, Disaster, Technology, Simulation

Technology Simulations Training and Apps: The Use of Technology in Disaster Preparedness and Response

Man-made disasters (e.g. workforce and school violence, active shooters, acts of terrorism, etc.) are growing concerns as nations incorporate measures to secure their respective homelands. Wildfires, flooding, hurricanes, tornadoes, droughts, winter storms, etc., are escalating natural disasters worldwide. As Social Science researcher Quarentelli has predicted (1996 and 2001) the increase in disasters and the emergence of new and more impactful disasters, there would be an increase in injury and death yielding more significant economic impact (Philips, Neal, & Webb, 2016). Constant reports of man-made and natural disasters inundate media platforms informing the public of the devastation.

Man-made disasters negatively impact every nation through the deliberate actions of one or more responsible parties. Through intent, fault, or failure of man-made formations; man-made disasters can take on various forms (e.g. terrorism, bioterrorism, active shooter and killer incidents, workplace or school violence, cyber-attacks, etc.) (Murphy, 2019). Providing further insight, LaSane (2019) contended in Business Insider 9 that man-made disasters made a major impact on our world. These disasters ranged from the 1935 “Dust Bowl” (i.e. dust storm ranging for hundreds of miles wide and thousands of feet high due to ignorance in farming practices) to the 2014 Flint, MI water crisis. This water crisis was the result of Michigan officials deciding to switch the source of Flint's drinking water to the Flint River rather than Detroit City water; thus, revealing evidence of coliform bacteria indicating pathogens are present in the water. Furthermore, the treacherous and malice execution of the 9/11 attacks led our nation to expeditiously establish an agency in 2003 focused on ensuring that the homeland is safe, secure,

and resilient against terrorism and other hazards—the U. S. Department of Homeland Security (Reese, 2013). Nevertheless, natural disasters have become more prevalent.

Examples of devastation through natural disasters will be the 2023 Hawaii Wildfires. ABC News reported that a string of wildfires ravaged Hawaii, primarily on the island of Maui in early August. The wind-driven fires signaled evacuations and resulted in extensive damage that killed at least 101 people and left two people missing on Maui's northwest coast (Shalvey, Arancio, El-Bawab, & Deliso, 2023). In prior years and on the mainland, fires destroyed highly affluent neighborhoods across California, Texas, and Florida. The National Interagency Fire Center (as cited by the Insurance Information Institute, 2019) indicated that there were 71,499 in 2017 wildfires, compared to 65,575 wildfires in the same period in 2016. Floods and flash floods kill hundreds of people around the world each year, more than any other weather type. According to Almkhatar, Migliozi, Schwartz & Williams (2019), the “Great 2019 Floods, affected nearly 14 million people in the mid-western and southern states. The authors further stated that The Mississippi River Mayors’ Council projected that the cost of infrastructure damage and emergency response was at least \$2 billion. Regarding tornadoes, they are also most common in the central part and Great Plains regions of the United States, including Mississippi. As of February 2019, there were 1,575 initial reports of tornadoes in the United States in 2019 of which at least 1,053 were confirmed (Storm Prediction Center, 2019). With the heightened concern about both increasing man-made and natural disasters, current and future emergency and disaster management professionals must train for a higher level of preparedness, which will yield a more effective response. Technology simulation serves as an ideal training aid for these professionals.

Definition of Emergency and Disaster Management and Technology Connection

Buck (2011) stated the definition of Emergency Management by the Federal Emergency Management Agency (FEMA) as “the managerial function charged with creating the framework within which communities reduce vulnerability to hazards and cope with disasters” (p. 43). FEMA further stated that Emergency Management encourages safer and less vulnerable communities; thus, giving communities the ability to manage hazards and disasters. Emergency management's mission is to protect communities by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from all types of disasters. Regardless of natural or man-made disasters, there is an immediate call to action in producing competent professionals to address the four functions of Emergency Management. FEMA's four functions in Emergency Management: mitigation, preparedness, response, and recovery.

Mitigation: Attempts to prevent hazards from developing into disasters altogether or to reduce the effects of disasters. Mitigation is the effort to reduce the loss of life and property by lessening the impact of disasters. Mitigation is achieved through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk.

Preparedness: Impact of disaster events on people. Preparedness is a continuous cycle of planning, managing, organizing, training, equipping, exercising, creating, evaluating, monitoring, and improving activities. Preparedness ensures effective coordination and enhancement of concerned organizations' capabilities to prevent, protect against, respond to, recover from, create resources, and mitigate the effects of natural disasters, acts of terrorism, and other human-made disasters.

Response: The response phase includes the mobilization of the necessary emergency services and first responders in the disaster area. The response is likely to include the first wave of core emergency services, such as firefighters, police, and ambulance crews.

Recovery: Restore the affected area to its previous state. It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions made after immediate needs are addressed. Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment, and the repair of other essential infrastructure (p. 43-44).

As Emergency and Disaster Management addresses the needs associated with the four functions, its integration with technology will further advance efforts in creating a sounder infrastructure for executing an emergency response to assist communities in becoming resilient after the devastation. Technology applications will aid in continuous improvement through proper planning, forecasting, detecting/securing, and information sharing. Information Technology serves as a suitable example of technological integration in Emergency and Disaster Management. As an example, Buck (2011) asserted that Information Technology (IT) is a vital tool in Emergency Management that supports planning and time reduction. The Internet and social media serve as more specific examples of IT that performs many capabilities that impact Emergency Management's proficiency. The Internet and social media heighten awareness through web pages that inform and prepare citizens. The Internet and social media are modern platforms providing an opportunity for community discussion groups, making disaster plans available online, and providing educational disaster management material to specific entities and the public. However, technology simulations will enhance competencies, enrich problem-solving and critical thinking, and ultimately enhance response and recovery initiatives.

Technology Simulations

Technology simulations can be pivotal in positively impacting the disaster response world. Simulation provides an imitative representation of disaster scenarios in which emergency and disaster management functions can be employed. This training mechanism may aid in efficient and effective emergency and disaster response. Not only does technology simulation produce a more effective emergency and disaster response, but it also provides a safer environment for professionals, a greater probability of mitigating property damage, and an improved probability of saving lives. Some examples of disaster simulators are produced by the Environmental Tectonics Corporation and the National Environmental Health Association to describe a few.

Environmental Tectonics Corporation (ETC) developed the Advance Disaster Management Simulator (ADMS), which provides unscripted and open-ended virtual reality simulated disaster scenarios with outcomes based on the training participants' decisions (ETC, 2024, Why Virtual Simulations Section). ETC further stated that ADMS is physics-based technology with built-in artificial intelligence to provide you with a true-to-life experience set in real time. This technology allows the training participant to make dynamic decisions about real-life disaster incidents, which is interactive and engaging. The Corporations emphasized that ADMS provides a realistic 3D environment in which instructors can build many possible incidents and where training participants can experience real-time feedback of their commands, which helps build knowledge, skills, experience, and confidence. ADMS, among other similar systems, is targeted to solve real-world problems surrounding natural and man-made disasters.

Another example of technology simulations at work is the Disaster Readiness Simulator. The National Environmental Health Association (NEHA, 2024, Disaster Readiness Simulator Explainer Section) indicated that they are developing a Disaster Readiness Simulator offering a groundbreaking approach to preparing for the reality of contemporary disasters. The simulator will enable organizations to accurately test and understand their emergency response expertise and human resource functions. This web application enhances preparedness for multifaceted disaster scenarios by ensuring personnel are optimally allocated according to specialized expertise. The Disaster Readiness Simulator intends to enhance collaboration across the emergency response, environmental public health, and public health systems to better prepare, respond, and recover from contemporary disasters. ADMS and the Disaster Readiness Simulator are examples of great teaching tools that help participants assess and improve preparedness plans through real emergency and disaster situations. Outcomes of those who participate in simulation training may include, but are not limited to the following:

1. Technology simulation will provide students with workforce experiences needed in Emergency Management and/or Disaster Preparedness so that they are prepared for Emergency Management and Disaster Response workforce and/or related academic degree programs; and
2. Simulation training will enhance emergency response decision-making to help minimize loss of life and property.

Both of these, among other related systems, provide evidence of how technological innovation continues to improve approaches to preserving life and property in our world.

Conclusion

Technology simulations provide a virtual platform for disaster scenario exercises, promoting discussion on continuous improvements to disaster preparedness and response and lessons learned. According to the World Health Organization (WHO) (2024, Simulation Exercises Section), simulation exercises validate and enhance preparedness and response plans, procedures, and systems for all hazards and capabilities. The WHO further contended that technology simulation for emergency and disaster response allows participants to review and assess planning assumptions, procedures, operational plans and guidelines, and standard operating procedures. As the WHO provided an extensive list of simulation exercise benefits, one overarching benefit is that simulation exercises improve disaster response coordination and collaboration. Such innovation promotes better emergency and disaster preparedness that may reduce losses associated with natural and man-made disasters. Overall, technology simulation will encourage efficiency and effectiveness in disaster response; thus, leading to heightened recovery and resiliency for those impacted.

References

Akmel, T, & Oaks, M. & Barker, R. (2002). The status of Technology Education: A national report on the status of the profession. *Journal of Industrial Teacher Education*, 39(4). <https://scholar.lib.vt.edu/ejournals/JITE/v39n4/akmal.html>

Buck, J. L. (2011). The state of security: the growing presence of Emergency Management technologies on college campuses. *Technology International Interface Journal*, 12(1), pp. 43-46. [http://tij.org/issues/issues/fall2011/abstracts/Z__TIIJ%20fall%202011%20v12%20n1%20\(paper%206\).pdf](http://tij.org/issues/issues/fall2011/abstracts/Z__TIIJ%20fall%202011%20v12%20n1%20(paper%206).pdf)

Buck, J. L., Alant, B. P., Ellis, D. & Sherwood, R. (2014). International Exchange: the attitudes and aspirations of Technology Education students in the United States and South Africa. *Technology International Interface Journal*, 14(2), pp. 39-48.
[http://tijj.org/issues/spring2014/Z_TIIJ%202014%20v14%20n2%20\(PDW-2\).pdf#page-41](http://tijj.org/issues/spring2014/Z_TIIJ%202014%20v14%20n2%20(PDW-2).pdf#page-41)

Bureau of Labor Statistics (2023). Emergency Management Directors. *Occupations. Occupational Outlook Handbook*. <https://www.bls.gov/ooh/management/emergency-management-directors.htm>

Environmental Tectonic Corporation (ETC) (2024). ADMS Simulations. <https://www.etcsimulation.com/adms-simulation.html>

Federal Emergency Management Agency (FEMA) (2019). Emergency Management Institute Mission. <https://training.fema.gov/mission.aspx>

Federal Emergency Management Agency (FEMA) (2024). Welcome to the Emergency Management Institute. <https://training.fema.gov/emi.aspx>

Feinman, C. L. (2017). Help wanted: next generation of Emergency Managers. *Domestic Preparedness*. <https://www.domesticpreparedness.com/commentary/help-wanted-next-generation-of-emergency-managers/>

ITEEA (2024). What is Technology and Engineering Education?
<http://www.iteea.org/AboutITEEA/about.htm>

Murphy, J. L., McLin, D., & Thomas, R. (2015). Using Service Learning to enrich knowledge, training, and civic responsibility for Emergency Management Technology students. *Technology International Interface Journal*, 17(2), pp. 39-48.
http://tijj.org/issues/issues/spring2017/X_TIIJ%20spring%202017%20v17%20n2.pdf#page=46

National Environmental Health Association (2024). Disaster Readiness Simulator. <https://www.neha.org/disaster-readiness-simulator>

Officer.com (2017). Professional certification in Emergency Management: Get the credit you deserve for your work in Emergency Management.
<https://www.officer.com/home/article/10249956/professional-certification-in-emergency-management>

Webster, H. C. (2010). Best careers: Emergency Management Specialist. *U. S. News and World Report*. <https://money.usnews.com/money/careers/articles/2010/12/06/best-jobs-2011-emergency-management-specialist>

The World Health Organization (WHO) (2024). Simulation Exercises. <https://www.who.int/emergencies/operations/simulation-exercises>

Shalvey, Kevin; Arancio, Victoria; El-Bawab, Nadine; Deliso, Meredith (August 9, 2023). "I was trapped": Maui fire survivors speak out as emergency declared". *ABC News*. Archived from the original on August 10, 2023. Retrieved August 10, 2023.