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A PROPOSED

RESEARCH AGENDA

FOR THE

EMERGENCY MANAGEMENT HIGHER EDUCATION COMMUNITY

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EXECUTIVE SUMMARY

This report is the product of a 2-day focus group, where 11 participants gathered to develop a 3- to 5-year research agenda focusing on hazards, disasters, and emergency management. It is interdisciplinary and focused squarely on advancing science to seek answers to real-world complex problems. It is thus explicitly aimed at bridging the gap between research and practice. The following pages identify five major guiding principles and five research thrusts essential to realizing this agenda:

GUIDING PRINCIPLES

1. Scanning the Horizon – recommends that researchers and practitioners thoroughly review the literature and outputs from various disciplines focusing on disaster to look for what has already been done, what is in progress, and what needs to be done to address continuing or critical gaps in the extant literature.
2. Fostering Interdisciplinary – highlights the critical need for teams working from formal and applied sciences, engineering, social sciences, natural sciences, and the humanities to work together to better consider components of the built, social, economic, and natural environment, while also placing research in social and political context.
3. Embracing Ethics – emphasizes the importance of incorporating ethical considerations at every stage of research and practice. This means moving beyond Institutional Review Board approvals to integrating a careful, philosophically informed ethical framework at every turn in research – from question formation to data presentation.
4. Transferring Knowledge – underscores the need for research to be translated and transferred to multiple end users, accessible in a variety of languages and mediums, and achieve greatest impact by advocating for, publishing in, and creating more open source platforms and public access to scientific research.
5. Maximizing Impacts – calls for conducting evaluations to assess whether programs and policies are actually achieving a desired change and are being implemented into practice.

RESEARCH THRUSTS

1. Justice, Equity, and Capacity Development – calls for researchers to address how justice and equity considerations influence the entire disaster life cycle, as well as the ways in which capacity might be developed among those remaining at elevated risk post disaster. This principal research thrust cuts across the remaining four thrust areas.
2. Risk Buildup and Disaster Exposure – aims to encourage the research community to examine how cumulative personal and collective disaster loss influences developmental trajectories for individuals, family dynamics, and neighborhood and community resilience.
3. High Risk Habitation Zones – draws attention to the need for more research centered on environmental and social vulnerability to both high-impact and chronic disasters.
4. Data, Technology, and Societal Impacts – recommends that cross-disciplinary research in the areas of data, technology, and societal impacts should focus on both innovation and risks associated with old, new, and emerging technologies.

5. Infrastructure for Humanity – invites researchers to engage in humane and equitable design that moves from a "systems failures" approach to studying infrastructure to a focus on systems stability, flexibility, and agility. This includes striving toward universal design and accessibility for all.

The goal of this agenda is to serve the academic research community and emergency management professional practice. Ultimately, the hope is that this work will contribute to workforce development through education. As current and future research projects align with the targeted thrust areas and guiding principles, new boundaries and opportunities will emerge and evolve. It is thus critical that we socialize this document, engage in fearless dialogue regarding this agenda, and treat this text as a living document subject to revision and change.

A Proposed Research Agenda For The Emergency Management Higher Education Community

Introduction

This report outlines a research agenda on hazards, disasters, and emergency management. It is interdisciplinary and focused squarely on advancing research to seek answers to real-world complex problems. It is also explicitly aimed at bridging the gap between research and practice. The report identifies five major guiding principles for hazards and disaster research and five research thrusts essential to realizing this agenda.

The agenda is written to inform ongoing and future research, workforce development, education, and emergency management practice over a 3- to 5-year time horizon. The report itself is intended for academic researchers and students from various disciplines, emergency management organizations, and Federal partners.

Purpose

Research plays a pivotal role in the Nation's efforts to meet the objectives of the National Preparedness Goal (NPG).[1] Accordingly, the purpose of this research agenda is to guide research development. It is also intended to help shape academic program implementation, collaboration, emergency management practices, and future policy directions.

Background

At the 19th Annual Emergency Management Higher Education Symposium, held June 5–9, 2017, and hosted by the FEMA Higher Education Program, nearly 250 emergency management faculty from across the Nation gathered. During that meeting, participants recommended that FEMA contribute to emergency management practice by articulating a research agenda on hazards, disasters, and emergency management. On the basis of that recommendation, the FEMA Higher Education Program convened a focus group of interdisciplinary researchers to begin to discern what this agenda should include. The Higher Education Program Manager reached out to faculty at Ohio University and the Natural Hazards Center at the University of Colorado Boulder to identify participants and set the focus group agenda.

The information that is presented in this report has linkages to earlier work around next-generation core competencies for emergency managers. (See Appendix C for a discussion of those connections.) It also expands and extends the earlier contributions.

Approach

On August 8 and August 9, 2017, 11 people gathered to conceptualize the agenda. Ten attended in-person at the FEMA National Emergency Training Center (NETC) in Emmitsburg, Maryland,

[1] FEMA. (2015). National Preparedness Goal, Second Edition (This link can also be accessed at the following URL: https://www.fema.gov/media-library-data/1443799615171-2aae90be55041740f97e8532fc680d40/National_Preparedness_Goal_2nd_Edition.pdf). *United States Department of Homeland Security*.

and one person participated via teleconference line. (See Appendix A for a full list of participants.)

The stated goal of the focus group was to: *Recommend a 3–5 year research agenda for FEMA that serves the research community, emergency management professional practice, and workforce development through stronger integration of research into education.* Participants were asked to review the FEMA NPG in advance of the focus group and were also invited to share additional materials and to consider a set of questions prior to arrival. (The full agenda and questions to ponder can be found in Appendix B.)

The focus group began with introductions, an overview of the FEMA National Preparedness System[2] (NPS), and the setting of Gracious Space.[3] The design thinking process was also shared as a possible roadmap to discovering the agenda. Design thinking employs a human-centered approach to solving challenges. This process begins with understanding and cultivating empathy of the full spectrum of stakeholders, defining the challenge from various possible perspectives, allowing the opening for creative solutions, prototyping possible solutions, and testing those solutions with many feedback loops along the way. The intent of using this design thinking process was to help the focus group participants to craft a draft document that would reflect trends in the broader research community. Although the FEMA Higher Education Program community of practice was envisioned as the primary audience for this work, the group could see alignment to other FEMA directorates and divisions, as well as many other potential stakeholders from other Federal agencies, academic programs, and the broader research community.

Notes were taken during the meeting, which served as an initial basis for this report. In addition, the group agreed to a collective writing approach, where the focus group chair led the initial development and writing of the full draft report, and each focus group participant worked on different drafts of the report for a scheduled period of time.

Once the draft report was completed, a webinar was scheduled by the FEMA Higher Education Program for October 19, 2017. The intent of the webinar was to share the outcomes from the focus group with the emergency management research, education, and practice community and to receive feedback. After the webinar, suggestions and reactions were incorporated into the final report, with the committee chair again taking the lead with some committee members assisting with the second round of revisions. The full draft was delivered to FEMA on November 30, 2017. The completed report was then reviewed internally, and for a third time disseminated to the committee chair and then the full committee for review. The final report is intended to be shared widely to a variety of potential stakeholders and users, including researchers, students, educators, practitioners, funders, and other supporters.

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[2] FEMA. (2011). National Preparedness System (This link can also be accessed at the following URL: https://www.fema.gov/media-library-data/20130726-1855-25045-8110/national_preparedness_system_final.pdf). *United States Department of Homeland Security*.

[3] Gracious Space is a practice created and shared by the Center for Ethical Leadership. It consists of four areas related to welcoming, the physical environment, creating space for diversity, and promoting learning in public. Center for Ethical Leadership. (n.d.). Gracious Space (This link can also be accessed at the following URL: http://www.ethicalleadership.org/gracious-space.html).

GUIDING PRINCIPLES AND RESEARCH THRUSTS

GUIDING PRINCIPLES

It is important to improve the quality and style of research that is being conducted. Therefore, this report includes five guiding principles for academics to consider as they develop their research agendas.

Scanning the Horizon

Fostering Interdisciplinary

Embracing Ethics

Transferring Knowledge

Maximizing Impact

GUIDING PRINCIPLE – SCANNING THE HORIZON

A substantial body of knowledge exists on disasters in a variety of disciplines. Researchers and practitioners should thus thoroughly scan the many fields of study prior to any new research efforts. Such an activity invites researchers to ponder – what has already been done, what is in progress, and what needs to be done to address continuing or critical gaps in the extant literature. In this era of rapid diffusion of knowledge amid a growing field of emergency management and hazards and disaster studies across several disciplines, horizon scanning activities become all the more important to ensure that research is not being repeated or unnecessarily funded and that areas for new breakthroughs in scientific understanding will be identified and pursued.

Horizon scanning can help researchers put their studies into scientific and historical context. In some ways, such an activity is examining existing lines of literature, beyond one's home discipline, in order to promote innovation and novel research. Horizon scanning also requires that researchers and practitioners engage in more careful and systematic meta-analyses of what we know and what we need to know. These analyses can help to ensure that researchers are asking the right questions.

GUIDING PRINCIPLE – FOSTERING INTERDISCIPLINARY

As the problems and challenges facing society and the environment have become more complex, the need for larger, more multi and interdisciplinary teams has become increasingly apparent. It is critical that teams working from formal and applied sciences, engineering, social sciences, natural sciences, and the humanities work together to better consider components of the built, social, economic, and natural environment, while also putting studies in cultural and political context. It is equally important for teams to work closely with emergency management personnel and national initiatives that support, organize, and carry out disaster-related activities.

Grand challenges, such as the complexity of risk reduction across diverse jurisdictions and populations, do not exist in disciplinary isolation. The world is made up of complex overlapping systems that, in order to be fully understood, require a diverse set of minds and scientific approaches. In order to achieve true interdisciplinary, researchers must take the time to learn each other's science including methods, methodologies, data collection tools, modeling environments, and the ontologies, epistemologies, metrologies, and conceptual and theoretical frameworks that ground their approach to research.

The need for more interdisciplinary work must be supported by a variety of stakeholders, which will likely include Federal agencies, nonprofits, foundations, the private sector, and other potential funders and supporters of research and application.

GUIDING PRINCIPLES – EMBRACING ETHICS

Ethical standards of research with human subjects have been formally regulated in academia since the National Research Act of 1974 and the development of the Belmont Report in 1978. [4],[5],[6] These standards require that all research involving human participants follow three core principles of ethics including: respect for persons, beneficence, and justice. As interdisciplinary research becomes more common, it is important that scientists in disciplines such as engineering–that do not typically work directly with human subjects–become more familiar with ethical standards to guide their work. There have been many advancements at the Federal and university levels to streamline the Institutional Review Board (IRB) process as research continues to expand across disciplines, universities, and Federal partnerships, each which has its own systems for ethics monitoring and approval.

In addition to following formal ethical standards and guidelines outlined by the IRB, it is imperative that ethics also be considered during every stage of research and practice. This means moving beyond IRB approvals, and instead, integrating a careful, ethical framework at every turn in research – from question formation to data presentation.[7] To achieve this goal, it is important that researchers and research teams carefully consider ethical practice from the early stages of concept development all of the way through publication, knowledge dissemination, and implementation or research findings.

[4] Rosenstein, D.L. (2004). Decision-Making Capacity and Disaster Research. *Journal of Traumatic Stress* 17/5: 373-381.
[5] Collogan, L.K., Tuma, F., Dolan-Sewell, R., Borja, S. & Fleischman A.R., 2004. Ethical Issues Pertaining to Research in the Aftermath of Disaster. *Journal of Traumatic Stress* 17/5: 363-372.
[6] North, C., Pfefferbaum, B., & Tucker, P. (2002). Ethical and Methodological Issues in Academic Mental Health Research in Populations Affected by Disasters: The Oklahoma City Experience Relevant to September 11, 2001. *CNS Spectrums, 7*(8), 580-584. doi:10.1017/S1092852900018186
[7] Browne, K.E., and Peek, L. (2014). Beyond the IRB: An ethical toolkit for long-term disaster research. *International Journal of Mass Emergencies and Disasters* 32.1: 82-120.

GUIDING PRINCIPLE – TRANSFERRING KNOWLEDGE

We are aware, in a report meant to call for future research, that there is already much important research available. That research, as well as yet to be developed research, should be translated and transferred to multiple end users to ensure maximal impact.[8]

To achieve this guiding principle, accessibility is key. Accessibility refers to both the accessibility of conducting research, the transferability of the end project across different audiences who learn in various ways, and the physical accessibility to the work. Too often, the people who need the research do not have access to published findings because of the expense of accessing scholarly journal articles, the lack of time to read lengthy articles, or the lack of capacity to understand highly technical methods and findings. Research may not be translated into other languages and may not be distributed widely enough to serve all populations.

In addition to making research more accessible, it should also be shared in creative, visual ways. Shaping a narrative around research findings and telling a story can be one of the best ways of capturing the attention of intended audiences outside of academia. This information can also be shared across many outlets, including social media platforms that are dynamic and have varying audiences.

Emergency management professionals would greatly benefit from regular and consistent access to a robust repository of scholarly research, data sets, and tools as they are being trained to serve and protect our communities.[9] One of the core competencies of emergency management practitioners identified *critical thinking*[10] and *continual learning*[11] as critical for the next generation workforce. As part of the guiding principle of transferring knowledge, researchers can help bridge the gap between research and practice by continuing to advocate for, publish in, and create more open source platforms and public access to scientific research.

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[8] Fothergill, A. (2000). Knowledge transfer between researchers and practitioners. *Natural Hazards Review* 1(2): 91-98.

[9] For such resources, see the Natural Hazards Center at the University of Colorado Boulder (This link can also be accessed at the following URL: http://hazards.colorado.edu) which has been designated as the Nation's clearinghouse for such information and for linking research and practice communities.

[10] *Critical thinking* "places emphasis on the importance of finding and recognizing relevant evidence, making clear the relationships between potential causes and effects, and understanding the relationship between sometimes complex variables before making decisions" (p.5). Next Generation Core Competency Focus Group, FEMA. (2016). The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

[11] *Continual learners* "develop and nurture a frame of mind that values and utilizes curiosity, reflection, and the development of new capabilities" (p. 5). Next Generation Core Competency Focus Group, FEMA. (2016). The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

GUIDING PRINCIPLE – MAXIMIZING IMPACTS

Assessment, measurement, and evaluation of impact is important to understanding the value and power of research[12], [13], especially when such research produces use-inspired findings.[14] When research is turned into action, there are often no evaluations conducted to assess whether programs and policies are actually achieving a desired change. Thus, this fifth guiding principle calls for exactly this kind of work to ensure that new programs and initiatives are systematically evaluated. This evaluation work will create a feedback loop where scientists can learn if the recommendations they produce are useful to and achieving the intended objectives. If they are not, new research will need to be conducted to improve upon the gaps and shortcomings from earlier findings.

Another common goal of disaster research is to influence policy. Scholars can maximize the impact of research by forming partnerships with Federal- and state-level organizations, visiting and sharing research findings with policymakers, and sitting as experts on panels that have the capacity to create and inform policy change. Policymakers can maintain relationships with researchers and emergency management practitioners through attending annual meetings such as the Natural Hazards Research and Applications Workshop and the International Association of Emergency Managers Conference.

RESEARCH THRUSTS

As disasters continue to increase in both frequency and severity, additional research and evidence-based programs and policies are critical to stemming the tide of rising losses. This section identifies five research thrusts that should be prioritized in the coming years. These areas are cross-cutting and will be best addressed by interdisciplinary teams of researchers and practitioners. Importantly, these five areas align with and expand the recently updated core competencies for emergency managers published by FEMA.[15] The five thrust areas are:

- Justice, Equity, and Capacity Development
- Risk Build-up and Disaster Exposure
- High Risk Habitation Zones
- Data, Technology, and Societal Impacts
- Infrastructure for Humanity

The following sections provide context for each thrust area followed by a description of the area, a list of potential supporting research questions, and a discussion of how it aligns to the emergency management core competencies. The focus group participants agreed that all of these

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[12] Stalling, R. (ed). (2003). *Methods of Disaster Research. International Research Committee on Disaster*: Xlibris.
[13] Phillips, B. (2014). *Qualitative Disaster Research.* NY: Oxford.
[14] Stokes, D.E.. (1997). *Pasteur's Quadrant: Basic Science and Technological Innovation.* Washington D.C.: Brookings Institution Press.
[15] Next Generation Core Competency Focus Group, FEMA. (2016). The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

areas are important in and of themselves, and so the presentation of the five areas is not meant to imply a "rank ordering" in terms of importance or relevance to emergency management, as we envision each of these as being vitally important to shape the future of emergency management research and practice. At the same time, our decision to place justice, equity, and capacity development first was intentional, as we see this as the cornerstone for reducing disaster risk and promoting current and future resilience. Without a justice and equity lens, it will be difficult to achieve the full potential of the other areas.

RESEARCH THRUST – JUSTICE, EQUITY, AND CAPACITY DEVELOPMENT

Context

Social and economic inequality translates into disparities in the abilities of individuals, households, and communities to prepare for, respond to, and recover from disaster. Because existing and growing inequality in the United States[16] both generates and exacerbates disaster losses, many people remain at considerable risk.[17]

Description

This agenda calls for additional research to address how justice and equity considerations impact the entire disaster life cycle, as well as the ways in which capacity might be developed among those remaining at elevated risk post disaster. This is consistent with the core competency of *sociocultural literacy*[18] for emergency management practitioners. While the issues discussed here are identified as a stand-alone area of future inquiry, it is important to note that they are also relevant to and cut across the remaining four thrust areas.

Questions

The following questions are illustrative of this research thrust:

- *How do racial and economic injustice, economic inequality, and diminished political capacity influence those at risk before, during, and after disasters, and how does this occur?*
- *Does a more just and equitable setting influence adoption of disaster preparedness and hazard mitigation actions?*
- *Does redressing justice and equity increase capacity among those at risk?*

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[16] Brueggemann, J. (2012). *Inequality in the United States: A Reader.* New York, NY: Routledge.

[17] Peek, L. (2017). A just resilience. *Boulder Daily Camera* (This link can also be accessed at the following URL: http://www.dailycamera.com/guest-opinions/ci_31250022/lori-peek-just-resilience)

[18] *Sociocultural literacy* "provides the lens to examine and understand human behavior, and the ways in which humans, both individually and collectively, may increase their vulnerability to risk" (p. 4). Next Generation Core Competency Focus Group, FEMA. (2016). *The Next Generation Emergency Management Core Competencies*. (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

RESEARCH THRUST – RISK BUILDUP AND DISASTER EXPOSURE

Context

The United States is currently experiencing unprecedented levels of disaster exposure. For instance, in 2017 alone, the United States endured 16 disaster events with losses in excess of a billion-dollars.[19] In addition to these high consequence mega-disasters that cause substantial economic loss, widespread loss of life and injury, and lasting mental health consequences, the United States is also simultaneously experiencing more low-visibility, repetitive loss disasters.

In an era of rising disaster losses, more individuals and communities have experienced increased disaster exposure and, consequently, increased harm. Consistent with the core competencies of *risk governance* [20] and *facilitating community risk understanding and ownership*, [21] this research thrust aims to encourage the research community to examine how cumulative personal and collective loss, as caused by disaster, influences developmental trajectories for individuals, family dynamics, and neighborhood and community resilience.

Description

To ensure the success of preparedness and mitigation actions, careful consideration of risk buildup and rising disaster exposure is paramount. Tierney[22] describes risk buildup as when social, political, and economic actions increase the risk portfolio for communities. To use the imagery of two scales, think of mitigation and preparedness activities as reducing the weight of risk. Conversely, on the other side of the scale, unsustainable development in hazardous areas, population growth, organizational malfeasance, and other risk accumulating activities create an imbalance and imperil those at risk even further. When risk buildup continues unabated, disaster exposure increases, tipping the scale toward more harm and loss.

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[19] NOAA. 2017. U.S. Billion-Dollar Weather & Climate Disasters 1980-2017 (This link can also be accessed at the following URL: https://www.ncdc.noaa.gov/billions/events.pdf)

[20] *Risk governance* for emergency management professionals "requires recognition that risk is inherent in interdependencies, risk governance spans individuals' ownership of risk, and the present and future risk implications are inherent in stakeholders' decisions and activities" (p. 6). Next Generation Core Competency Focus Group, FEMA. (2016). The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

[21] *Facilitating community risk understanding and ownership* is an emergency management leadership style intended to "communicate, promote, and support the need for individuals, families, businesses, and organizations to "own" the risks to which they are exposed within their discreet communities" (p. 6). Next Generation Core Competency Focus Group, FEMA. (2016). The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

[22] Tierney, K. (2014). *Social Roots of Risk: Producing Disasters, Promoting Resilience*. Stanford, CA: Stanford University Press.

Questions

The following questions are illustrative of this research thrust:

- *What actions influence or incentivize risk build-up?*
- *What political and organizational approaches are most effective at reducing risk accumulating activities?*
- *How can communities incentivize mitigation and assist those who have experienced cumulative disaster loss?*

RESEARCH THRUST – HIGH RISK HABITATION ZONES

Context

In this time of increasing exposure to both high-impact and chronic disasters, it is critical that we acknowledge that risk is not evenly distributed geographically. Nearly half of all residents of the United States live within 50 miles of coastal areas,[23] which are the most rapidly growing areas in the country. These coastal areas are also the most likely to be home to so-called mega-cities that have populations over 10 million.[24] Such population expansion in combination with rising sea levels, more intense and frequent storms and flooding, rising economic inequality, and aging infrastructure, make these areas more susceptible to catastrophic disasters. As a consequence, the Nation may expect to see increasing and potentially devastating loss of life and livelihoods.

While it may be desirable, from some perspectives, to encourage or mandate that populations move away from high-risk areas, is this a just and equitable solution? If the goal is safe habitation, who is responsible for community relocation and does it include access to food, housing, education, health care, and healthy environments? Said differently, if vulnerable people move out of vulnerable places, where will they live and will they have the chance to thrive?

Description

Recent events such as Hurricane Katrina in 2005, the British Petroleum Oil Spill in 2010, Superstorm Sandy in 2012, and Hurricanes Harvey, Irma, and Maria in 2017, have shown just how vulnerable coastal communities are to acute onset, high-impact natural and technological hazards. The lack of risk mitigation and preparedness and the ongoing fallout from these disasters underscores the need for more research and action in this area of study.

At the same time, numerous other disaster hot spots exist around the country. In such locations, communities are experiencing recurring and chronic disasters related to outbreaks of severe weather and tornadoes, drought, heat waves, flooding, ice/snow storms, and wildfires. In addition, millions of Americans attend outdoor sports and entertainment events each year. These events create localized risk and habitation zones that present new challenges to protect life and

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[23] NOAA. 2013. National Coastal Population Report Population (This link can also be accessed at the following URL: https://aamboceanservice.blob.core.windows.net/oceanservice-prod/facts/coastal-population-report.pdf) Trends from 1970 to 2020. NOAA State of the Coast Report Series. National Oceanic and Atmospheric Administration, Department of Commerce, developed in partnership with the U.S. Census Bureau.

[24] Harris et al., Strategic Studies Group. (2014). *Megacities and the United States Army: Preparing for a Complex and Uncertain Future* (This link can also be accessed at the following URL: https://www.army.mil/e2/c/downloads/351235.pdf)

property against various ever-changing threats. Evolving technologies are also generating new risks, such as induced seismicity events emerging from hydraulic fracturing practices.

This research thrust is related to the core competencies of emergency management that address *understanding complex systems* and *community leadership, team building and resource management.*

Questions

The following questions are illustrative of this research thrust:

- *What new strategies exist for safe habitation and economic development in a context of deepening threats to coastal communities?*
- *What policies and programs inform sustainable hazards mitigation activities across a range of urban and rural contexts?*
- *How can communities with limited resources develop and maintain safe built and social environments to withstand future threats?*

RESEARCH THRUST – DATA, TECHNOLOGY, AND SOCIETAL IMPACTS

Context

The 21st Century has been punctuated by rapid technological advancements. While those advancements have brought new social problems and challenges, it is also true that many of the challenges of the prior century have been solved through technological advancements. Stronger buildings and bridges have safely withstood disasters, communication technologies have assisted in response efforts, drones have located people trapped in rubble, medical devices and pharmaceuticals allow for many to live longer and fuller lives, and mapping technologies and crowd-sourced data have provided important real-time disaster information to document and respond to extreme events.

There has been rapid change, with increasing acceptance and adoption of autonomous driving vehicles, wearable technologies, mobile devices, drones, and mobile applications.[25] For example, researchers have developed smart clothing that can be used for home health care[26] and disease prevention.[27] While use is not ubiquitous, smart clothing and accessories are utilized to send personal health messages, as well as mass emergency alerts through, for example, smart watches.

The evolution of communication technologies and devices suggest additional warning methods must be considered in any research agenda. Americans are consuming media differently than just 10 years ago. Nearly 93% of people now get their news from an online source[28] and nearly half

[25] Bennett, DD., Phillips, B.D., & Davis, E. (2016). The Future of Accessibility in Disaster Conditions: How Wireless Technologies Will Transform the Life Cycle of Emergency Management. *Futures* (This link can also be accessed at the following URL: http://dx.doi.org/10.1016/j.futures.2016.05.004)

[26] Chen, M., Ma, Y., Song, J., Lai, C. F., & Hu, B. (2016). Smart clothing: Connecting human with clouds and big data for sustainable health monitoring. *Mobile Networks and Applications*, *21*(5), 825-845.

[27] Axisa et al. (2005). Flexible technologies and smart clothing for citizen medicine, home healthcare, and disease prevention. *IEEE Transactions on information technology in biomedicine*, *9*(3), 325-336.

[28] Pew Research Center. (2017). *Digital News Fact Sheet* (This link can also be accessed at the following URL: http://www.journalism.org/fact-sheet/digital-news/)

of U.S. households have access to streamed content.[29] While television is not obsolete, streamed content currently impedes the ability to receive warning messages. A new frame for the "digital divide," shows low income communities embracing new technologies and devices, such as subscription on demand video services, because it allows them to save cost, but it may amplify their risk in the event of a disaster where they may not receive a warning.[30]

Indeed, as rapidly changing technological advancements may be helping, it is also clear that evolving technologies may simultaneously produce new and sometimes unexpected risks along with dependency upon these technologies. For example, as information technology has grown exponentially, populations living in developed and developing countries are confronted with increased cyber security threats. Efforts to perfect the next generation power system, Smart Grid, identify enormous benefits and expose potential security and privacy challenges.[31], [32] Populations have also been affected by changing economies related to technology, as people are now confronted by rapidly changing media used to communicate and organize their lives.

Description

New cross-disciplinary research in the areas of data, technology, and societal impacts should focus on both innovation and risks associated with old, new, and emerging technologies. The personal gadgets, household technologies, communication software, and medical devices represented in this research thrust are often used at the individual level and may contribute to the reduction of vulnerabilities and a surge of risk awareness. In addition, local jurisdictions and state and Federal emergency management agencies are also simultaneously moving toward these technological innovations, which may have both intended and unintended, positive and negative, consequences. This research thrust is closely related to the emergency management core competencies that address incorporating evolving technologies[33] and scientific literacy.[34]

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[29] Lynch, J. (2016). U.S. Adults Consume an Entire Hour More of Media Per Day Than They Did Just Last Year. (This link can also be accessed at the following URL: http://www.adweek.com/tv-video/us-adults-consume-entire-hour-more-media-day-they-did-just-last-year-172218/)

[30] Horrigan, J.B., Duggan, M. (2015). *Pew Research Center* (This link can also be accessed at the following URL: http://www.pewinternet.org/2015/12/21/4-one-in-seven-americans-are-television-cord-cutters/)

[31] Komninos, N., Philippou, E., & Pitsillides, A. (2014). Survey in smart grid and smart home security: Issues, challenges and countermeasures. *IEEE Communications Surveys & Tutorials*, *16*(4), 1933-1954.

[32] Liu, Y., Hu, S., & Ho, T. Y. (2014).Vulnerability assessment and defense technology for smart home cybersecurity considering pricing cyberattacks. In *Proceedings of the 2014 IEEE/ACM* International *Conference on Computer-Aided Design* (pp. 183-190). IEEE Press.

[33] *Incorporating Evolving Technologies* "requires an understanding of available technology, recognition of the expertise needed to utilize such technology, and a grasp of the security measures necessary to protect the technology; and an ability to recognize and evaluate the value of technological solutions to emergency management" (p. 4). Next Generation Core Competency Focus Group, FEMA. (2016). The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

[34] *Scientific Literacy* is "helps emergency management professionals understand and interpret the scientific evidence as it relates to hazards, risks, and vulnerabilities so it can be effectively communicated to policy makers and the public" (p. 4). Next Generation Core Competency Focus Group, FEMA. 2016. The Next Generation Emergency Management Core Competencies (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

Questions

The following questions are illustrative of this research thrust:

- *What tools and technologies have led to measurable life safety improvements in response to disaster?*
- *How are technological advancements changing emergency preparedness, response, and recovery functions?*
- *How might access to citizen driven data impact response and recovery efforts?*
- *How can technological advancements decrease the risks faced by individuals and communities and increase safety for humanity?*
- *How do injustices and social inequities interfere with adoption or use of technological advancements? In what ways can technological advancements reduce disparities for those experiencing justice and inequity concerns?*
- *What are the impacts for emergency management and society when technologies fail in an event?*

RESEARCH THRUST – INFRASTRUCTURE FOR HUMANITY

Context

Engineers, architects, builders, and other professionals are essential actors in disaster resilient design. Their research and practice has led to stronger and improved building codes and standards and advanced modeling environments that identify risk and infrastructure systems failures. Ultimately, this work has helped communities to mitigate risk and to build back better,[35] stronger, and faster when disaster strikes. Federal agencies such as the Department of Homeland Security and the National Science Foundation have issued funding calls that involve collaborative partnerships between engineers, computer scientists, and social scientists to identify gaps in these advancements and new frontiers for research.

Description

Although there have been significant advances, more research is needed, particularly at the intersection of infrastructure and society. It is imperative that a community's infrastructure and housing stock become stronger prior to extreme events so that they can withstand harsh conditions and bounce back more quickly. Thus, a robust academic research effort should move from a "systems failures" approach to studying infrastructure to a focus on systems stability, flexibility, and agility. This means prioritizing disaster risk reduction-oriented research and research focused on incentivizing mitigation and preparedness activities. Moreover, ensuring that building materials are affordable, aesthetically appealing, and culturally appropriate are all concerns worthy of further attention.

Enhancing the built environment for all before disaster strikes is critically important. After a disaster occurs, building back better becomes all the more important so recovery does not exacerbate pre-existing conditions and inequalities. Building back better takes time, money,

[35] Vajjhala, S., Monks, E., Hempen, E. (2016). Building back better and faster: How-post disaster infrastructure rebuilds can become more timely and efficient. *Brookings* (This link can also be accessed at the following URL: https://www.brookings.edu/blog/the-avenue/2016/09/13/building-back-better-and-faster-how-post-disaster-infrastructure-rebuilds-can-become-more-timely-and-efficient/)

leadership, community engagement, top down and bottom up efforts that respect the wishes of the community and also respond to realistic concerns regarding current and future risks in an era of climate change. Research on how and when communities have been able to incentivize and invest in mitigation and build back better, and with an eye toward universal design and accessibility for all, is critically important.

With a goal to promote more humane and equitable design, research in this area is related to the *scientific literacy, geographical literacy, disaster risk management,* and community engagement[36] core competencies for emergency management practitioners.

Questions

The following questions are illustrative of this research thrust:

- *What are the greatest infrastructure needs of our most socially vulnerable communities – before, during, and after disaster?*
- *How can engineering advancements in stability, flexibility, and agility be implemented more quickly? How can modeling, forecasting, and prediction advancements inform infrastructure design and community development goals?*
- *What new materials and technologies improve universal designs?*
- *What are the benefits and threats of infrastructure designed with "smart" systems?*

CONCLUSION

There are several opportunities that currently exist to actualize the agenda presented in this report and it will be best implemented by including a broad range of research stakeholders in the landscape of practice.[37] The focus group has identified five guiding principles for research and five important research thrust areas to help inform research as well as academic teaching.

As current and future research projects align with these areas, new boundaries and opportunities will emerge and evolve across these thrust areas. It is thus critical that we socialize this document, engage in fearless dialogue regarding this agenda, and treat this text as a living document subject to revision and change.

[36] *Geographic literacy* "is evident in the ability to conceptualize the interconnections, interactions, and implications of complex environments, as well as, the ability to utilize available analysis and technological tools to track environmental changes that result in changing risk profiles" (p. 4). Next Generation Core Competency Focus Group, FEMA. (2016). "The Next Generation Emergency Management Core Competencies." (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/ngcc%20final%20competencies%204-28-2016.pdf)

[37] Wenger-Trayner. (2014). Learning in landscapes of practice (This link can also be accessed at the following URL: http://wenger-trayner.com/resources/publications/learning-in-landscapes-of-practice/)

APPENDIX A – FOCUS GROUP PARTICIPANTS

Wendy Walsh, Program Manager for the Higher Education & Executive Academy, Emergency Management Institute, Federal Emergency Management Agency, convened a 2-day focus group on August 8–9, 2017, in Emmitsburg, Maryland. Ten additional people shared their expertise as part of the visioning process for this document. Collectively, their experience spanned many disciplines including emergency management, engineering, homeland security, meteorology, public health, sociology, and international relations.

DeeDee Bennett, University of Nebraska Omaha
Kevin Brame, National Fire Academy
Kevin Kloesel, University of Oklahoma
David Mendonca, National Science Foundation
Steven Patterson, Johns Hopkins University – Applied Physics Lab
Lori Peek, University of Colorado Boulder – Chair*
Brenda Phillips, Ohio University, Chillicothe – Co-Chair
Jennifer Tobin, University of Colorado Boulder*
Gary Webb, University of North Texas
Kristin Wyckoff, Department of Homeland Security

Danielle Green and Barbara Johnson from the Emergency Management Institute provided logistical support and note-taking assistance.

*Lori Peek and Jennifer Tobin wrote the first draft of the report, which was then circulated to the remainder of the committee. Tobin, Walsh, and Peek led the revisions process after the report was sent to various reviewers and presented for feedback via webinar, and after the report was revised, it was again distributed to the entire committee for review and feedback.

APPENDIX B – AGENDA

Higher Education Emergency Management Research Collective Focus Group
August 8–9, 2017, 8:30 a.m.–5:00 p.m. in Building N309 or 1-800-320-4330 PIN 376368
Emergency Management Institute, National Emergency Training Center
16825 South Seton Avenue, Emmitsburg, Maryland

Participating: Lori Peek–Chair, DeeDee Bennett, James Kendra, Kevin Kloesel, David Mendonca, Steven Patterson, Jennifer Tobin, Wendy Walsh, Gary Webb, and Kristen Wyckoff
Participating via telephone: Brenda Phillips – Co-Chair
Group logistics and support: Barbara Johnson ***Note Taker:*** Danielle Green
The overarching goal of this focus group is to:
Recommend a 3–5-year Research Agenda for FEMA that serves both emergency management professional practice and workforce development.
Activities that may help us to get to this goal include:

*image from-http://www.bethkanter.org

- Discussing research needs necessary to achieve the National Preparedness Goal (NPG).
- Connecting research needs and the NPG to higher education training, curriculum, and mentoring activities.
- Identifying researchers who are working on relevant bodies of knowledge.
- Discussing how we can leverage what we already know and make use of this to promote future research and current practice.
- Identifying actionable steps that FEMA can pursue to effectively support the Research Agenda.
- Identifying strategic partnerships that serve to support, develop, and actualize the Research Agenda.
- Completing the write-up and dissemination of the Focus Group findings via Webinar and other mechanisms.

What to do before you get here:

1. Read the National Preparedness Goal (NPG).
2. Create time prior to reflect and contemplate on the key 'questions to ponder' and envision a national emergency management research agenda to realize the NPG.
3. Clear your calendar for these 2 days, so we can focus and build the needed community to achieve our goal.
4. Share resources you think may be helpful to move us toward our goal to Barbara (Barbrara.Johnson3@fema.dhs.gov) by August 4 to facilitate full group dissemination.

Questions to Ponder

- What research is needed to realize the NPG?
- What research is needed to inform current and future Emergency Management Curricula and workforce development?
- Are there risks associated with establishing a research agenda?
- What is needed to ensure the research agenda serves researchers, teachers, students, practitioners, and members of the public?

Agenda Day 1

8:30 - Welcome, visual explorer self-introductions, gracious space.
9:00 - Overview of how this focus group came to be and a brief introduction to design thinking methodology. (Wendy)
9:30 - Dialogue regarding thoughts on the questions to ponder and how they might impact, guide, or inform our time together. Revisions to goals and approach for the Workshop?
10:30 - Break
10:45 - Discuss what the current relevant research landscape looks like and begin a list of who needs research- Who is the creator, designer, user, consumer, critic… Where is more inquiry needed?

- Empathy Maps- Why are we doing this?

11:30 - Lunch
12:30 - What is the challenge? Where are the gaps? Can we frame and define what is needed and why?
2:30 - Break
3:00 - How can we get there?

- Small groups dive more deeply into the gaps/topic- envision desired future- wild ideation.

4:30 - Where are we now?

- Larger group sharing of small group ideation.

5:00 - Adjourn
6:00 - Optional Cookout at Wendy's (vegetarian and meat options, libations, a couple of friendly dogs, and possibly s'mores if it's not excruciatingly hot out)

Agenda Day 2

8:30 - What percolated overnight? Any epiphanies or breakthroughs to share?
9:30 - Time to give it a shot- Let's draft the "FEMA Research Agenda 2018–2023"

- Small groups- big ideas.

10:30 - Break
10:45 - Begin to bring it all together-Report back to larger groups
11:30 - Lunch
12:30 - What is next? Who else should review this?

- Could we use the SENDAI structure for organizing our thoughts?
- What questions and inquiry have we left unanswered?

2:30 - Break
3:00 - Capture – Commitments to complete report, webinar, and dissemination
5:00 - Celebrate

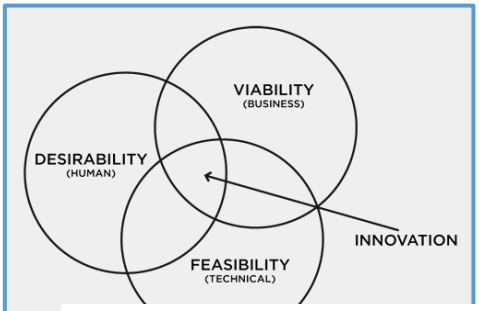
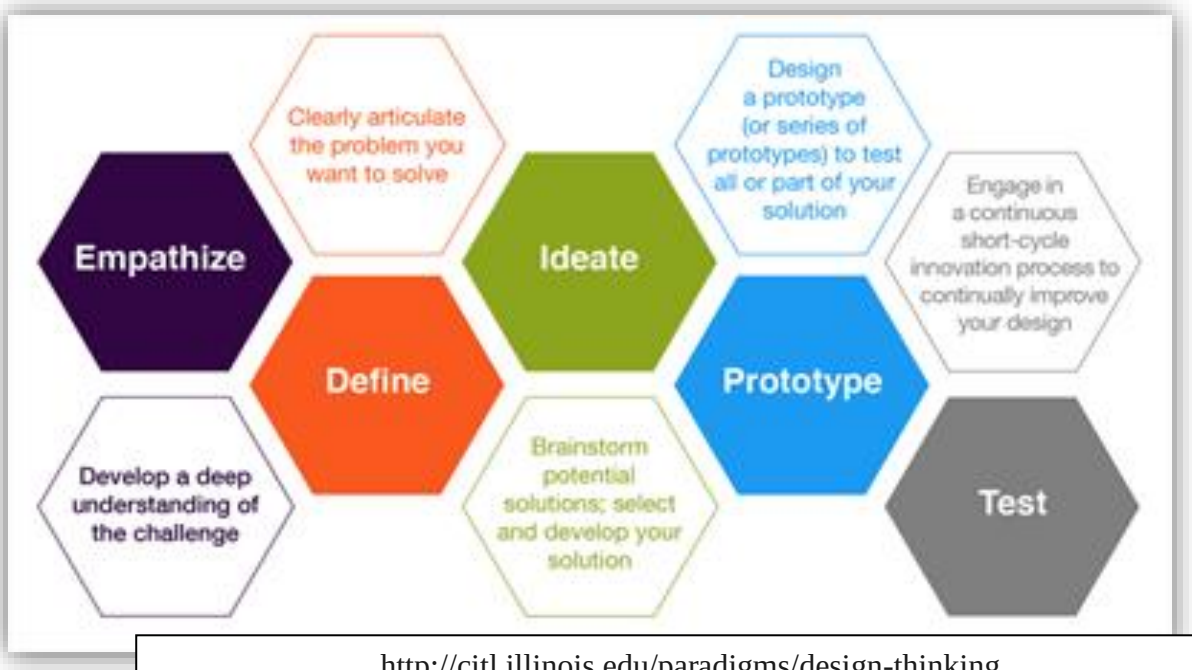


**Image from http://www.ideo.com*

Resources:

National Preparedness Goal (This link can also be accessed at the following URL: https://www.fema.gov/media-library-data/1443799615171-2aae90be55041740f97e8532fc680d40/National_Preparedness_Goal_2nd_Edition.pdf)
Sendai Framework (This link can also be accessed at the following URL: http://www.unisdr.org/files/44983_sendaiframeworksimplifiedchart.pdf)

Design Thinking (This link can also be accessed at the following URL: https://static1.squarespace.com/static/57c6b79629687fde090a0fdd/t/589ba9321b10e3beb925e044/1486596453538/DESIGN-PROJECT-GUIDE-SEPT-2016-V3.pdf)



http://citl.illinois.edu/paradigms/design-thinking

APPENDIX C – CORE COMPETENCIES DEFINITIONS

In April of 2015, the FEMA Higher Education Program supported a focus group to identify the next-generation core competencies for emergency managers. The context for the updated competencies was an increasingly interconnected and interdependent landscape, frequency and severity of disasters, technological advancements in infrastructure, and ethnic and cultural diversity of our communities. The resulting 12 competencies are a consensus list developed from the focus group participants and a 2-phase Delphi study of hazards and disasters scholars at various stages in their career.

The competencies fall into three nested categories that are interrelated, but have attributes that build the individual, the practitioner, or relationships. As a clarifying note, the category of Emergency Management Competencies that Build the Practitioner includes competencies that present a concept in conjunction with literacy; used in this sense, literacy is a more expansive perspective, and encompasses knowledge of a particular subject or field.

As a result of feedback and reflection from the 2016 and 2017 FEMA Emergency Management Higher Education Symposium, a final document entitled "The Next Generation Core Competencies for Emergency Management Professionals: Handbook of Behavioral Anchors and Key Actions for Measurement" (This link can also be accessed at the following URL: https://training.fema.gov/hiedu/docs/emcompetencies/final_%20ngcc_and_measures_aug2017.pdf) was created in August 2017. The refined definitions for the now 13 competencies are presented below:

- **EM Competencies that Build Relationships:**

Disaster Risk Management
The emergency management professional communicates and facilitates disaster risk awareness, assessment, measurement, and reduction across a broad spectrum of stakeholders. Disaster risk management is the application of strategies and policies to prevent new disaster risk, reduce existing disaster risk, and manage the residual disaster risk, ultimately contributing to loss reduction, resilience building, and thriving communities. An understanding of how systems interact to create risk, along with recognition that risk is interdependent with social systems is fundamental to the function.

Community Engagement
The emergency management professional is able to facilitate community ownership of risk. Community engagement involves an open dialogue and relationship development that fosters working constructively to reduce the shared disaster risk. The practices of clearly communicating information, giving voice to unheard community members, integrating divergent perspectives, promoting and supporting individuals, families, businesses, and organizations are vital for building the foundation of respect and support for a thriving community.

Governance & Civics

The emergency management professional understands how to participate with civic and legal processes, from politics to policy. The way society manages collective processes is referred to as governance, which seeks to identify, evaluate, and operate within the context of relational dynamics including those within power structures. Collaborative processes further expand the achievement of public value by bringing people together across the boundaries of public agencies, levels of government, NGOs, business, and civil society.

Leadership

The emergency management professional is comfortable leading within and across organizations. Effective emergency management leadership emphasizes team building, collaboration, collective leadership, and communication connectivity to a wide range of stakeholders, so that the complex risks can be addressed. Leadership is characterized by: informed decision-making, constructive administration and management techniques, fostering a shared vision, empowering others, establishing communication capabilities across varied networks, and creating an outcome-oriented environment for continual improvement.

- **EM Competencies that Build the Practitioner:**

Scientific Literacy

The emergency management professional possesses an understanding and working knowledge of scientific processes, as well as a familiarity with the natural, social, fiscal, and applied sciences. Diverse scientific knowledge is essential as they inform the management and understanding of disaster risk and vulnerability on local, regional, national, and global levels. Scientific literacy is the capacity to objectively and systematically work through complex problems, using the scientific process to identify questions, interpret evidence-based findings to inform decision making, and effectively communicate the results to policy makers and the public. Through the use of the scientific process and principles in relationship to hazards, risks, and vulnerabilities, practitioners can deliver enhanced value to enable the communities they serve to thrive.

Geographic Literacy

The emergency management professional possesses a foundational and comprehensive understanding of the geographic configurations of hazards, vulnerability, and risk. Geographic literacy comprises knowledge of the earth's physical and human systems, utilizing a spatial foundation where hazards, vulnerability, and risk can be conceptualized. The interconnections, interactions, and implications across complex physical, built, and social environments can be analyzed to track changing disaster risk profiles and inform decision making.

Sociocultural Literacy
The emergency management professional recognizes the social determinants of risk, as both the risks for and the effects of disasters are socially produced. A sociocultural foundation provides the lens to examine and understand human behavior, and the individual and collective ways in which humans may affect their relationship to risk, adaptive capacity, and ability to thrive.

Technological Literacy
The emergency management professional possesses a fundamental understanding of evolving technologies, their relevant application to practice, and timely adoption of these technologies. Technology refers to the mechanisms or devices developed from the application of scientific knowledge. Integrating emerging or evolving technology into emergency management practice requires an awareness of current innovations, the ability to evaluate their potential utility, the expertise to utilize technologies, and a grasp of the security measures necessary to protect the technology.

Systems Literacy
The emergency management professional sees the whole picture, particularly inter-relationships and patterns of change. Systems literacy helps the emergency management professional synchronize his/her understanding and practice with the ongoing shift away from a linear and hierarchical human order to one that is characteristically dynamic, complex, and exponential. The focus of systems literacy is on interdependent relationships that produce reactions, changes, and adaptations over time. This scientific foundation provides the emergency management professional a deeper understanding of the present for developing future focused strategies that enable adaptation and the ability to thrive.

- **EM Competencies that Build the Individual:**

Operate within the EM Framework, Principles, & Body of Knowledge
The emergency management professional utilizes a proactive, anticipatory, and innovative approach for guiding public policy and in the application of the emergency management framework and principles. Emergency management seeks to promote safer, more resilient, and thriving communities. All necessary actions are employed to mitigate against, prepare for, respond to, and recover from threatened or actual hazards. Emergency Management activities must be comprehensive, progressive, risk-driven, integrated, collaborative, coordinated, flexible, and professional (Blanchard, et al., 2007).

Possess Critical Thinking
The emergency management professional employs critical thinking to identify and reduce disaster risk in the communities they serve. Critical thinking is a disciplined and multifaceted intellectual process, which involves problem-solving, strategic, adaptive, and innovative thinking. The practice of recognizing relevant evidence, understanding relationships in multi-layered data, and making clear the connections

between potential causes and effects is fundamental to decision-making, adaptive actions, and thriving in uncertain environments.

Abide by Professional Ethics

The emergency management professional both abides by and champions professional ethics. Professional ethics delineate expected and appropriate conduct, principles, and moral and ethical values that guide practice in the midst of both known and uncertain environments. Ethics must be approached as a totality of principles, not as individual guidelines; together, the sum of principles provides an important foundation for action.

Value Continual Learning

The emergency management professional engages in continual learning as a central means of increasing their efficacy when operating in a dynamic risk environment. Continual learning is about building adaptive capacity through an iterative exchange of new information in relationship to prior understanding. The continual learning process allows ongoing improvement, which is critical to achieving system stability, resilience, and thriving opportunities in the midst of an uncertain and complex future. Continual learners develop and nurture a frame of mind that values and utilizes curiosity, reflection, experience, and the development of new understanding.

The research thrusts and guiding principles established in the present report align with the core competencies from the earlier focus group. This ideal congruity reemphasizes the importance of scholar-practitioner harmony and the necessity of transference of knowledge from research to practice and vice versa.