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This month 's The CIP report focuses on ***Resilience***. As one of the key topics from NIPP 2013, a more resilient infrastructure is an enduring goal. The first article, entitled *Thoughts on Resilience: Perspectives from the Field*, is comprised of three editorials written by Steve Hart with the Virginia Military Institute, Thomas Heinold with the U.S. Army Corps of Engineers, and Matthew Liotine with the University of Illinois at Chicago. Next, a paper written by L. Paul Lewis, John R. Hummel, and Ignacio Martinez-Moyano of Argonne National Laboratory highlights the relationship between the rule of law and resiliency.

GEORGE MASON UNIVERSITY
School of Law
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David A. Buczek, a fellow with the Center Infrastructure Protection and Homeland Security, presents an article on fatigue in first responder operations. Next, Pamela Collins looks at critical infrastructure security and resilience as an academic discipline. MAJ Hugh Dougalas highlights resilience and the assessment of potable water supply systems. Finally, Andreas Poppius of Stockholm University reviews resilience through a behavioral science lens.

We would also like to keep you updated on some developments in the dynamic environment here at GMU and CIP/HS. After more than six years as director of CIP/HS and a public service career that spans six decades, Mick Kicklighter retired from our ranks as of 1 January 2015. We are deeply grateful for his vision and the energy Mick has brought to CIP/HS. His contributions to this emerging discipline are immense. I am honored to succeed Mick as Director of CIP/HS and look forward to continuing this Center's thought leadership in this vital field of national security.

We would like to take this opportunity to thank this month's contributors. We truly appreciate your valuable insight. We hope you enjoy this issue of *The CIP Report* and find it useful and informative. Thank you for your support and feedback.

Regards,

Mark Troutman, PhD
Director, Center for
Infrastructure Protection and
Homeland Security

Thoughts on Resilience: Perspectives from the Field

Principles of Infrastructure Resilience

Steve Hart

As a young man my father told me, "Son, the principles of war never change, only the idiots that have to re-learn them." Thirty years of education and experience have validated Dad's observation that fundamental principles endure through time. In our emerging field of infrastructure resilience we are still trying to discover our fundamental principles. As my contribution to that evolution, these are the principles I use and teach; as principles that tell us *what* to consider and must be supported by techniques that tell us *how* to do it. Following the principles is not a formula for success; rather, violating the principles invites failure, shows him in through the front door, and gives him the seat of honor because an essential concept has been ignored.

Infrastructure problems are social problems. Because infrastructure exists to serve a societal need, infrastructure problems are social problems and must be addressed in the context of the society served. Failure to do so results in solutions that are technologically, financially, or socially unacceptable.

Law and policy both direct and constrain solutions. Infrastructure challenges take place in an environment shaped and defined by law and policy, which are collective statements of societal will on what we choose to do and not do.

Infrastructure resilience is a team sport.[1] Ensure that all necessary stakeholders have both voice and vote in the decision making and implementation processes.

Understand the networks. Infrastructures are by definition, networks, with specific elements often touching multiple infrastructures, i.e. a water treatment plant is a part of the water, wastewater, electrical, chemical, transportation, educational, and governmental infrastructures. A complete network analysis leads to understanding the nature and function of an infrastructure network, the characteristics of individual nodes and links, and the interdependencies with other infrastructure networks.

Know the enemies. In infrastructure resilience our enemy is described by the All Hazards Environment and we must consider all the things that can go wrong: natural disasters, deliberate malicious acts, accidents, and deterioration. Additionally, the different levels of each must be considered. Floods come in a variety of sizes, typically described by return intervals like 10 year, 100 year, and 500 year, and all must be considered.

Deliberately manage risk. The first five principles shape an understanding of the problem; risk management is the process of figuring out what to do about it. We lack the resources to do everything, so we must decide what we will do. This means we also consciously accept what we will not do. Deciding to protect a structure up to the 100-year flood level means that we accept the loss or severe damage of that structure in the 500-year flood.

Practice operational resilience. Operational resilience is the linking of specific actions in time, space, and purpose to achieve a resilient infrastructure. In implementing the risk management decisions, we implement engineering plans which impact the damage facilities will sustain in a hazard event; emergency management plans to save lives and property and restore services after a hazard event; repair plans to rebuilt facilities after a hazard event; financial plans to pay for it all; and human resources plans to ensure we have the right organizations. We do it all or we will not achieve a resilient infrastructure.

Are these the 'right' principles of resilience? Probably not, but hopefully they are at least useful and not too far off. Development of principles in a field takes a long time, and care must be taken to differentiate technique, which changes

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[1] Shamelessly copied, with full attribution, from my friend and colleague Wayne Boone of Precision Security Consulting.

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rather rapidly, from principle, which endures after developing slowly through vigorous, spirited, and friendly debate among the practitioners. After all, "Infrastructure resilience is a team sport."

*Dr. Steve Hart is an Adjunct Professor of Civil Engineering at the Virginia Military Institute, the Chief Engineer of Hart Engineering, LLC, and an aspiring 'gentleman farmer'. He is a founding member of the Center for Infrastructure Transformation and Education and a member of the Board of Directors for The Infrastructure Security Partnership. He can be reached at hart.engineering@yahoo.com.

Acknowledgement is graciously given to Bill Anderson of The Infrastructure Security Partnership and Wayne Boone of Precision Security Consulting with whom I discussed this article. Their advice helped me refine my thoughts for presentation in this format.

Achieving Resiliency by Calculating your Risks

Tom Heinold

"The Great Flood of 2015 has far exceeded previous record crests across the entire watershed. The hospital had to evacuate late last night, and the city's drinking water supply has been compromised. The National Guard is on the way with ice and water, but with so much widespread flooding and so many roads underwater, help could be days away. The water rose so quickly that even emergency vehicles were stranded in the downtown public works lot. Thousands have been driven from their homes with no food or water, and the city council and the public works and engineering departments are taking a beating for their apparent failure to plan for this catastrophic event..."

How resilient is your community in dealing with the next flood? Hopefully the situation described above won't apply to your city or town, but there are a staggering number of communities in our nation where a situation like this could play out *this year*. There are a few things that you can do to prepare, such as exercising your evacuation plan, making sure you have enough sandbags in stock, and confirming your contingency plans for shelter and water. You also need to *start now* to take on the more difficult, long-term solutions that will significantly decrease the risk of flooding.

There are a great many challenges when dealing with flood situations. Should we fight the flood, evacuate, or both? Hopefully you won't have to make these critical decisions right after Mother Nature gives your area a good soaking, but have you really thought it through beforehand so you are making the right decision as you prepare for an inevitable flood event? Most communities *think* they've thought it through, but too many fall victim to common myths and misconceptions that hinder their efforts to effectively reduce flood risk. The Army Corps of Engineers has helped cities and towns across America prepare for flooding, but there is still more work to do. Education is, as always, part of the solution.

The biggest myth to overcome is that flood risk can be eliminated. It can't. It can be reduced, and the impacts of flooding can be lessened, but the truth is that if you live or work in a natural floodplain, the water is going to come your way sooner or later. There is always residual risk, but many of those who live and work behind levees and floodwalls mistakenly think they are completely safe. They don't pay attention, they don't plan, and that leads to disaster. Knowing that some risk remains, however, can lead to better decisions about zoning, construction, and other development decisions for low-lying areas.

Cities have a tough job: they have to weigh the tax base, the economy, business development, civil services and emergency response, and a myriad of other concerns. Ideally, this infrastructure would all be built on high ground, and the only things remaining in our floodplains would be walkways, parks, and similar amenities that wouldn't suffer any significant damage when floodwaters creep outside the streambanks. However, we all know that most of our cities were established precisely because of their proximity to a river or the coast, and moving most of that productive infrastructure to high ground just isn't feasible. Or is it?

There is a general misperception regarding structural flood risk management measures. It relates closely to the "we're safe" myth, but

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it has more to do with long-term planning and life-cycle costs than with a feeling of security. Most local governments look at the feasibility of protecting what they have already built (or worse yet, plan to build) in the floodplain, and they figure, "It will cost us $1 million to build a levee, and we can avoid $10 million in flood damages over the next 50 years. It's a no-brainer; let's build ourselves a levee!" While this is a generally accepted practice for analyzing the feasibility of a levee system, most communities fail to consider the cost of relocations. While relocations can have a relatively high initial cost, they remove the risk rather than just reduce it, and if facilities are moved out of the floodplain, then future generations won't have to revisit the problem in the future. Spending $5 million on relocations rather than $1 million on a levee may very well be the best long-term solution, especially considering the cost of operating and maintaining a levee system for 50 years (and beyond) while continuing to be at risk from flooding.

One of the biggest problems with the relationship between levee systems and floodplain development is that they seem to support each other. Even the way the government regulates floodplains contributes to unwise decisions. The relationship is self-perpetuating. You have a critical facility in a floodplain. It appears that in the short term it's more cost-effective to protect it than to move it or flood-proof it, so you build a levee or a floodwall. Now that you have a levee, FEMA can update a Flood Insurance Rate Map (FIRM) that shows the area to be protected from a 100-year flood (and by the way, that is not a flood that can only happen once in 100 years, another common misconception, it's a flood that has a 1% chance of occurring *this year*, and the odds of such an event increase quickly over time). And now that the FIRM shows the area as being protected, insurance rates drop, and it seems to make more sense to build additional facilities in the floodplain. Now you have even more infrastructure to protect, and building an even higher levee is now justified because you would avoid even more flood damages. The vicious circle goes on and on. These implied incentives might look good on paper or in a City's "economic sustainability" report (after all, letting all those new homes and businesses move into the floodplain really increased your tax base). What they fail to acknowledge is that someday a flood event that overtops the levee will come. When that happens, instead of a nuisance from which the city could quickly recover, the words used to describe the event will be "disastrous," "crippling," or even "deadly," and the first paragraph of this article makes the front page of the local paper.

So what can local governments do to stop the vicious circle and mitigate or even avoid future flood risk? Rather than just requiring new construction in a "protected" floodplain area to be one foot above the 100-year mapped floodplain (a fairly common standard), consider zoning rules and ordinances that prevent such construction in the floodplain at all, or at least insist on standards such as 5 feet above the 100-year flood surface profile, or perhaps even more depending on the stream or river characteristics. Instead of building a higher levee system, consider employing non-structural measures like flood-proofing, raising structures, or better yet, relocations. Develop a long-term vision for your community that is sustainable, that doesn't commit future generations to perpetual operation and maintenance costs, and that avoids risk rather than just reducing it. Take a closer look and ask your city council or your planning & zoning commission, "Will you be able to afford the next big flood?" The answer might cause you to take a different approach than the outmoded "if we build [a levee], they will come" approach to floodplain development.

* Tom Heinold currently serves as the Deputy Chief of Operations for the U.S. Army Corps of Engineers, Rock Island District and has been a Flood Area Engineer for more than a decade. He is a retired Army Engineer Colonel, the President of Rock Island Post of the Society of American Military Engineers, and is a Registered Professional Engineer in the State of Illinois. The views of Mr. Heinold do not reflect the opinion or policy of USACE.

Principles of Infrastructure Resilience

Matthew Liotine

On September 26, 2014 a contractor working at an FAA air traffic control center in Aurora, Illinois de-

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liberately set fire to a control room in that facility, rendering it inoperable for several weeks. Hundreds of flights throughout the country were cancelled and thousands of travelers were affected. The vulnerability of a highly localized critical infrastructure was exploited. The nation's air traffic control system design was unable to contain the effects of the incident.

While our national strategy encourages local planning and response, allocation of funds based on local needs could be suboptimal since most infrastructure spans multiple jurisdictions and organizations. Use of information technology within critical infrastructure has increased interdependencies and linkages between different infrastructures in different regions. T*hus regional incidents can become national or even global events*. Additionally, as population centers grow and threat agents increase with terrorism and cyber-threats, t*he likelihood of incidents and potential damage intensifies.*

Critical infrastructure is comprised of assets and systems whose operation is vital to our nation's economic well-being, security, public health, or safety. The National Infrastructure Protection Plan (NIPP) established a national approach for integrating critical infrastructure security and resiliency across 16 critical infrastructure sectors. Homeland Security Presidential Directive-8 (HSPD-8) proposed a Target Capabilities List outlining capabilities that should be developed and maintained to prevent, protect against, respond to, and recover from terrorist attacks and major disasters.

These capabilities are underpinned by fundamental tenets that are guiding principles for planning and designing critical infrastructure. Critical infrastructure needs to maintain functionality in light of adverse events. Resiliency is the ability to recover quickly from disturbance or damage and degrade gracefully when damage is unavoidable. It includes limiting injury and containing or remediating damage to critical components swiftly. To achieve resiliency, some guiding principles are in order:

- *Find the weak spots* – Vulnerability analysis identifies critical assets, their weaknesses and their susceptibility to threats. It reveals which elements in a system can and cannot be controlled and provides guidance on prescribing remedial actions.

- *Know the risks* – Risk is the expected net amount of assets, resources, lives, users, etc. that could be lost or adversely impacted resulting from a threat. Risk analysis estimates the impacts, either local or widespread, of likely adverse events affecting the infrastructure.

- *Prioritize* - Since response and protection is a money issue, risk analysis can help prioritize corrective actions and allocate the resources necessary to implement them. Characterizing residual risk will aid in understanding the effectiveness of remedial measures.

- *Think process* – Infrastructure resilience planning should be implemented as a recurring process, and not just as part of a project. Each phase of infrastructure planning and design should incorporate inspection from a resilience perspective.

A recent GAO report revealed apparent inconsistencies and inefficiencies in how DHS recommended critical infrastructure vulnerability assessments are carried out. There is still much work needed to standardize and integrate methods across different disciplines and sectors so that comparable analyses are performed. While the above principles are fundamental to infrastructure protection, their uniform institutionalization has yet to be realized.

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Incorporating the Rule of Law in Resiliency Analyses

by L. Paul Lewis, John R. Hummel, and Ignacio Martinez-Moyano

In 2005, the United Nations (UN) World Conference on Disaster Reduction convened in Kobe, Hyogo, Japan, with the goal of developing a 10-year strategy to guide countries in fostering resiliency to natural disasters.[1] The Hyogo Framework for Action (HFA) established five priorities to enhance community resiliency, emphasizing improvements in the rule of law as it relates to communities' governing systems. The end of the first 10-year period of the HFA presents an opportunity for policymakers to examine how the rule of law could be incorporated in the analyses of progress toward the resiliency goals articulated in the HFA priorities.

This paper discusses the relationship between the rule of law and resiliency, presents a case study of how the rule of law could be analyzed in the context of community resiliency based on the HFA priorities, and proposes a model of how the rule of law supports the community system activities necessary to achieve the resiliency enhancements described in the HFA.

Resiliency and the Rule of Law

Definitions of "resiliency" abound in the literature. For the purposes of this work, we have defined resiliency as "the ability of an entity — e.g., an asset, organization, community, or region — to anticipate, resist, absorb, respond to, adapt to, and recover from a disturbance from either natural or man-made events.[2] Defining resiliency as *an ability* speaks to both its physical capacities, as well as the human activities necessary for the entity to act. Effectively exercising these abilities requires that the entity be governed according to applicable and accepted processes and concepts given the context of the act, such as equality, fairness, or transparency. Resiliency is thus related to an entity's governing system.

The rule of law is a foundational feature of governance. In addressing the issue of community resiliency, we have used the UN's definition of the "rule of law": "A principle of governance in which all persons, institutions and entities, public and private, including the State itself, are accountable to the laws that are publicly promulgated, equally enforced, and independently adjudicated, and which are consistent with international human rights norms and standards."[3] These characteristics are essential to the organization of the governing system, as well as its formulation of legitimate and appropriate laws and policies, providing support and oversight to other community systems. The rule of law serves to organize and enable the actions of a community that require concerted efforts from multiple systems. This coordination is critical to the exercise of abilities in both the above definition of resiliency and the HFA priorities.

The Role of Rule of Law in Resiliency Analyses

To assess how rule of law factors can impact resiliency assessments, the authors conducted a case study using the HFA. The five priorities of the HFA are each subdivided into a set of core indicators, as listed in Table 1.

The HFA required that the 168 participating member states perform "self-assessments" of their progress in achieving the five priorities.

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[1] United Nations International Strategy for Disaster Reduction, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disaster* (Kobe, Hyogo, Japan: United Nations, 2005), http://www.unisdr.org/2005/wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf.

[2] Argonne National Laboratory, *Final Report for the Workshop on Analytical Support for Societal and Regional Resiliency in Support of National Security*, ANL/DIS-14/4 (Argonne, IL: Argonne National Laboratory, 2014).

[3] United Nations Security Council, Report of the Secretary-General, *The Rule of Law and Transitional Justice in Conflict and Post-Conflict Societies*, Aug. 23, 2004, http://unrol.org/files/2004%20report.pdf.

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Table 1. The Hyogo Framework for Action Priorities and Core Indicators

HFA Priority	Core Indicators
1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.	1. National policy and legal framework for disaster risk reduction exists, with decentralized responsibilities and capacities at all levels. 2. Dedicated and adequate resources are available to implement disaster risk reduction plans and activities at all administrative levels. 3. Community participation and decentralization is ensured through the delegation of authority and resources to local levels. 4. A national multi-sectorial platform for disaster risk reduction is functioning.
2. Identify, assess, and monitor disaster risks and enhance early warning.	1. National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors. 2. Systems are in place to monitor, archive, and disseminate data on key hazards and vulnerabilities. 3. Early warning systems are in place for all major hazards, with outreach to communities. 4. National and local risk assessments take account regional/trans-boundary risks, with a view to regional cooperation on the reduction.
3. Use knowledge, innovation, and education to build a culture of safety and resilience at all levels.	1. Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc.) 2. School curricula, education material, and relevant trainings include disaster risk reduction and recovery concepts and practices. 3. Research methods and tools for multi-risk assessments and cost benefit analysis are developed and strengthened. 4. Countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.
4. Reduce the underlying risk factors.	1. Disaster risk reduction is an integral objective of environment related policies and plans, including land use natural resource management and adaptation to climate change. 2. Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk. 3. Economic and productive sectorial policies and plans have been implemented to reduce the vulnerability of economic activities. 4. Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes. 5. Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes. 6. Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.
5. Strengthen disaster preparedness for effective response at all levels.	1. Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective are in place. 2. Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes. 3. Financial reserves and contingency mechanisms are in place to support effective response and recovery when required. 4. Procedures are in place to exchange relevant information during hazard events and disasters and to undertake post-events reviews.

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These assessments were conducted by the countries themselves without any external check on the results; i.e., no objective validation process was required by the HFA. However, a rule of law assessment, such as the World Bank Governance Indicators,[4] can be used to determine whether the self-assessments are reasonable and to assess the likelihood that a country will be able to achieve the HFA priorities. For example, Australia gave itself relatively high scores for HFA achievement, indicating a positive outlook for its development of disaster risk reduction strategies,[5] as shown in Figure 1. When compared with the World Bank's assessment of Australia's rule of law capabilities,[6] the country's self-assessment seems to be a reasonable conclusion; it is likely that Australia will be able to achieve the HFA goals.

Figure 1. Comparison of Rule of Law Metrics for Australia

Figure 2. Comparison of Rule of Law Metrics for Guinea-Bissau

On the other end of the scale, Guinea-Bissau gave itself low assessment scores in its progress toward achieving the five priorities of the HFA,[7] as shown in Figure 2. Comparison to the same applicable World Bank assessment indicators suggests that this negative forecast is also reasonable because the metrics point to major underlying problems from a rule of law perspective. We can conclude that the likelihood that Guinea-Bissau can achieve the HFA priorities is low. These examples are indicative of the majority of comparisons between the HFA self-assessments and the World Bank rule of law assessments.

The Role of Rule of Law in Supporting Community Resiliency Activities

This case study provided an overview of which community systems and associated activities would be necessary to achieve the HFA priorities, as well as how significant a factor the governance issues related to the rule of law would be. Incorporating the rule of law in resiliency analyses requires that the community of interest be viewed as a "system of systems" in which a community's resiliency can be impacted either positively or negatively, depending on the effectiveness of those systems operating individually and in tan-

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[4] "World Governance Indicators," World Bank, 2014, available at http://info.worldbank.org/governance/wgi/index.aspx#home.
[5] PreventionWeb, *National Progress Report on the Implementation of the Hyogo Framework for Action* (2013–2015) – Interim, Australia, last updated July 4, 2014, available at http://www.preventionweb.net/files/40149_AUS_NationalHFAprogress_2013-15.pdf.
[6] "World Governance Indicators," available at http://info.worldbank.org/governance/wgi/index.aspx#home.
[7] PreventionWeb, National Progress Report on the Implementation of the Hyogo Framework for Action (2009–2011), Guinea-Bissau, last updated April 20, 2011, available at http://www.preventionweb.net/files/19614_gnb_NationalHFAprogress_2009-11.pdf.

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Figure 3. Conceptual Model of the Characteristics of Resilient

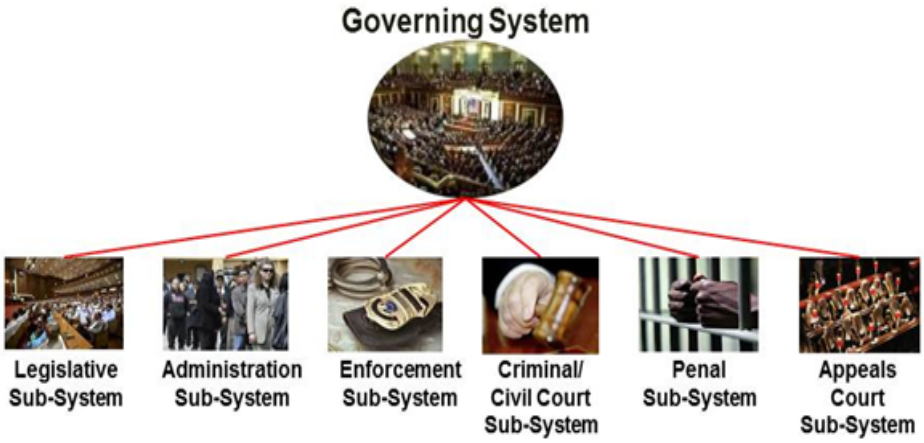

Figure 4. Sub-Systems that Are a Part of a Governing System

dem. Figure 3 shows a conceptual view of the systems that contribute to a resilient community.

The community systems at the top and bottom of the figure represent those that would need to be engaged to enhance resiliency. The human landscape system to the left represents all of the human players who would be involved as decision makers, implementers, and those impacted by the activities. Effective operation of these systems, each performing tasks unique to its function and in support of the others, is required to exercise the capabilities that define resiliency. The environmental system noted on the right represents the physical environment in which all of the interactions would occur. Each community system is made up of sub-systems that carry out particular tasks, as shown in Figure 4.

By examining just the first core indicator associated with HFA priority 1, we can see that developing this framework requires the collaborative participation of several community systems. Figure 5 illustrates the activities and interactions among the governing, financial, industry/business, and utilities/public infrastructure systems that are required for the development and execution of this core indicator.

The governing system is needed to propose, amend, and finalize the policies and strategies, as well as provide the resources and services for the policy framework operation. The financial, industry/business, and utility/public infrastructure systems are required to provide resources and services, as well as feedback on the policy and legal framework that is proposed by the governing system. Similar representations can be generated for the other core indicators and priorities. Various sub-systems of each system would be involved, and the various sub-activities could be expressed at the level of detail required to accomplish the activity. In addition, the activity details could also identify the specific players involved, the times required for them to act, and any resources required to accomplish the activity. In each activity, the question of whether the rule of law impacts the activity positively or negatively will be a deciding factor in the success of that activity and, ultimately, the ability of the entity to achieve the resiliency goal.

Conclusion

The significant relationship between the rule of law and resiliency in the HFA demonstrates the crucial need to incorporate the rule of law in community resiliency analyses. The rule of law is a fundamental aspect of effective governance and a critical contributor to societal resiliency. It provides a platform to organize and

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coordinate the participation of diverse societal actors and institutions to achieve resiliency goals such as those described in the HFA. Incorporation of the rule of law in resiliency analyses will ultimately enhance policy makers' understanding of a community's overall operations and progress toward resiliency.

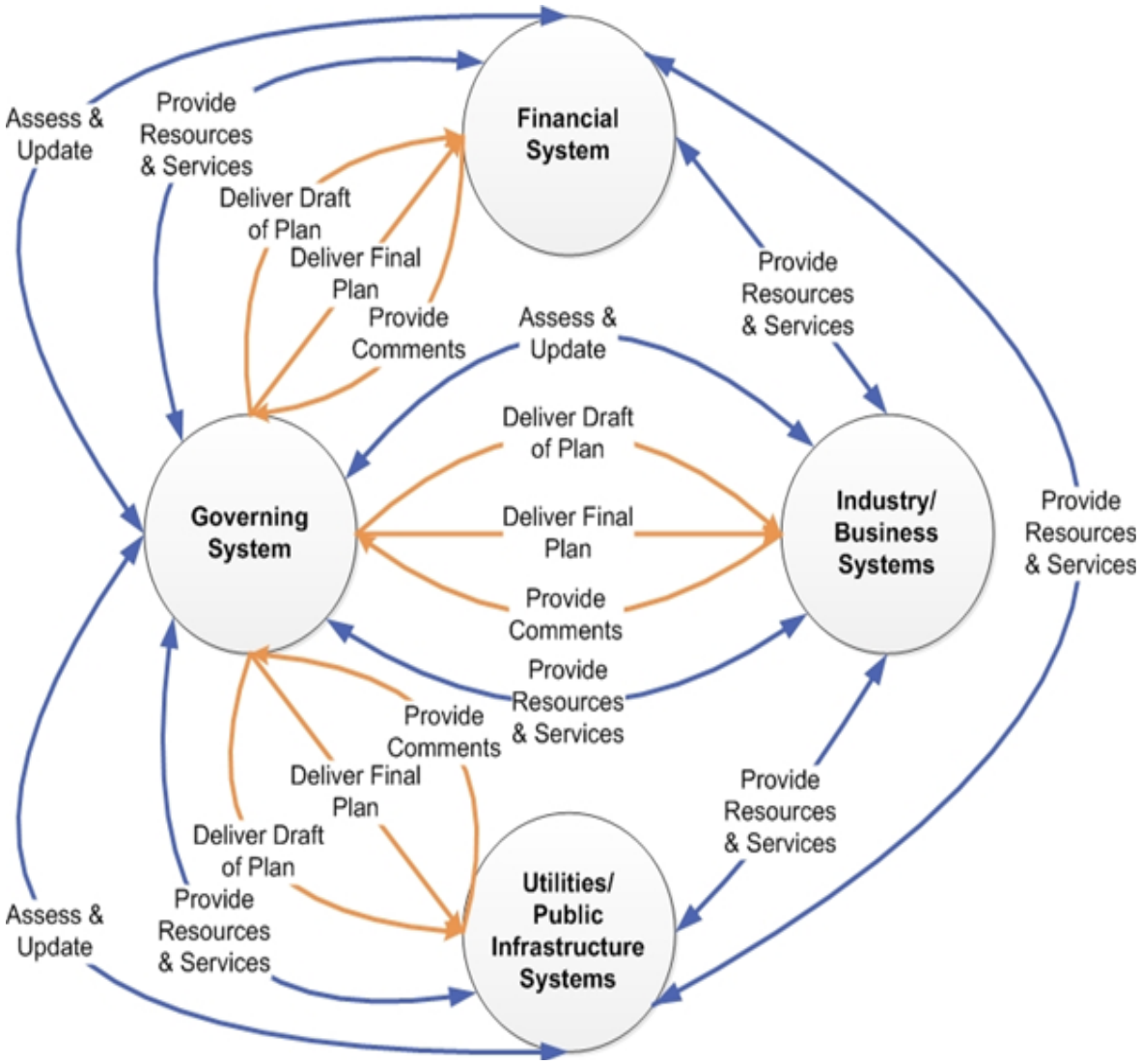

Figure 5. Notional Model of Activities Associated with A Core Indicator of HFA Priority 1

Acknowledgment

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Fatigue in First Responder Operations

by David A. Buczek

The first responder community is a critical component of our nation's infrastructure and represents our collective ability to effectively respond to emergencies. Police, fire, and emergency medical services (EMS) personnel all play important roles in evaluating emergencies, making sound decisions, and providing an effective response. Professionals in these areas are heavily trained in their craft and expected to be alert and ready to respond at a moment's notice should an emerging or actual emergency occur. But when first responders reach the end of their endurance human fatigue can manifest in an emergency situation and may negatively impact outcomes. The good news is that by understanding fatigue and its main causes, the first responder community can effectively control and mitigate the negative impacts of fatigue on their operations.

The Human Physiology of Fatigue

Fatigue can be defined as a physiological state that reduces a person's ability to perform mental and physical tasks and increases the risk of injury or accident. Fatigue leaves us feeling groggy, weary, and sleepy, and negatively impacts both our mental acuity and physical capabilities. From the perspective of human physiology, fatigue results from a lack of adequate sleep or extended periods of wakefulness. It may also result from the time of day, such as an overnight shift, or from prolonged or heavy mental or physical activity.

We all experience fatigue at some point each day, and that is normal. But, when first responders are overly tired, fatigue can intrude on work life. Fatigue slows mental reaction times and causes people to make mistakes, even in well-practiced activities. Fatigued workers have difficulty concentrating, lose the ability to effectively anticipate events or actions, and lose the ability to communicate effectively with coworkers. Fatigue is unpredictable and causes variations in performance—one minute we feel alert, and the next we can find ourselves nodding off.

In safety-critical situations, fatigue can pose a real safety hazard. One Harvard research study published in the Journal of the American Medical Association[1] discussed how the extended shifts and long work weeks of police officers and the resulting fatigue may contribute to the fact that more officers are killed by unintended adverse events than during the commission of felonies.

Fatigue can also cause serious health consequences. Working at night when the human body craves sleep and attempting to sleep during the day when the body wants to be awake results in poor sleep and accumulating fatigue. Employees who work extended hours report increased use of sick leave, more health complaints, and more doctor visits than workers in traditional daytime jobs. Sleep loss has also been associated with greater amounts of stress, alcohol and drug abuse, obesity, diabetes, and a lower sense of overall well-being.

When Is Fatigue a Hazard?

Fatigue can manifest in first responder operations in many ways. The most common is when situations require working long or extended duration shifts, or until

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[1] Shantha M.W. Rajaratman, et al., "Sleep Disorders, Health, and Safety in Police Officers," *Journal of the American Medical Association* 306, no. 23 (Dec. 21, 2011), available at http://jama.jamanetwork.com/article.aspx?articleid=1104746.

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emergency situations are resolved. Research shows that being awake for 17 hours can impair neurobehavioral performance comparable to a blood alcohol level (BAL) of 0.05 percent.[2] Being awake for 24 hours can impair performance to the equivalent of 0.1 percent BAL. Common first responder operations don't require staying awake for up for 24 hours. However, small amounts of sleep loss each day can build up over the course of a week and result in a highly fatigued condition. All organizations have strict rules about working while under the influence of alcohol, yet the scheduling practices of some in our first responder community and surge requirements in emergency situations may be placing our workers in a similarly compromised position.

According to recent studies,[3] humans are poor judges of their own fatigue. After being awake for long periods, our subjective feelings of fatigue remain low while our performance decrements increase. When fatigue begins to manifest into our work life, we are ill-prepared to recognize or manage it. A number of safety-related sectors with the potential for long work hours, such as transportation, have recognized these hazards associated with fatigue and have implemented strict hours of service limitations on workers in an attempt to take our inability to recognize and address fatigue out of the safety equation.

Causes of First Responder Fatigue

The environment in which first responders work has attributes that can cause fatigue. Some of these attributes include:

- High intensity work
- Extended duty periods
- Night work
- Rotating shift patterns

For first responders, any work shift that is particularly intense, or that extends beyond the traditional eight hours of work, is both mentally and physically taxing and can result in fatigue. Physically and mentally demanding work can quickly drain our reserves. Experienced first responders who are dealing with an emergency situation are pushed mentally and experience "eustress," that feeling of "being in the zone" and performing at peak effectiveness. Inexperienced colleagues, faced with the same situation may experience "distress," a feeling of anxiety when trying to perform at the expected level of effectiveness. Both eustress and distress are mentally draining and can lead to fatigue.

In a similar way monotonous or low-intensity work, especially at night, signals the brain to take advantage of downtime and seek rest. This can cause inattention or dozing off—what fatigue scientists call "microsleeps." Well-rested test subjects began to experience microsleeps after only eight minutes of straight-road driving in a simulator.[4] Without stimulation, we all can experience fatigue-like symptoms in a short period of time.

Normally, people are wired to be awake during the day and asleep at night. Sometimes referred to as our "internal body clock," exposure to sunlight kicks our body into gear in the morning, and darkness initiates our sleep system in the late evening. When working rotating shift patterns and scheduled to work a midnight shift, we work against our body clock, and our sleep/wake patterns are disrupted. When we try to catch up on sleep during the day, our body wants to be awake, and our sleep is not as long, deep, or restorative. If we don't get the eight hours of necessary sleep each day, fatigue builds over time; this is called sleep debt. By the end of a work week, we can be dangerously fatigued. Adequate rest or nap breaks, if possible, on midnight shifts help trim our sleep debt and keep us alert while working nights.

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[2] Drew Dawson and Kathryn Reid, "Fatigue, Alcohol and Performance Impairment," Nature 388, no. 235 (July 17, 1997), available at http://www.nature.com/nature/journal/v388/n6639/abs/388235a0.html.

[3] Hans P.A. Van Dongen, et al., "The Cumulative Cost of Additional Wakefulness," SLEEP 26, no. 2 (2003), available at https://www.med.upenn.edu/uep/user_documents/dfd16.pdf.

[4] Rebecca Michael, "An examination of monotony and hypovigilance, independent of fatigue, a Relevance to Road Safety" (PhD Thesis, Queensland University of Technology, Centre for Accident Research and Road Safety, 2011), available at http://eprints.qut.edu.au/45603/.

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Even when employers offer fatigue-friendly shift patterns, balance mental demands of the job, and offer adequate rest breaks, if employees don't properly manage their own sleep hygiene, fatigue can still find its way into the workplace. When employers provide rest opportunities between work shifts, employees need to take advantage of them. Employees should be well-educated about fatigue and its associated health and safety risks, countermeasures they can employ to manage fatigue in their personal lives, and ways to protect their sleep each day.

Mitigating Fatigue in First Responder Operations

The first step in mitigating fatigue in first responder operations is identifying where it might be present. Fatigue scientists have developed biomathematical fatigue modeling software that assesses levels of fatigue in workers as they progress through work shift patterns. Sophisticated algorithms in these tools take into account the human body's sleep/wake rhythms, the need for sleep, and the decremented performance caused by hours of wakefulness. The modeled results allow analysts to identify shift patterns that increase fatigue hazards and then generate "what-if" alternatives that may reduce those hazards.

Analysis can also be conducted on existing data sources to identify associations or patterns between possible fatigue hazards and specific workplace events or incidents. Data from safety reporting systems and incident reports can be analyzed to define specific causal or contributory factors that lead to fatigue and tie fatigued workers to negative outcomes in the operation.

Staff can then use fatigue modeling and safety-related data analysis results to identify how often a fatigue hazard is present and the time of day it occurs. The severity of a fatigue hazard, represented as decremented cognitive performance, then needs to be defined. Bringing together operational Subject Matter Experts (SMEs) with knowledge of risk areas and operations is necessary to assess when fatigue can be accepted and when it establishes a risk to worker and public safety that must be mitigated.

With knowledge of exposure data, hazard and risk analysis results, and an understanding of the unique first responder environment where a fatigue risk exists, mitigation specific to each risk can be engineered. By addressing each risk individually—preventing fatigue from occurring or mitigating it once it is present—fatigue risk can be controlled to acceptable levels and the safety of employees and the public maintained.

Conclusion

Law enforcement officers need to be alert, make critical fast-paced decisions that may deal with life and death, and perform at their best to ensure the safety of the public that they serve. Firefighters must respond quickly to emergencies, and have the mental acuity and physical reserves needed to make proper decisions, communicate clearly and effect emergency operations for the duration of an event. Emergency medical personnel must be alert, have full mental clarity and the executive functioning necessary to keep myriad patient facts in working memory while recalling the medical training necessary to provide immediate critical medical care. If fatigue-related errors are allowed to intrude in any of these first responder roles, the results can be hazardous to the safety of our communities.

Many of today's 24/7 work environments are fraught with fatigue and the first responder community is one of them. NASA, for example, assumes fatigue to be present in its flight operations (both in-flight and ground control) and seeks to actively mitigate the risks that fatigue presents to the safe completion of a mission. All first responder professionals need to be aware of fatigue, its causes, and its impacts, and take active measures to identify, analyze, and mitigate its effects on safe operations. Doing so will avert potential safety hazards and ensure the ongoing effectiveness of this critical component of our nation's infrastructure.

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Critical Infrastructure Security and Resilience: The Evolution of an Academic Discipline

by Pamela Collins

This short article examines the process of becoming an academic discipline within an institution of higher education and whether or not critical infrastructure security and resilience (CISR) has evolved to such a level of consideration. Academic disciplines have exploded since the 1960's and there is an ongoing debate on what elements are necessary to constitute a "legitimate" disciplinary field. Although these elements vary among scholars there are a number of common elements such as a community of scholars; a particular object of research; body of accumulated specialist knowledge; specialized technical language; a presence in university course offerings; and professional associations. This article examines where in the stage of academic evolution CISR might actually be and the pros and cons of CISR as an academic discipline.

CISR Academic Evolution

Critical infrastructure security and resilience (CISR) is not a post-9/11 phenomenon and has been a part of emergency preparedness and response in this country dating back to the 18th century. In recent history the 1980s saw an increased concern and discussion at the local and state levels regarding the declining U.S. physical infrastructure (i.e., roads, bridges, dams, etc.). It was this interest that led to a federal report on the state of infrastructure in America and elevated the issue to the federal level.

However, it was not until The President's Commission on CISR created in 1996, a year after the bombing of the Murrah Federal Building in Oklahoma City, that CISR became part of the national and political dialogue.

Precipitously, George Mason University School of Law began discussions with congress and other leadership in May of 2001 for the creation of a research program that examined the legal, policy, economic, and technical implications of CISR. In light of the events of 9/11, that need became a top priority, and the Center for Infrastructure Protection and Homeland Security (CIP/HS) at George Mason University began officially the work of creating the nation's first interdisciplinary, multi-institutional program to address critical infrastructure as a discipline.[2] This was done through its partnership with the U.S. Department of Homeland Security, called the Critical Infrastructure Higher Education Initiative (CI HEI). The CI HEI courses are available to any university who is interested in developing areas of studies or degree programs in CISR.[2]

Now over a decade later the subject of CISR has become ubiquitous with the spread of homeland and national security education. Homeland Security courses and degree programs have sprouted up all over the country, due in part to the work of the Naval Post Graduate Schools Center for Homeland Defense & Security, (CHDS) and their masters degree program. The CHDS also maintains a substantial database of theses on CISR and other homeland security issues.

This program continues to be made available to any university interested in starting a program. Part of the expansion of degree programs in Homeland Security can be attributed to CHDS convening a meeting of faculty representing academic programs from across the country to discuss the key curricular components that should be included in undergraduate programs or certificates in Homeland Security. CISR was identified as a core requirement of any homeland security curriculum and based on

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[1] Kathi Ann Brown, *Critical Path: A Brief History of Critical Infrastructure Protection in the United States* (Fairfax, VA: Spectrum Publishing Group, Inc., 2006).

[2] "Course Materials," *Center for Infrastructure Protection & Homeland Security*, accessed on Jan. 22, 2015, available at http://cip.gmu.edu/courses.

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that meeting the following CISR areas of study were identified as critical:

- Critical Infrastructure, Key Resources, and Interdependencies;
- Critical Components in an Infrastructure in Particular Contexts (State, Local, Private, etc.);
- Various Methods to Achieve Levels of Protection;
- Financial and Operational Relationships;
- Strategies, Policies, Programs, and Agencies Involved;
- Global Security Threats and Hazards; and
- Scalable Assessment Methodologies"[3]

The proliferation of homeland security courses and degree programs, while not the sole indicator of an academic discipline, suggests that homeland security degree programs represent an "emerging" academic discipline. According FEMA's Emergency Management Institute (EMI) there are at least 131 higher education programs related to Homeland Security, Homeland Defense, and/or Terrorism as of 2011. FEMA also estimates emergency management has grown from zero in 1993 to 259 as of 2011.[4]

Academic Discipline: Pros & Cons

The question of whether or not CISR represents an academic discipline is predicated on the notion that such a label is the next natural step for the development of undergraduate and graduate degrees in infrastructure protection and resilience. Most would agree that CISR represents an interdisciplinary program and can be found in most homeland security degree programs. It is also present in engineering, emergency management, public health, and other related degree programs.

But what exactly is an "academic discipline" and is this the best path for those in higher education who are doing research and teaching on this subject, regardless of their academic department moorings? The literal definition refers to training someone to follow a rigorous set of instructions that are based upon particular subjects, methods, concepts, and tools. Disciplinary fields provide the structure of knowledge in which faculty members are trained and socialized; carry out tasks of teaching, research, and administration; and produce research and educational output.[5]

Consideration for the status as an "academic discipline" is often assessed based upon analytical frameworks used to classify a field of study. There are numerous frameworks and criteria used to assess what constitutes a discipline and depending on the framework the analysis may vary. For example some frameworks of note include Kuhn's *The Structure of Scientific Revolutions*, King and Brownell's *The Disciplines of Knowledge, and the Biglan Model*.

Kuhn's paradigm development relates to the maturity of the field. For example mathematics has very clear and agreed upon ways of defining, ordering, and investigating knowledge. Kuhn's central claim is that a careful study of the history of science reveals that development in any scientific field happens via a series of phases. The first he called "normal science," which focused on *communities* of scientists clustered round a shared paradigm. This approach was described as "the sociology of science – in which researchers began to examine scientific disciplines much as anthropologists studied exotic tribes."[6]

The *Biglan Model* is a framework based upon a taxonomy of academic disciplines based on three identified dimensions to academic disciplines:
(1) *The degree to which a paradigm exists (hard vs. social sciences);*
(2) *The extent to which the subject matters (pure vs. applied);*

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[3] John Rollins and Joseph Rowan, *The Homeland Security Academic Environment: a Review of Current Activities and Issues for Consideration* (Homeland Security and Defense Education Consortium, 2007)
[4] Federal Emergency Management Agency (FEMA), *Higher Education Program Bits and Pieces* (Emmitsburg, MD: National Emergency Training Center, 2011), available at http://content.govdelivery.com/bulletins/gd/USDHSFEMA-22535a.
[5] Janice M. Beyer and Thomas M. Lodahl, "A Comparative Study of Patterns of Influence in United States and English Universities," *Administrative Science Quarterly* 21, no. 1 (Mar. 1973): 104-129.
[6] Thomas S. Kuhn, *The Structure of Scientific Revolutions,* 3rd Ed. (Chicago: University of Chicago Press, 1996).

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(3) *The involvement with living or organic matter (natural & physical sciences.*[7]

In other words, is CISR part of the hard sciences or soft sciences? The next question is, what type of field is CISR? For example would it be considered to fall more in the pure fields which are less concerned about practical application (mathematics, history, and philosophy), or is it viewed as a field with application to knowledge (law and engineering)?

The final framework is based upon the work of King and Brownell's *The Curriculum and the Disciplines of Knowledge* and is based upon nearly a dozen criteria that make up the analytical framework.[8] What makes this an interesting framework is a scoring tool that provides a quantitative (weighted) scale by which you measure the maturation of a particular discipline.

Conclusion

Theoretically by applying any one of the three frameworks described above we should be able to make an assessment as to whether or not CISR represents an emerging or developed academic discipline. However, the problem or limitation to using any of these frameworks is that there are few standalone CISR programs or concentrations of courses to apply the framework criteria to.

What we can refer to, for comparison, is a thesis published by Michael Falkow in fulfillment of his master's program at the Naval Postgraduate School, CDHS. Falkow asked a similar question about homeland security, and his findings suggested that, in spite of the fact there are a significant amount of homeland security degree programs, homeland security was best described as a "Young or Emerging Academic Discipline" falling short of being designated a "Full Fledged Parent Academic Discipline."[9]

Although we can say with some certainty that many of the homeland security degree programs have CISR coursework, this alone does not lend itself to the critical analysis necessary to declare CISR as an academic discipline. CISR is recognized as a core requirement of a homeland security degree and also as a subject matter that merits consideration in other disciplines such as engineering, business, political science, and public administration.

Part of the evolution for CISR as an academic discipline will be the extent to which individuals could obtain some type of CISR certification that demonstrates professional competence in CISR. There would also need to be an agreed upon set of knowledge and skills institutionalized in a curriculum. Finally there would need to be a recognized community of professionals who are linked to a career path or profession outside academia.

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[7] Anthony Biglan, "The Characteristics of Subject Matter in Different Academic Areas," *Journal of Applied Psychology 57*, no. 3 (May 1973): 195-203.

[8] Arthur R. King, Jr. and John A. Brownell, The Curriculum and the Disciplines of Knowledge: A Theory of Curriculum Practice (Huntington, NY: Robert E. Krieger Publishing Co., 1976).

[9] Michael D. Falkow, "Does Homeland Security Constitute An Emerging Academic Discipline" (master's thesis, Naval Post Graduate School, 2013), http://calhoun.nps.edu/handle/10945/32817.

Assessing Potable Water Supply System Resilience

by MAJ Hugh Dougalas

In proclaiming November 2014 "Critical Infrastructure Security and Resilience Month," President Barack Obama cited the nation's water systems as warranting particular attention and observed that the great bulk of the nation's water supply infrastructure assets are privately owned. Additionally, in his remarks, the President referred to his administration's "Build America Investment Initiative," which outlines the Federal Government's effort to marry economic development by providing employment opportunity in the construction industry to increasing the resilience of the country's potable water-providing networks.[1]

"Every anthropologist loves his own tribe," the saying goes. And as a Californian, I admit to a certain *seismic bias.* By that, I mean that when it comes to resilience and the mitigation of disasters, my thoughts turn immediately to earthquakes. My suspicion is that for Americans living on the Gulf Coast, the catastrophe at the top of the list is a hurricane, while residents of Oklahoma and Kansas are concerned with tornadoes. Tribal loyalties notwithstanding, each of these naturally occurring phenomena represents tremendous destructive potential to water supply infrastructure. The Multidisciplinary Center for Earthquake Engineering Research (MCEER) at the University of Buffalo has developed a concept of resilience which considers four fundamental properties, what they call the "Four Rs" – Robustness, Redundancy, Resourcefulness, and Rapidity.[2] While originally proposed as a means of evaluating resilience properties with respect to earthquakes, it is my opinion that these four fundamental properties can be useful in assessing the overall resilience of the nation's potable water supply system and provide useful insight concerning public policy, capital expenditure, and engineering research.

Robustness - the ability to withstand stress or demand without degrading; more generally, strength. Presently, the nation's water supply system is not strong. Many of the components comprising the vast conveyance network have reached the end of their useful lives. In the American Society of Civil Engineers' (ASCE) *2013 Report Card for America's Infrastructure*, the nation's drinking water sector received a grade of D, with ASCE noting that the approximately 170,000 public drinking water systems across the country suffered a combined 240,000 water main breaks.[3] The city of Los Angeles, California need not wait for an earthquake to be forced to address a significant degradation in water supply system function. On July 29, 2014 a failure in a Department of Water and Power line under Sunset Boulevard released water to the street's surface at a rate of 75,000 gallons per minute and flooded the recently renovated Pauley Pavilion on the UCLA campus.[4]

In seeking to improve the nation's D grade and build robustness, one might ask, "Where to begin?" A satisfactory answer may be found by once again looking to the realm of earthquake engineering. Following the Sylmar earthquake of 1971 and focusing on hospitals, seismic and structural engineers have developed an advanced array of standards by which non-engineer stakeholders can compare the seismic performance of different buildings and

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[1] Proclamation No. 9199, 79 Fed. Reg. 65853 (Nov. 5, 2014), available at https://www.federalregister.gov/articles/2014/11/05/2014-26471/critical-infrastructure-security-and-resilience-month-2014.

[2] MCEER, *MCEER's Resilience Framework* (Buffalo, NY: University of Buffalo, 2006), available at http://mceer.buffalo.edu/research/resilience/Resilience_10-24-06.pdf.

[3] American Society of Civil Engineers, "Drinking Water," *2013 Report Card for America's Infrastructure* (ASCE, 2014), available at http://www.infrastructurereportcard.org/a/#p/drinking-water/overview.

[4] Zach Helfand and Chris Foster, "Pauley Pavilion: Workers Use Squeegees on Flood Waters at UCLA," *Los Angeles Times* (July 29, 2014), available at http://www.latimes.com/sports/sportsnow/la-sp-sn-pauley-pavilion-flooding-ucla-20140729-story.html.

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make decisions relating to their facilities. Appropriate amendments to the building code, architectural/engineering design tools, and legislation have followed. The 1976 Uniform Building Code (UBC) represented the first codification of seismic design criteria based on a rating system for the expected performance of a structure during an earthquake. In addition, the Federal Emergency Management Agency (FEMA) has published its FEMA P58: Next-Generation Building Seismic Performance Assessment Methodology "package" which makes possible the reasonable anticipation of the consequences of both new and existing buildings' response to an earthquake.[5] Also, Senate Bill 1953 became law in California in September of 1994. This law is widely credited as having improved public safety by requiring the upgrade of acute care hospitals such that they are capable of continued operation and provision of care following a seismic event.

No system to assess performance of water supply systems during a catastrophic event presently exists. However, research and development are in progress. For example, the United States Resiliency Council (USRC) is a recently formed non-profit organization which has established its Certification of Resilient Engineering (CoRE) ratings addressing safety, reparability, and functionality.[6] In a manner similar to that in which the U.S. Green Building Council issues LEED ratings, the USRC issues CoRE ratings. Presently, USRC develops ratings to gauge earthquake risk to structures, but future-generation metrics will be utilized in assessing multi-hazard risks to other infrastructure assets.

The 1976 UBC, FEMA P58, and SB 1953 can each trace its origin to the time-consuming and difficult work done by scientists and engineers such as forensic investigation and stochastic process evaluation. This work must continue. Once engineers and other technical experts establish performance metrics appropriate for water supply, they will provide useful tools to water system owners and operators, legislators, regulators, insurers, bond underwriters, and others as they make important decisions regarding improving the robustness of the nation's water supply infrastructure.

Redundancy - the extent to which elements of a system can be substituted. At first glance, achieving redundancy in a water supply system may appear an insurmountable challenge. There is only one Lake Mead. If it is no longer viable as a source owing to damage to Hoover Dam and/or failure of other nodes in the system, one does not go to another enormous freshwater lake for water. However, redundancy can be, to a limited extent, readily built in. Individual citizens are in possession of great storage capacity and can prepare for interruption in municipal water service by filling and securing vessels. Indeed, it is likely that every emergency preparedness handbook places water storage at the top of its essential task list. By taking the meeting of potable water needs into their own hands, individuals and families buy time for water supply system operators to return to normal operation.

Redundancy may also be improved through construction of small-scale, stand-by potable water production systems which can be operated until day-to-day function of the main system is restored. Representing both the high and low ends of the technology scale, these can be constructed and set aside for emergency use. High-tech systems such as desalination, ultra violet radiation, reverse osmosis, and electro-dialysis water production plants are not typically employed as a means of meeting long-term, high-volume demand. Each presents drawbacks which must be addressed such as high energy consumption, brine disposal, and/or frequent and expensive membrane replacement. Similarly, a low-tech system such as a slow sand filter is a poor choice to meet the potable water demands of a large population over a sustained period. However, each of the systems listed above can be constructed to operate on an as-needed basis and provide localized redundancy.

Resourcefulness - the capacity to identify problems, establish priorities, and mobilize resources to achieve objectives. Synonyms

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[5] R. O. Hamburger, C. Rojahn, J.A. Heintz, and M.G. Mahoney, "FEMA P58: Next-Generation Building Seismic Performance Assessment Methodology," *National Information Centre of Earthquake Engineering 15WCEE* (2012), available at http://www.iitk.ac.in/nicee/wcee/article/WCEE2012_4156.pdf.

[6] Evan Reis, Kate Stillwell, Ron Mayes, and Eric Von Berg, *The U.S. Resiliency Council Principles of Formation* (Atherton, CA: U.S. Resiliency Council, 2011), available at http://www.seismic.ca.gov/meeting_info/nov8_2012/08.1%20Item%20VIII%20USRC%20SSC%20Packet%20121101.pdf.

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include creativity and ingenuity. One of the means by which our nation's water supply system can be made more resilient is by reducing the demands upon it. Remarkable resourcefulness is evident in this area. It is likely impossible to open your monthly water bill and not find a flyer which describes programs and mechanisms for reducing consumption of potable water. High-efficiency toilets, washing machines, and kitchen and shower nozzles are readily available and innovative financing and rebate programs managed by water purveyors are plentiful. In addition, diverting potable water from its present use in non-potable application is underway. The use of treated wastewater for landscape irrigation is widespread and the food and beverage industry, after conducting and financing extensive research into "tuning" wastewater to the crops and soil conditions to which the wastewater is applied, has demonstrated the efficacy of this practice.[7] Devices which render non-potable water fit for human consumption, though principally utilized by backpackers and hunters, are easy to operate and maintain, inexpensive, and portable. They can also be found in just about any camping/outdoors section of department stores. The technology employed in these devices holds promise.

Rapidity - the capacity to achieve objectives in a timely manner and mitigate negative consequences. Earlier in this paper I identified myself as a resident of California. Here, the reader can be forgiven if he believes I also reside in Fantasyland. In his proclamation, President Obama noted that a national program of upgrading water supply infrastructure would necessarily involve coordination of effort among individual citizens. I would characterize such cooperation as the expenditure of social capital. While Federal debt is at an all-time high and many states' annual budgets indicate huge deficits, America possesses social capital in abundance. In his book, *A World of Wealth: How Capitalism Turns Profit Into Wealth*, author Thomas Donlan recounts how, in the immediate aftermath of a hurricane in the Florida panhandle, "price gougers" traveled to the disaster-stricken area to sell essentials such as water, gasoline, generators, etc.[8] An attorney in the area sued men who were selling gasoline at 300% mark-up along the side of the road, and the Florida legislature, following Hurricane Andrew in 1992, enacted a law which criminalized charging elevated prices for goods and services in an officially declared state of emergency. Mr. Donlan states that, while it may be difficult for their "victims" to accept, the price gougers serve an essential service as the potential for quick profit induces the rapid delivery of critical goods to the disaster area. He goes on to illustrate that, in addition to price gougers, thousands of volunteers also traveled to the area, providing water and other commodities at no cost at all. Boy Scout Troops, church groups, and other volunteer organizations performed brilliantly in the alleviation of the suffering of their fellow citizens. It goes without saying that the Attorney General did not subsequently file suit to compel payment for the goods and services from the recipients. In summary, with regard to the property of rapidity, our nation's water supply infrastructure is sound. It exists in our social capital, befitting a free and fertile people.

The technical and economic challenges facing our water supply infrastructure are significant, and developing a resilient system for securing this vital natural resource is an urgent matter. Our nation's leaders have recognized our situation and wisely established addressing it a national priority. However, like any great challenge, developing a resilient water supply system also represents a tremendous opportunity. For many Americans, the opportunity to apply the nation's nearly inexhaustible intellectual and organizational capacity in attending to our water supply system's robustness, redundancy, resourcefulness, and rapidity is too good to pass up.

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[7] "Our Earth, Our Natural Resource," Anheuser Busch Corporation Website, accessed Nov. 27, 2014, available at http://anheuser-busch.com/index.php/our-responsibility/environment-our-earth-our-natural-resources/; see also Dennis L. Stack, "Resource/Energy Conservation Met By Land Application of Industrial Wasterwaters," (n.d.), available at http://infohouse.p2ric.org/ref/25/24347.pdf.

[8] Thomas G. Dolan, *A World of Wealth: How Capitalism Turns Profit Into Progress* (Upper Saddle River, N.J.: FT Press, 2008): 114-118.

Resilience and Behavioral Science

by Andreas Poppius

This article aims to show one way to handle and analyze *intention*, in this case not only the intention of the adversary, but also the intention of the protectee. The foundation of this analysis is to be found in classical behavioral science and is, in this case, based on Abraham Maslow's human needs hierarchy. No matter if it is your friend or foe, everyone bases their actions on their conscious or unconscious incentives.

Hopefully, this article also gives you the opportunity to develop your productive mindset regarding security analysis even further.

How to Identify Intention?

When identifying antagonistic threats, one has to evaluate the capacity, intention, and opportunity of one's adversaries in order to understand the level of threat and the level of risk associated with it.[1] Most threat analysts are likely to be familiar with at least similar definitions even though they may differ depending on the method used.

Surely many of you safety and security professionals through the years have met people you are tasked to protect doing the most irrational acts, exposing themselves to an even greater danger by breaking safety and security regulations. But why? Why increase the danger to oneself, risking more than already needed? It is hard to give merely one rational answer to this question, but basics are the same—human behavior has its origin in a variety of human needs.

As the security industry develops more and more, it demands extra knowledge from its professionals. In earlier ages, technical solutions implemented mainly to protect some kind of physical assets without paying that much attention to the people actually affected by the security measures were common. In today's service, we as professionals need an integrated understanding of both technical protective measures as well as behavioral matters. Social unrest, radicalization, and social engineering are just a few behavioral related threats that societies need to deal with on various levels today.

Hopefully, this article will help you gain yet another perspective on how to approach these problems, when the persons have not yet turned from protectees to contingencies or even, in worst cases, threats. To build resilient societies, organizations, and corporations, one must have knowledge of how to build (and continuously retain) resilient citizens, members and employees.

The Human Needs Hierarchy

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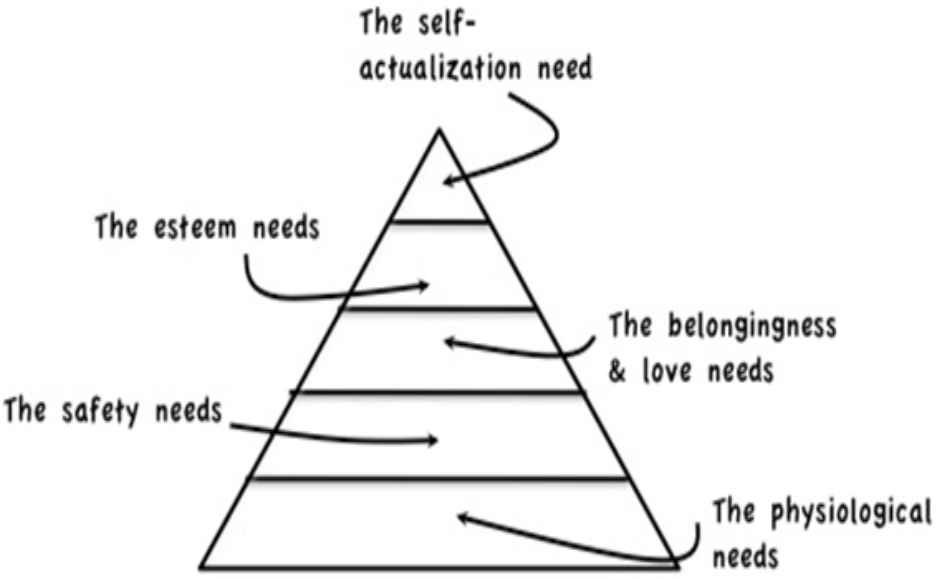

Figure 1. Maslow's human needs hierarchy.

[1] Försvarsmakten, *Handbok Säkerhetstjänst Säkerhetsskyddstjänst* (Stockholm: Försvarsmakten), 292 – 295.

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Abraham Maslow once stated that the human needs could be divided into five levels. These five levels were eventually described in a pyramid – the human needs hierarchy (Fig. 1).[2] One could argue against his theory (and some have done so through the years), but it has been used in psychological research since its first appearance in the 1940's regardless.

This article will not continue the debate of its use in research, but just let it be one illustration of human needs. You will find arguments, though, that for anyone engaged in the fields of safety, security, and protection of *people*, knowledge of human behavior is essential, but from another perspective than only understanding threats from antagonistic actors.

Not knowing how the protectees are acting could be fatal (for everyone involved) or at least make the protective measures meaningless. For example, you may be spending resources on something that is doomed not to work from the beginning. In this illustration, Maslow's human needs hierarchy will be used as a wide description of human needs, needs that will not necessarily integrate with an organization's or community's safety and security procedures.

Maslow states that a person could not ascend from a lower level to a higher before the lower is satisfied. Of course there are variations in this statement, but this is the basic understanding of the human needs hierarchy – one level has to be fulfilled at a time.[3] Please also note that this is only a brief description of Maslow's hierarchy in order to give you an understanding of the framework. For those of you who find this interesting, further reading is both recommended and encouraged.

Level One – The Physiological Needs

These needs consist, according to Maslow, mainly of what we need to do in order to survive physically, e.g. homeostasis, breath, eat, drink, sleep, and have sex. At this level, we are not talking about "I am hungry, because I had no lunch-hunger," but the extreme hunger that occurs among people who really have no access to food.[4]

Level Two – The Safety Needs

In this step, Maslow claims that we need to feel safe. Safety in this case could be security, stability, protection from the environment, freedom from fear, and dependency. We also need a "framework" to exist within, which might consist of laws and limits. When we no longer feel endangered, we continue to the next level.[5]

Level Three – The Belongingness and Love Needs

Here, we need to both receive and give affection. We actively seek to belong, for example in a group or in a family. If we do not find somewhere to fit in, we will continuously hunger for the interaction with others and might end up in groups identifying themselves with a common enemy.[6]

Level Four – The Esteem Needs

For all humans in our society with a few exceptions, a sense of self-esteem or self-respect is of importance. We desire strength, competence, and confidence. In this case, we also desire respect and esteem from others in order to gain reputation and prestige. When our esteem-needs are satisfied, we start to feel self-confident and capable.[7]

Level Five – The Self-Actualization Need

The final step, the peak of the pyramid, shows that we, as individuals, need to do what we are fitted for. If we don't, restlessness and dissatisfaction might occur. According to Maslow, this level cannot be reached (or rather, the need for self-actualization will not emerge) if earlier needs are not met.[8]

(Continued on Page 22)

2 Abraham H. Maslow, Motivation and Personality (New York: HarperCollinsPublishers, 1970), 15-23.
3 Ibid., 17.
4 Ibid.
5 Ibid., 18.
6 Ibid., 20.
7 Ibid., 21.
8 Ibid., 22.

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How to Turn Theory into Action?

In what ways can Abraham Maslow's theories now aid today's safety and security professionals, working with questions of resilience and business continuity management? Simply by knowing the psychological presumptions explained in this article, you have progressed far toward an answer.

There are almost as many ways to analyze risks and making security assessments as there are people doing it, but with several common factors. First, one must understand the whole of the organization. In this case, that would also include the people we are to protect (or our potential adversaries, as this article begun with, all depending on your perspective).[9]

Using Maslow's theory, we could analyze the conditions of our protectees step-by-step. Preferably, you phrase different kinds of questions to help you do this, and it could be used from both a personal and societal perspective. Of course, the societal perspective will only give you a perspicuous picture of the concerned area or the relevant part of an organization, but it will anyway be useful.

Please note that the questions presented here are merely examples and suggestions to illustrate one way of how to use the theory practically (Fig. 2). In the following example,

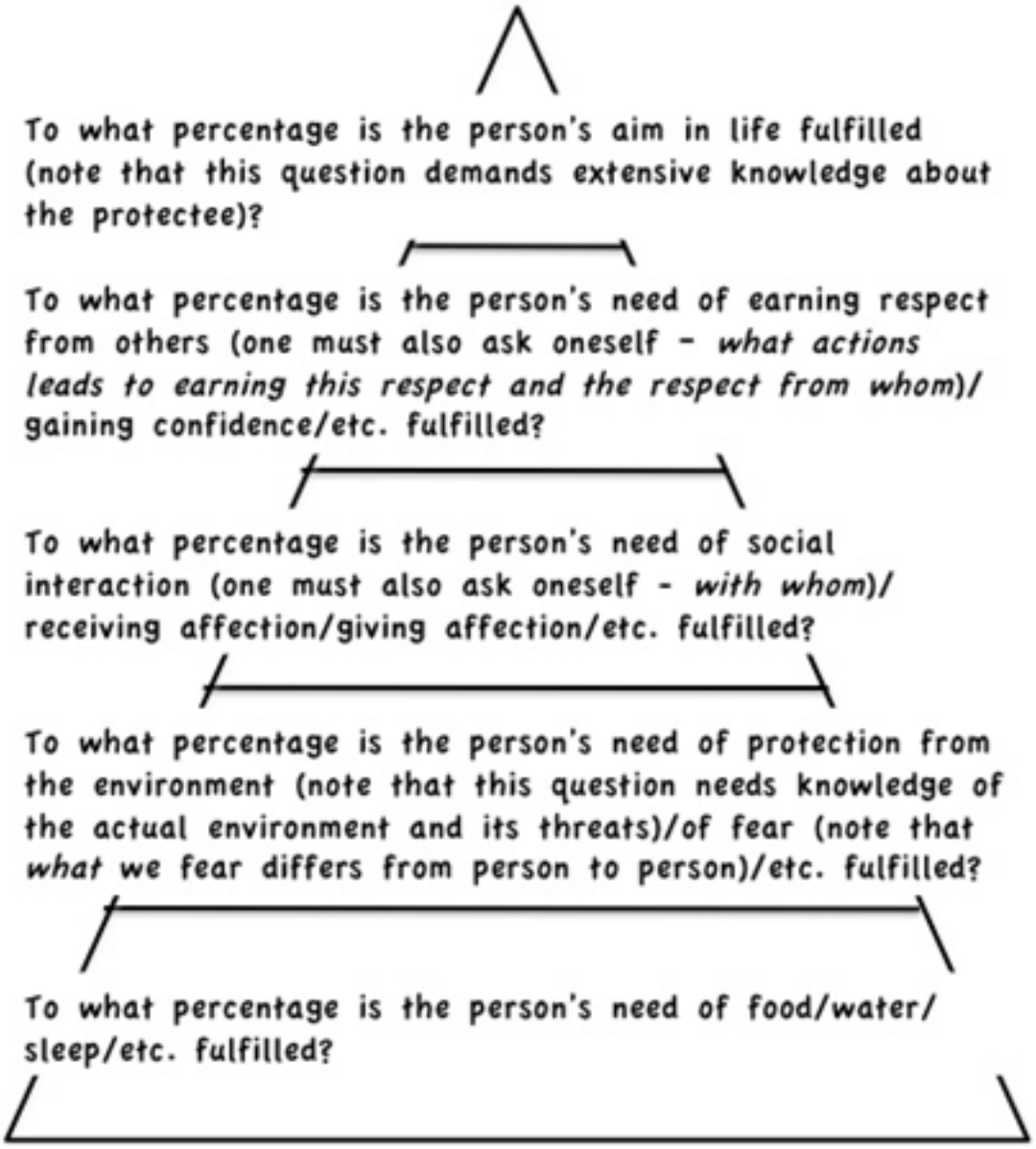

Figure 2 Examples of phrased questions developed from the human needs hierarchy, related to each level from a personal protective perspective. Lesser percentage (if a percentage scale is used) fulfilled means a lesser probability of achieving the next level and a larger probability of inconveniences.

you may use percentage as a way to measure a "fulfillment-value." This will make it more precise, but you could just as well phrase yes or no questions or use another kind of self-made scale.

What questions you use depends on what subject you are to analyze and your understanding both of organization and environment (both physical and structural). As you ascend the pyramid, you also need to know more and more about the object you are analyzing. Most often it is not possible to answer the questions related to the peak,

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[9] Andreas Poppius, "Personlig säkerhet" (lecture, Swedish civil contingencies agency, Swedish rescue team, Elite Hotel, Stockholm, September 24, 2013).

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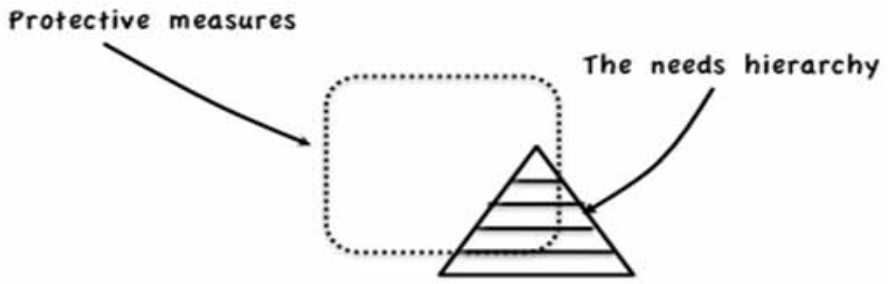

Figure 3 The protective measures related to the human needs hierarchy in an inefficient manner, which will force people to act outside the applied protection.

because you seldom have the opportunity to gain the knowledge in the depth needed.

After analyzing the answers, when you put your data into action, you must ensure an increase of the protectees "fulfillment-value." When handling the first steps, this could be rather easy (e.g. make sure everyone got water, food, and shelter), but continuing to the higher levels, it will start to be difficult (e.g. feel a sense of belonging, giving and receiving love and affection, and ability to do what one is fit to do). Start with the simple things and work your way up. Do not despair if you do not reach all the way to the top.

Let's say that you now have done that and there are no inconveniences at the moment. Suddenly, the environment changes (or the protectees move to another environment) and an unexpected threat occurs, a threat that definitely will especially affect the level-two questions. You act according to your profession and add extended protective measures to deal with the threat efficiently, which you do by containing the protectees. The threat can no longer affect the protectees, correct?

Well, here is a reappearing problem. Regardless if you work with the protection of VIPs or the protection of community citizens, you must ensure that the protectees' need-hierarchy fits *within* your protective measures (or that the measures fit *around* the protectees need-hierarchy, depending on your perspective).

No matter how brilliant the actions or reactions you take to deal with a threat, if the protectees cannot accomplish their needs protected from it, someone will eventually expose themselves to danger. Then imagine if your protectees cannot even fulfill their fundamental and basic needs (such as gain access to food or water) within the protective measures. Then they will be forced outside the protected area (Fig. 3).[10]

Time is here an important factor as well. Of course most people could accept difficulties fulfilling, for example, level four and five for a short time, but according to Maslow, not without knowing that it will end.[11]

Then, in order to gain impact of one's security and safety measures, one must place the protectees need inside the "perimeter" of the same (Fig. 4).[12] This might of course be expensive, since it demands quite a bit from the area concerned(geographical or organizational). Even so, doing the analysis will help you to better understand the given presumptions, and it will be easier to prioritize better know-

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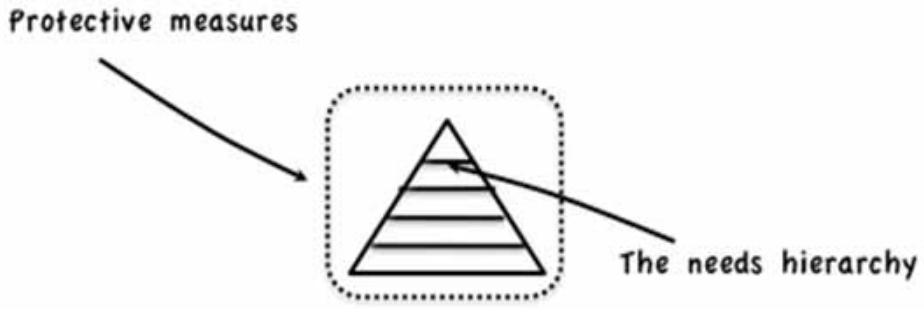

Figure 4 The protective measures related to the human needs hierarchy in an efficient manner—there is a lesser or no need to act outside of the organizational or physical security measures.

[10] Andreas Poppius, "Säkerhetsarbete i högriskmiljö" (lecture, ASIS Sweden, sub-section south recurrent sessions, The Bishops Arms, Malmö, June 18, 2013).
[11] Maslow, *Motivation and Personality*, 17.
[12] Poppius, "Säkerhetsarbete i högriskmiljö".

(Continued from Page 23)

ing the risks of making necessary exemptions.

Conclusions

Use phrased questions based on Maslow's human need hierarchy, either as a checklist for yourself or, preferably, working with others (especially the protectees).

Engaging the protectees (when possible) somewhere in the process, vouch for higher impact in the introduction of new security measures. If you cannot engage everyone, make a fair selection and work with some.

Always remember the risks attached to letting part of the need-hierarchy outside the "perimeter" of the physical or organizational security measures. Sometimes you have no choice – then start with the physiological needs and work your way up.

This model could be used for both single protectees as well as for societies. Remember however that the need-hierarchy is intended to explain behavior from a personal perspective and not a group. Not everything is applicable.

Strive to the top, but remember that it demands quite some knowledge of the protectees to get there.

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