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Community Resilience Workshop February 18-19, 2015

David R. Mizzen
Applied Research Associates, Inc.

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Community Resilience Workshop February 18-19, 2015

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By
David R. Mizzen
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- Laurie Johnson, Laurie Johnson Consulting
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Community Resilience Workshop
Hilton San Diego/Del Mar
Del Mar, CA

February 18-19, 2015

Meeting Summary

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List of Acronyms

Acronym	Definition
100RC	100 Resilient Cities
AAR	After Action Report
ACI	American Concrete Institute
AIA	American Institute of Architects
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
AWWA	American Water Works Association
BDC	Bassetlaw District Council
BIA	Business Impact Analysis
BOMA	Building Owners and Managers Association
BRIC	Baseline Resilience Indicators for Communities
CaLEAP	California Energy Assurance Planning
CARRI	Community and Regional Resilience Institute
CART	Communities Advancing Resilience Toolkit
CIP	Capital Improvement Plan
COLTs	Cell on Light Trucks
CRI	Coastal Community Resilience Index
CRS	Community Rating System
CSO	Community Service Organization
D2D	Device To Device
DOC EDA	Department of Commerce Economic Development Administration
DOE	Department of Energy
DOT	Department of Transportation
DRSP	Disaster Resilience Standards Panel
DRSPCC	Disaster Resilience Standards Panel Coordinating Committee
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EQ	Earthquake
FACA	Federal Advisory Committee Act
FEMA	Federal Emergency Management Agency
GETS	Government Emergency Telecommunications Service
HAZMAT	Hazardous Materials
HVAC	Heating, Ventilation, and Air Conditioning
IA	Iowa
ICC	International Code Council
ISAC	Information Sharing and Analysis Centers
ISO	International Organization for Standardization
LEED	Leadership in Energy & Environmental Design
LEPC	Local Emergency Planning Committee
LLC	Limited Liability Company
MAP-21	Moving Ahead for Progress in the 21 Century Act
MPO	Metropolitan Planning Organization
NACO	National Association of Counties
NAHB	National Association of Home Builders
NASA	National Aeronautics and Space Administration
NASEO	National Association of State Energy Officials
NCC	National Communications Center for Communications
NCCIC	National Cybersecurity & Communications Integration Center
NDRF	National Disaster Recovery Framework
NEMA	National Electric Manufacturers Association
NFIP	National Flood Insurance Program
NGA	National Governors Association
NHMP	Natural Hazard Mitigation Plan
NIBS	National Institute of Building Sciences

NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
ODU	Old Dominion University
OEWD	Office of Economic and Workforce Development
PII	Personally Identifiable Information
PPD-21	Presidential Policy Directive 21
PSAP	Public-Safety Answering Point
PTSD	Post-Traumatic Stress Disorder
RKB	Resilience Knowledge Base
ROI	Return on Investment
SCADA	Supervisory Control Data Acquisition
SPUR	San Francisco Planning and Urban Research Association
STP	Surface Transportation Program
TSP	Telecommunications Service Priority
TTE	Transport, Telecommunications and Energy
UN	United Nations
UNIDSR	United Nations International Strategy for Disaster Reduction
US	United States
USA	United States of America
WPS	Wireless Priority Service

1. Introduction

Presidential Policy Directive 21 defines resilience as the ability to "prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions."[1] Many communities have developed disaster response plans to prepare for disaster events. These disaster response plans help save lives, protect property, and limit economic damage. However, disaster resilience also includes determining vulnerabilities, improving performance of the built environment during a disaster event, and minimizing recovery times and economic losses.

Buildings and infrastructure systems (transportation, water, wastewater, energy and communications) play an important role in any community. Historically, buildings and infrastructure systems have been designed and treated as separate entities without much consideration for one another. However, recent events (e.g., Superstorm Sandy, Hurricane Katrina, and the Joplin Tornado) show that dependencies between buildings and infrastructure systems play a huge role in a community's ability to recover in both the short and long-term.

To address this problem, NIST leads a team to convene quarterly workshops in different regions of the country to inform development of a comprehensive, community-based Disaster Resilience Framework. The goal of the workshops is to engage a diverse group of stakeholders and obtain their input for developing the Framework. Version 1.0 of the Disaster Resilience Framework will provide a general Framework of codes, standards, available tools, and best practices to regional, state, local, and tribal authorities that they can use to plan for and support community resilience. NIST will convene a Disaster Resilience Standards Panel (DRSP) in 2015 to expand on and refine Version 1.0 of the Framework. The DRSP will also develop Model Resilience Guidelines to catalogue and disseminate best practices and the state-of-the-art in resilience.

NIST kicked off Framework development at the first stakeholder workshop, held at the NIST Gaithersburg, MD Campus, on April 27, 2014. NIST held the second workshop at the Stevens Institute of Technology in Hoboken, NJ on July 30, 2014. The third workshop occurred at the NCED Conference Center and Hotel in Norman, OK on October 27-28, 2014. The fourth workshop, summarized in this document, was held at the Hilton San Diego/Del Mar in Del Mar, CA. Between the third and fourth workshops, the original authors and new NIST Disaster Resilience Fellows collaborated to develop a 75% draft of the Disaster Resilience Framework, incorporating stakeholder input from previous workshops. The draft was posted to the NIST website for stakeholder review prior to the workshop.

This document summarizes content from the February 18-19 NIST Community Resilience Workshop and stakeholder input. The meeting agenda appears in Figure 1.

[1] PPD-21 (2013) Presidential Policy Directive/PPD-21, The White House, February 12, 2013. http://www.whitehouse.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil

DISASTER RESILIENCE WORKSHOP

SAN DIEGO, CA • 2.18–19.15

Community Resilience

NIST National Institute of Standards and Technology U.S. Department of Commerce

AGENDA

February 18, 2015

7:45 – 8:30 am	**Registration and Continental Breakfast** – *Salon C Foyer*
8:30 – 9:00 am	**Opening Session** – *Salon C* *Welcome and Introduction*
9:00 am – 10:15 am	**Plenary – Disaster Resilience Framework Overview** – *Salon C* 9:00 Introduction/Executive Summary 9:15 Social Institutions and Links to the Built Environment 9:30 Community Disaster Resilience for the Built Environment 9:45 Interdependencies 10:00 Tools and Metrics
10:15 – 10:30 am	**Break**
10:30 am – 12:15 pm	**Disaster Resilience Framework Overview** *continued* – *Salon C* 10:30 Buildings 10:45 Transportation 11:00 Energy 11:15 Communication 11:30 Water 11:45 Discussion
12:15 – 1:15 pm	**Lunch** – *Upper and Lower Courtyards*
1:15 – 2:15 pm	**Plenary Speaker: Laurie Johnson, Laurie Johnson Consulting** – *Salon C* *Foundational Elements of Community Disaster Resilience, Pre- and Post-Disaster*
2:15 -2:30 pm	**Transition to Breakouts**
2:30 – 5:00 pm	**Breakout 1: Framework and DRSP** Community Resilience – *Equestrian* Buildings – *Salon E* Transportation – *Salon A* Power and Energy Systems – *Salon B* Water and Wastewater Systems – *Salon D* Communications – *Salon F* Social Aspects of Resilience – *Steeple Chase II* Resilience Metrics – *Steeple Chase I* Disaster Resilience Standards Panel Planning – *Triple Crown*
5:00 pm	**Adjourn**

February 19, 2015

7:15 – 8:00 am	**Continental Breakfast** – *Salon C Foyer*
8:00 – 8:30 am	**Award Announcement of NIST Community Resilience Center of Excellence** – *Salon C*
8:30 – 10:00 am	**Plenary – Planning and Implementation for Community Resilience** – *Salon C* **Greg Guibert**, *Chief Resilience Officer, City of Boulder, CO* **Emily Steinhilber**, *Assistant Director of Coastal Resilience Research, Old Dominion University* **Jay Wilson**, *Clackamas County Resilience Coordinator, Clackamas County Emergency Management, Oregon* **Lucile Jones**, *Science Advisor for Risk Reduction in the Natural Hazards Mission, US Geological Survey* **Patrick Otellini**, *Chief Resilience Officer, San Francisco, CA*
10:00 – 10:15 am	**Break**
10:15 am – 12:00 pm	**Breakout 2: Planning and Implementation** Community Resilience – *Equestrian* Buildings – *Salon E* Transportation – *Salon A* Power and Energy Systems – *Salon B* Water and Wastewater Systems – *Salon D* Communications – *Salon F* Social Aspects of Resilience – *Steeple Chase II* Resilience Metrics – *Steeple Chase I* Disaster Resilience Standards Panel Planning – *Triple Crown*
12:00 – 1:00 pm	**Lunch** – *Upper and Lower Courtyards*
1:00 – 2:15 pm	**Final Report Out and Wrap up** – *Salon C*

For attendees that did not pay for catering, lunch is available in the Hotel restaurant. Please note, coffee and snacks are only for attendees who have paid for catering.

Figure 1. Agenda for February 18-19th NIST Community Resilience Workshop

2. Opening Session – February 18, 2015

The Opening Session for the Fourth Stakeholder Workshop of the NIST Community Resilience Program convened at 8:30 a.m. Mr. Stephen Cauffman (NIST) delivered introductory remarks and welcomed participants. Mr. Cauffman introduced Dr. Howard Harary, NIST Director of the Engineering Laboratory, where this resilience program is housed.

Summary of Dr. Harary's Remarks

[The prepared text of Dr. Harary's comments is located on the NIST.gov website.]

Southern California is an appropriate location for our fourth stakeholder workshop on Community Resilience because it is vulnerable to a variety of hazard types. Last year (2014), wildfires impacted Southern California and Washington, and Napa was impacted by an earthquake. Overall, there were 45 major disaster declarations last year, marking the first year since 2002 with fewer than 50 disaster declarations.

However, since 2002, the country has been affected by seven of the ten most costly disasters in history, including Hurricanes Katrina and Sandy. With climate change becoming a factor, it is anticipated that coastal flooding, droughts, and more intense storms will become more prevalent. Therefore, achieving disaster resilience should be a top priority for the nation, states, businesses, citizens, and communities. Communities, in particular, are impacted by disasters. Communities have a responsibility to become more proactive to better withstand hazard events such that they do not become disaster events.

To provide guidance to communities, NIST has undertaken this effort to develop a Disaster Resilience Framework. Our goal is to reduce the impacts of hazard events on our society and economy by enhancing the resilience of buildings and infrastructure systems in communities. To achieve this, we need to start thinking about the dependencies between infrastructure systems and buildings. We also need to recognize that the built environment supports the economic and social dimensions of a community.

Providing guidance to communities to make resilience an integral part of their long-term planning will help limit disruption in future hazard events, make communities more attractive places to live, and make them more desirable to businesses and industry.

The Federal Government has many programs related to resilience. For example, the Department of Commerce made resilience a part of its strategic plan. The NIST resilience program contributes to efforts by multiple government agencies to prepare the nation for the effects of climate change, as documented in the President's Action Plan.[2]

Framework development to date has benefitted greatly from input collected at previous workshops. Since our last workshop (October 2014), we added nine Disaster Resilience Fellows to our team. These fellows have contributed substantially to Framework development. This is the last workshop where we will collect and integrate input into the complete draft for public comment to be released in April. However, our stakeholder engagement efforts will continue through formation of the Disaster Resilience Standards Panel (DRSP), which will be composed of a broad cross-section of stakeholders. The DRSP will continue to advance the Framework, which will be a living document, and develop Model Resilience Guidelines to support Framework implementation.

NIST has also begun a research effort to develop tools to measure resilience at the community level. These tools will account for the interconnected nature of buildings, infrastructure systems, and the social systems they support. Furthermore, the NIST Applied Economics Office is working on an economic-based, decision-support tool to aid in decision-making with the Framework.

Before introducing the 75% draft of the Framework, Mr. Cauffman provided an overview of NIST's Community Resilience Program.

[2] Executive Office of the President, The White House. The President's Climate Action Plan. June 2013.

Summary of Mr. Cauffman's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Natural and human-caused disasters produce average losses of $57B annually. However, large events generate higher losses by themselves. For example, Hurricane Sandy alone generated over $65B in losses. Our response and rebuilding approach is impractical for dealing with natural disasters. Current planning does not account for the interconnected nature of buildings and infrastructure systems, or the social institutions they support. Furthermore, plans frequently neglect climate change.

From 2000 to 2011 there were between 45 and 81 Presidential Disaster Declarations annually. This slide [slide 3] shows our country is exposed to a wide variety of hazard types. Almost all regions of the country have had at least one Presidential Disaster Declaration.

For this Framework, we use the Presidential Policy Directive 21 (PPD-21) definition of resilience: "resilience" means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Community resilience includes implementing measures to ensure the community recovers to normal in a reasonably short timeframe.

A community's social needs drive the functional requirements of buildings and infrastructure systems [slide 5]. Since buildings and infrastructure systems are often damaged by hazard events, the community's social and economic sectors are also impacted. A number of hazards can impact the built environment, including natural hazards, human-caused hazards, degradation of infrastructure, and climate change [slide 6]. Although the Framework does not explicitly address all these factors (e.g., degradation and climate change), communities should recognize these considerations. To counteract these hazards, we can establish performance goals and take steps to limit the recovery time of our built environment through mitigation, response, and recovery strategies.

Two aspects of the Framework that are essential to consider when planning for resilience are functionality and dependencies. As previously discussed, buildings and infrastructure system functionality is essential to enable social systems to provide continued service. Thus, to become resilient, communities need to consider dependencies between buildings and infrastructure systems, as well as the relationship of individuals and organizations with the built environment.

In the Framework we provide three hazard levels: Routine, Expected (i.e., design level), and Extreme.

We define the proposed performance goals in terms of time to recover functionality of buildings and infrastructure systems after a hazard event. Performance goals are defined in terms of specific timeframes, categorized as short-term (days), intermediate (weeks), and long-term (months).

This is our fourth stakeholder workshop. Our first workshop (April 2014 at the NIST Gaithersburg, MD campus) served as a kick-off meeting. At the second meeting (Hoboken, NJ, July 2014) we collected feedback on the 25% draft of the Framework, which was posted to the NIST website about one week before the workshop. At the third workshop (Norman, OK, October 2014) we collected input on the 50% draft. We will release the 100% draft for public comment at the April 27, 2015 workshop at Texas Southern University in Houston, TX.

During this workshop, we will collect feedback on the 75% draft of the Framework. Nine breakout sessions will discuss the chapters for Social Aspects of Resilience, Community Resilience, Buildings, Transportation Systems, Power and Energy Systems, Communication Systems, Water and Wastewater Systems, and Resilience Metrics. A breakout session will also discuss the Disaster Resilience Standards Panel and develop its charter. Our goals are to acquire input from stakeholders for inclusion in the 100% draft, engage you as stakeholders to provide continued input, and develop interest for membership in the DRSP.

You may contact me via email (stephan.cauffman@nist.gov or resilience@nist.gov) or phone (301-975-6051). We will also update our website regularly. The website provides a lot of useful information for this program (http://www.nist.gov/el/building_materials/resilience/).

3. Disaster Resilience Framework Overview – February 18, 2015

After the overview of the NIST Community Resilience Program, chapter leads discussed the high level chapters of the 75% draft Framework:

- Dr. Therese McAllister, NIST – Executive Summary and Chapter 1: Introduction
- Dr. Erica Kuligowski, NIST – Chapter 2: The Social Context for Community Resilience
- Mr. Chris Poland, Consulting Engineer – Chapter 3: Community Disaster Resilience for the Built Environment
- Dr. Kent Yu, SEFT Consulting Group – Chapter 4: Dependencies and Cascading Effects
- Dr. Frank Lavelle, Applied Research Associates – Chapter 10: Community Resilience Metrics

Summary of Dr. McAllister's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Communities have a large number of issues, polices, and regulations to address, each of which requires time and resources to resolve. Unfortunately, low probability-high consequence hazard events are often a low priority unless a community has recently been impacted by such an event. Resilience planning enables communities to recover rapidly after a hazard event and improve the built environment.

Cedar Rapids, Iowa is a good example of a community that implemented long-term planning to become more resilient. Cedar Rapids is vulnerable to multiple hazards, including flooding and tornadoes. Because the town is downstream from a Nuclear Power Plant, they developed evacuation plans in case a hazard event occurred at the plant. When Cedar Rapids experienced 31 feet of flooding in 2008, above the 500-year flood level, they used their evacuation plan to move all residents to safety, ensuring no loss of life. However, the community took another step forward after the flood and developed a recovery and reinvestment plan. The plan's three main focus areas were: 1) Improve flood protection; 2) Reinvest in housing, neighborhoods, and businesses to make the area more attractive; 3) Rebuild better such that construction is flood resistant and sustainable.

Community resilience relies on a governance structure for direction and services, and a built environment that supports the social institutions. Community resilience is a long-term goal and planning process. However, emergency and interim solutions can be implemented if a hazard event occurs tomorrow. To achieve community resilience, we need to envision a better outcome, understand the community, develop a resilience plan, and initiate implementation of the plan.

Communities have many types of capital (i.e., financial, built, political, social, human, cultural, and natural).[3] Our Framework focuses on the built capital of communities such that it supports other capitals.

For this Framework, the built environment includes buildings, facilities, and physical infrastructure for power, communication, transportation, water, and wastewater systems. The Framework addresses the performance of these systems and how they support the community's social functions. Communities can improve the performance of their buildings and infrastructure systems by taking action both before and after a hazard event. Before an event occurs, communities act to improve performance through planning, preparedness, mitigation, design, and construction. Post-disaster, communities can use emergency response, reconstruction, and relocation to recover functionality.

Many other national programs focus on resilience. Federal Emergency Management Agency (FEMA) mitigation plans are developed by communities to obtain grants for the purpose of mitigating against hazard events. FEMA develop the National Preparedness Goal in 2011, which identified roles and

[3] Flora, C.B, M. Emery, S. Fey, C. Bregendahl (2008) Community Capitals: A Tool for Evaluating Strategic Interventions and Projects. Pp. 1186-1187 in Goreham ed., *Encyclopedia of Rural America: The Land and People*. Millerton, N.Y.: Grey House Publishing.

responsibilities of local, state, and federal programs through frameworks for prevention, protection, mitigation, response, and recovery.[4] The NIST Disaster Resilience Framework prioritizes development and recovery of the built environment such that it supports the community's social needs.

The concept of resilience [slide 8] is to maintain acceptable levels of functionality during and after disruptive events, and recovery full functionality within a reasonable timeframe. Making improvements to buildings and infrastructure systems ahead of a hazard event reduces loss of functionality after an event, allowing more rapid recovery. We also encourage building to a higher standard such that future events do not cause the same level of disruption.

Achieving resilience does not have to be expensive. Plans can be completed and implemented over a long time period to help allocate resources appropriately. Each community is different and will, thus, have its own challenges, solutions, and plans. Our Framework defines steps to help communities develop their own resilience plans: 1) Establish a Core Resilience Team; 2) Characterize the Social Community; 3) Characterize the Built Community; 4) Develop Community Resilience Plan; 5) Implement Non-Construction Strategies; 6) Implement Construction Strategies.

In the breakout groups, we would like to hear your ideas on how to improve the Executive Summary. We will work to convey a clear understanding of the Framework goals, benefits of its use, and actions required to achieve resilience. We would also like to hear how to encourage your community to use the Framework.

Summary of Dr. Kuligowski's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 2 of the Framework discusses the social context for community resilience. The social and economic functions of a community drive the requirements for performance of the built environment. Hazard events can damage the built environment, disrupting social and economic functions within the community. Therefore, it is important to understand the social aspects of a community as plans are made for the built environment.

Disaster resilience planning occurs at many different levels (national, regional, state, community, neighborhood, and individual/family). Our Framework focuses on what can be done at the community level [slide 3]. In Chapter 2, we describe social needs using Maslow's hierarchy.[5] The four stages are survival (i.e., the most basic needs such as food, water, and shelter), safety and security (e.g., stability, employment, and health), belonging (e.g., family, friends, neighborhood), and growth and achievement.

Social institutions vary by community. Social institutions that commonly exist in communities include family and kinship, economic, government, healthcare, education, Community Service Organizations (CSOs) religious/other belief systems, and media. Communities should: 1) Understand which social institutions are present; 2) Understand the social institutions' functions; and 3) Understand what is needed for them to function.

For example, healthcare serves communities in several ways (e.g., treatment for injuries and illness, jobs for workers, functioning information systems, etc.). Communities have different types of health services that meet the needs of survival and safety & security from Maslow's Hierarchy.

Similarly, CSOs also serve communities in multiple ways (e.g., assisting people in meeting basic needs, providing emotional & mental health support, and enhancing the quality of life). There are also many different types of CSOs (e.g., civic, social and recreational clubs, senior citizen associations, and youth programs). CSOs are very important to consider because they help communities meet all four of the needs discussed in Maslow's Hierarchy.

[4] NPG (2015) National Preparedness Goal, FEMA, February 6, 2015, https://www.fema.gov/national-preparedness-goal.
[5] Maslow, A.H. 1943. A Theory of Human Motivation. Psychological Review 50 (4) 370–96.

As previously discussed, the social aspects of a community depend on the performance of the built environment. However, social institutions also depend on one another. For example, the government depends on the functionality of the economic sector to collect taxes (e.g., sales taxes). Family/kinship depends on a number of social institutions (e.g., healthcare, education, economic, government, media) because these institutions supply jobs so people can provide security for their families.

To help identify the needs of the built environment, community members need to first understand their community by determining its needs and identifying the social institutions (the services they provide, the needs [of Maslow's Hierarchy] they meet, and how they rely on one another). Once it identifies the needs of the social institutions, the community can link those needs to the built environment. As an example, Chapter 2 contains example tables [slides 10-11] to show example links between the built environment and the social institutions. Communities can use these tables to document the purpose the infrastructure systems serve to a given social institution [slide 10], and how the infrastructure system meets that purpose [slide 11].

Many other considerations are also important for communities during planning. Social vulnerabilities, learning from other communities, and engaging with both community decision-makers and those key to implementing the Framework are all important in planning for communities to become more resilient.

In the breakout sessions, we would like feedback from participants on the organization of Chapter 2, the social institutions and their function(s), dependencies between the social institutions, links to the built environment, and examples from communities that have successfully set priorities and engaged the public in their planning processes.

Summary of Mr. Poland's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 3 outlines the process that can be used by communities to incorporate resilience into their long-term planning. References to individual buildings in the chapter are to structures, including their equipment and contents that house people and support the social institutions. We define building clusters as "groups of buildings that serve a common function, such as housing, healthcare, retail, etc." Infrastructure systems are "physical networks, systems and structures that support community social institutions including transportation, energy, communications, water, and wastewater."

In terms of recovery, communities should think about the time required to restore the functionality of buildings and infrastructure systems. That is, how quickly do we need to restore functionality of a building cluster and its supporting infrastructure systems. The National Disaster Recovery Framework (NDRF) defines three timeframes for recovery [slide 3] that we use to categorize our recovery times in three phases: short, intermediate, and long-term. [6]

In the *short-term* the community's focus is likely on making sure it is secure and stable, performing rescue operations, and clearing transportations routes. To achieve this, building clusters, such as critical facilities, emergency housing and their related infrastructure systems, need to be functional. In the *intermediate-term*, focus shifts to restoring neighborhoods and meeting social needs. Communities need to ensure many building clusters (e.g., housing, healthcare, main street, schools, churches, and related infrastructure systems) are functional. In the *long-term*, the goal of communities should be to achieve social and economic recovery. To achieve this, building clusters for commercial and industrial businesses, and supporting infrastructure systems need to be functional.

The Framework discusses a process to plan for resilience [slide 5]. First, communities establish their performance goals regardless of the type of event. Then, communities begin to look at the hazards and the

[6] FEMA (2013). *National Disaster Recovery Framework.* Federal Emergency Management Agency, Washington DC.

performance anticipated for those hazards. Specifically, a community should identify its prevailing hazards, define their building and system clusters, and select a hazard type, level, and intensity. For a specific hazard type and event, the community determines the anticipated performance of building clusters and infrastructure systems using the existing conditions and completes a summary matrix to understand the dependencies between the systems at a higher-level. The community can then repeat this process for each hazard level and type, as necessary, before developing and implementing strategies to make its buildings and infrastructure more resilient.

Every community is different and must identify the hazards it faces, whether wind, earthquake, flood, fire, snow, rain, or human-caused events. The Framework defines three levels of hazard: 1) Routine (events that occur frequently); 2) Expected (design level used for buildings); and 3) Extreme (maximum considered possible). The hazard intensity includes the anticipated affected area (local, community, or regional) and disruption level (minor, moderate, or severe). The affected area and disruption level are important because they help a community understand where it can and cannot obtain mutual aid and additional resources.

Buildings are not designed with functionality in mind. When evaluating the performance of buildings in terms of functionality, we discuss four categories: 1) Operational; 2) Safe and usable during repair; 3) Safe, but not usable; and 4) Collapse. As previously discussed, we can think about recovery in three phases: 1) short (days); 2) intermediate (weeks); and 3) long-term (months).

In the Framework, we define performance goals as 30%, 60%, and 90%. The goals indicate the percentage of cluster functionality required to initiate assigned activities (30%), initiate usual operations (60%), and operate at normal capacity (90%).

For infrastructure systems, we define three levels of functionality: I) 90% service provided within days, 100% within weeks; II) 90% service within weeks and 100% within months; III) 90% service within months and 100% within years. Again the percentage available (i.e., performance goals) indicates the operational functionality of the infrastructure system.

Using the Centerville example in the Framework, we complete the performance goals for each building cluster and infrastructure system. We then present results in a summary matrix [slide 10]. For a routine event, with a localized affected area, and minor disruption, the differences between the goals (90% boxes) and anticipated performance (Xs) are small [slide 10]. For the expected event with "community" selected as the affected area and a moderate disruption level, differences between the goals and anticipated performance become larger [slide 11]. These large gaps indicate a lot of room for improvement, particularly for buildings, water, and wastewater. For the extreme event, where the affected area would be regional and the disruption level is severe, gaps between the goals and anticipated performance remain large [slide 12]. This indicates that recovery planning and strategies should be considered to help reduce recovery time when planning for this type of event.

In the breakout session, we would like input on the pathway to resilience process we discussed to ensure it is complete and feasible. Furthermore, we would like to hear about experiences where similar plans have been developed and implemented. And finally, we would like to know how you see resilience strategies being integrated into existing community planning efforts.

Summary of Dr. Yu's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Communities should consider dependencies between buildings and infrastructure systems and the potential for cascading effects when developing resilience plans. Dependencies between physical systems add another dimension of complexity to disaster recovery. To restore water service, liquid fuel supply, and other important services, you need electric power. However, to restore electric power, repair crews need access to roads. And to use those roads, repair crews need access to liquid fuel.

Understanding dependencies within an infrastructure system (internal dependencies) and between systems (external dependencies), as seen in the 2003 Northeast blackout, is important in planning. Within the electric power system (internal dependency), an electricity generating plant went offline during a period of high demand. The loss of the generating plant put greater strain on nearby high-voltage power lines, which caused the first lines to come into contact with overgrown trees and trip relays. Unfortunately, a bug in the software that alerted the operators delayed the operators' response to address failures by over an hour. Consequently, load transferred to other transmission lines, causing more trip relays. More than 200 power plants were forced to shut down because the transmission grid was down, ultimately leading to a blackout that impacted approximately 50 million people in the Northeast US and Canada.

Failure of the electric power system then caused failures in other systems [slide 2]. The loss of electric energy trapped hundreds of people in elevators; and all trains into/out of New York were shut down. The failure also prevented gas stations from pumping liquid fuel. Cell towers lost functionality because battery life expired; and generators ran out of fuel during the extended outage. Finally, the loss of electricity caused US broadcast networks to shut down and water pumps not to function.

There are many types of dependencies to consider: internal and external, time, space, and source. As discussed in the example, internal dependencies are those within an infrastructure system, including equipment, supplies, and operations centers.

External dependencies (i.e., dependencies on other infrastructure systems) are also important to consider so you are aware of how other failures will impact your system and what other systems will be impacted by failures of your own system.

The time dimension in recovery is also important because dependencies are likely to change from one recovery phase (short, intermediate, long) to another.

Achieving performance goals [slide 6] is influenced by the external dependencies as well as the prioritization of needs of the community.

The space dimension (i.e., geographic dependency) is another important consideration that is influenced by the type of hazard a community faces. For example, if a community faces a localized hazard event such as a tornado or tsunami, neighboring communities may be able to provide aid. However, when an event impacts a region, such as a hurricane or earthquake, mutual aid and supplies must come from much further away. In addition, the space dimension also involves the co-location of infrastructure systems. Many infrastructure systems (communications, power, water, wastewater), for example, have dependencies on roadways and bridges since they are within the right-of-way of roads.

Source dependencies are also a concern. For example, the liquid fuel farm in Portland, Oregon relies on pipelines and pump stations that deliver fuel from Washington State.

Overall, dependencies are complex and should be considered in resilience planning. Communities should develop strategies to reduce the impacts of cascading effects of dependencies.

Summary of Dr. Lavelle's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 10 of the Framework is the last of the higher-level chapters of the Framework. When considering metrics, each community needs to understand how resilient it is and determine whether its efforts will make a significant difference. Communities need metrics to assess planning decisions they make with respect to improving the built environment. These metrics can address a number of factors including siting, design, construction, operation, maintenance, protection, and repair and restoration.

There are three primary types of metrics: recovery times, economic vitality, and social well-being. Recovery times in the Framework (i.e., performance goals) are easy to understand, but can be difficult to confidently predict. Recovery times can be estimated based on past experience, expert judgment,

modeling, or some combination of these methods. As discussed earlier, the recovery times of the built environment directly impact both the economic vitality and social well-being of the community.

Economic vitality can be measured in a number of ways, including a community's ability to attract and retain businesses and jobs, maintain and grow the tax base, reduce poverty, provide services/amenities, and maintain a vibrant and thriving economy.

Social well-being is often measured as the ability of a community to meet its needs, such as those outlined in Maslow's Hierarchy (see the discussion of Chapter 2 – survival, safety and security, sense of belonging, growth and achievement).

The Framework discusses many existing methodologies , including the San Francisco Planning and Urban Research Association (SPUR) Framework,[7] Oregon Resilience Plan,[8] United Nations International Strategy for Disaster Reduction (UNISDR) Disaster Resilience Scorecard,[9] Community and Regional Resilience Institute (CARRI) Community Resilience System,[10] Communities Advancing Resilience Toolkit (CART),[11] Baseline Resilience Indicators for Communities (BRIC),[12] Rockefeller City Resilience Framework,[13] National Oceanic and Atmospheric Administration (NOAA) Coastal Community Resilience Index (CRI),[14] and FEMA Hazus methodology.[15]

In a parallel project, we are analyzing these methodologies. In the analysis, we are rating the scope of the tool (i.e., what it addresses and its flexibility), its utility (i.e., ease of use), the impacts it measures, the techniques it uses, and its scientific merit.

In the breakout sessions, we hope to learn about other available metrics and their purpose(s). We would also like input on Chapter 10 of the Framework and to understand some of the foreseen challenges with using/developing metrics to measure resilience.

After discussion of the higher-level chapters was complete, chapter leads discussed the building and infrastructure system chapters:

- Mr. Robert Pekelnicky, Degenkolb Engineers – Chapter 5: Buildings
- Mr. Theodore Zoli, HNTB – Chapter 6: Transportation Systems
- Mr. Scott Tezak, TRC Solutions, and Mr. Stuart McCafferty, GridIntelltect – Chapter 7: Energy Systems

[7] SPUR (2009). The Resilient City: What San Francisco Needs from its Seismic Mitigation Policies, San Francisco Planning and Urban Research Association. San Francisco, CA.

[8] OSSPAC (2013). The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Oregon Seismic Safety Policy Advisory Commission Salem, OR.

[9] UNISDR (2014) Disaster Resilience Scorecard for Cities, Based on the "Ten Essentials" defined by the United Nations International Strategy for Disaster Risk Reduction (UNISDR) for Making Cities Resilient, Developed for UNISDR by IBM and AECOM, Version 1.5, March 10, 2014, http://www.unisdr.org/2014/campaign-cities/Resilience%20Scorecard%20V1.5.pdf.

[10] CARRI (2013) Community and Regional Resilience Institute, Community Resilience System, http://www.resilientus.org/recent-work/community-resilience-system, http://www.resilientus.org/wp-content/uploads/2013/05/CRS-Final-Report.pdf.

[11] Pfefferbaum, R. et al (2013) The Communities Advancing Resilience Toolkit (CART): An Intervention to Build Community Resilience to Disasters, Journal of Public Health Management & Practice: May/June 2013 - Volume 19 - Issue 3 - p 250–258, doi: 10.1097/PHH.0b013e318268aed8.

[12] Cutter, S. L., K. D. Ash, and C. T. Emrich (2014). The geographies of community disaster resilience, *Global Environmental Change*, 29:65-77.

[13] Rockefeller (2014) City Resilience Framework, The Rockefeller Foundation, http://www.rockefellerfoundation.org/uploads/files/0bb537c0-d872-467f-9470-b20f57c32488.pdf.

[14] NOAA (2010) Coastal Resilience Index: A Community Self-Assessment, http://masgc.org/assets/uploads/publications/662/coastalcommunity_resilience_index.pdf.

[15] FEMA (2012). Hazus-MH 2.1 User Manual. Washington, D.C.: Federal Emergency Management Agency.

- Mr. David Mizzen, Applied Research Associates – Chapter 8: Communication and Information Systems
- Mr. Donald Ballantyne, Ballantyne Consulting – Chapter 9: Water and Wastewater Systems

Summary of Mr. Pekelnicky's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 5 of the Framework focuses on buildings. Buildings include a broad scope of uses and occupancies. In many cases, building codes and standards are used with life-safety in mind (e.g., seismic standards); however, current codes and standards do not focus on building functionality. Thus, buildings may be safe after a hazard event, but "safe" does not always mean "usable."

The performance goals table for an expected event for buildings is shown in slide 3. For those of you familiar with the SPUR Framework, the idea of performance goals is not new. Performance goals for the building clusters in Centerville, USA show large gaps that need to be addressed. The building clusters fall under different functional categories, which impacts desired recovery times. For example, building clusters under the critical facilities functional category need to be functional in the short-term, immediately after a hazard occurs. However, building clusters in the housing and community recovery functional categories are needed in the intermediate recovery phase.

As previously discussed, we use a different method of categorizing buildings in the Framework. The four categories are: A) Safe and operational; B) Safe and usable during repair; C) Safe and not usable; and D) Unsafe. As many of the other chapters discuss, considering dependencies is important in resilience planning. For buildings, water and power are critical dependencies. Also, for most buildings to be useful, workers need to enter the building. You should also consider adjacent buildings because they can impact the structural integrity of your building (e.g., the adjacent building may collapse onto your building), or prevent people from accessing your building (e.g., if the building collapses onto the roadway).

New/future buildings can use the most up-to-date codes/standards. It is easier to change standards for new buildings than requirements for existing buildings. The challenge is that current codes and standards do not address every hazard type or functionality, and many other codes (architectural, mechanical, and structural) are not aligned with one another.

As we increase our knowledge of how to improve building performance, codes and standards constantly evolve and change. Existing buildings may be more vulnerable to damage because they do readily not benefit from the increased knowledge. Retrofitting is not always the best solution because it can be expensive and disrupt the building's functionality.

There are strategies to improve performance of existing buildings. For example, communities can establish their needs and plan based on the hazard(s) they face, and maintain back-up water and power supply such that they do not rely solely on the power grid and water utility. Furthermore, it is important to prioritize what buildings are most critical to the community, and maintain a balance of mandatory and voluntary upgrades to buildings.

In the breakout sessions, we would like to learn about your experience with vulnerabilities that could impact resilience. We would also like feedback on Chapter 5 to understand whether we overlooked any elements of the building sector, how to best address dependences, and what strategies can be used to achieve resilience of the buildings sector.

Summary of Mr. Zoli's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 6 focuses on transportation systems. Transportation is critical to communities both on a daily basis and in disaster recovery. Transportation is very complex because it includes multiple systems (roadways, rail, airports, harbors, ports, waterways, and pipelines). In fact, people and businesses rely on

many of these systems daily to get to/from work and transport goods. In addition, transportation is vital for evacuation and for accessing critical facilities. The performance of a community's transportation system will directly impact its ability to recover.

Transportation systems enable access for emergency responders and repair crews for other infrastructure systems. Transportation also allows access to shelters, healthcare facilities, banks, and grocery stores. Also, individual transportation systems have many dependencies on other transportation systems (e.g., rail impacts trucking) and other infrastructure systems. The increased intermodal transportation also is an important consideration, particularly in large urban centers.

Roads, bridges, highways, and tunnels are the main transportation system communities think about. The loss of a key transportation system component (e.g., bridge) can negatively impact a community's recovery. However, the type of failure will impact the amount of time it takes to recover. For example, debris or snow removal from roads does not take long. In contrast, replacing a bridge can take a very long time if a failure occurs.

Subways, freight, and commuter rail are all different systems. Freight rail, often privately owned, has become smaller over the past century, resulting in limited redundancy in the system. It is important to recognize that rail can impact multiple communities if disruptions occur. The dependencies chapter called this the source dependency in its discussion.

Air infrastructure systems are very sensitive to more routine events, such as bad weather. Airports are important, along with other elements, such as the rolling stock (i.e., airplanes), because these all need to be functional for the system to be operational.

When considering movement of goods and people, waterways are efficient systems. Inland waterways, for example, can be used to move massive amounts of goods. Thus, loss of an inland waterway can also result in a huge disruption to the transport of goods, which could impact a large portion of the country, rather than a single community.

Pipelines transport natural gas, crude oil, gasoline, and other products that are not moved by truck, airplane or barge.

When establishing performance goals, it is important to include the appropriate stakeholders – transportation users, owner/operators, and others in the community who depend on the transportation system (e.g., power, communication, water, and wastewater representatives). It is also important to prioritize the elements of the transportation infrastructure system. These can be broken down into elements needed in the short, intermediate, and long-term recovery phases [slide 12]. As discussed in previous presentations, performance goals can also be set for the elements of the transportation system [slides 13-15] for the routine, expected, and extreme events.

In the breakout groups, we would like feedback on the Framework methodology, identifying and managing dependencies, and how to integrate use of the Framework into community planning.

Summary of Mr. Tezak and Mr. McCafferty's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 7 focuses on energy systems. Energy/power systems are at the forefront of the resilience discussion. The energy industry is currently undertaking many large efforts that support resilience, such as projects to improve reliability and energy assurance projects. When considering the performance of energy systems, people tend to think about electric power. However, liquid fuel, natural gas, and emergency/standby power are also important aspects of the industry.

Performance goals can be completed to understand the performance of the various elements of the energy system. However, it is important to recognize that failure of some elements will cause failures in other parts of the system.

The regulatory environment presents challenges that need to be considered when implementing a resilience plan.

The four R's of resilience are **R**obustness, **R**edundancy, **R**esourcefulness, and **R**apidity. Robustness is the ability to withstand external demands without degradation or loss of functionality. Redundancy provides alternate ways to maintain functionality when the system is under stress (Smart grid technologies have added redundancy to systems). Resourcefulness is the capacity to mobilize resources when a disruptive event occurs. Rapidity, which is extremely important in the energy industry, is the ability to restore functionality quickly when disruptions occur.

When considering the electric power system, the key elements are generation, transmission, and distribution. All elements have vulnerabilities to multiple types of hazards. There are many different views of how the energy system should perform in a hazard event, and getting community stakeholders on the same page is important. Furthermore, there are disparate definitions of hazard levels and performance expectations. Therefore, looking at the energy system at the community level has the potential to make improvements in understanding the system and anticipating its performance.

Slide 5 shows part of the performance goals table for the electric energy system. The generation and transmission components are quite robust and anticipated to perform well for an expected hazard event. However, it is important to recognize that if distribution to critical facilities is not functional, the performance of the generation and transmissions systems cannot compensate.

A number of external considerations need to be accounted for when planning for resilience (the regulatory environment, codes and standards for existing older facilities, existing newer facilities, and new construction, and non-construction issues such as vegetation management).

Emerging technologies in the energy industry may make energy systems more resilient (e.g., smart grid technologies such as addition of communications-enabled situational awareness) when hazard events occur. Furthermore, automating distribution and substations, and energy storage can enhance resilience of energy systems. Microgrids can be connected to the grid or be isolated while remaining functional, which allows facilities to remain operational.

Many implementation strategies that resulted from large investments in modernizing and improving energy systems can be used to improve resilience. The California Energy Assurance Planning (CaLEAP) program offers a methodology for how to plan and respond to disasters.[16] The Department of Energy (DOE) has an energy assurance program that provides guidelines. The National Association of State Energy Officials (NASEO) also gives guidelines for becoming more resilient at the state level.[17]

The NIST Framework focuses on resilience at the community level and considers a variety of domains, including energy, buildings, communications, water, wastewater, transportation, and tools/metrics. In the breakout sessions, we would like feedback on the energy chapter to make sure we are on the right track or determine whether the focus in any area needs to be redirected.

Summary of Mr. Mizzen's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 8 focuses on communication and information systems. The chapter's goal is to provide guidance to communities to: 1) Understand potential vulnerabilities to communications infrastructure; 2) Determine their own performance goals and identity resilience gaps; and 3) Close resilience gaps. Communication systems rely on many other infrastructure systems. Service providers' primary needs are access (i.e.,

[16] California Local Energy Assurance Program (CaLEAP) Report, Tools, and Online Assessment Guide – http://www.caleap.org/.

[17] National Association of State Energy Officials. State Energy Assurance Guidelines. http://www.naseo.org/Data/Sites/1/documents/publications/State_Energy_Assurance_Guidelines_Version_3.1.pdf.

transportation routes), fuel (for standby power), and security (for workers and equipment). Energy is the most obvious dependency since, for example, it is needed to charge cell phones and maintain functionality of air conditioning in Central Offices to cool equipment.

Communications systems include landline systems, Internet, and cellular systems. There are several components within each of these systems to consider when planning for resilience. Service providers have, however, been successful in learning from past events and becoming more resilient.

For example, the City of New York compared the performance of two Central Offices: 1) the 140 West Street, which was hardened after World Trade Center 7 collapsed onto it on 9/11; and 2) the 104 Broad Street Central Office, which was approximately one mile away from the 140 West Street Central Office but had not been hardened.[18] After 9/11, Verizon took steps to protect the 140 West Street from multiple hazards such that disruptions could be limited, including elevating electrical switchgear and standby power, encasing copper lines in plastic casing and using fiber optic cables, and adding pumps to mitigate flood damage. As a result, after Hurricane Sandy struck the region, the 140 West Street Central Office used temporary fuel tanks to restore functionality within 24 hours of an outage. In contrast, the 104 Broad Street Central Office, which had not been hardened, had electrical switchgear and standby generators in the basement, and copper wires were encased in lead casing. As a result, 104 Broad Street experienced an outage of 11 days after Hurricane Sandy due to flooding, and was only able to restore functionality after obtaining replacement generators, switchgear, and a heating, ventilation, and air conditioning (HVAC) system. This case study illustrates that many things can be done to limit recovery time following an event.

When setting performance goals [slide 7], it is important to identify the resilience gaps (i.e., difference between 90% and X) and prioritize what gaps to address first. Service providers have many strategies to become more resilient. In the 2011 earthquake and tsunami in Japan, watertight doors that were used on Central Offices in the inundation zone performed well and may be a viable alternative in the United States instead of raising critical/electrical equipment.[19] Other strategies include mounting critical equipment in earthquake prone regions, ensuring adequate standby power is available, eliminating single points of failure, or using cell on light trucks (COLTs) when a short-term solution is needed.

Critical facilities also should be aware of three programs: 1) Government Emergency Telecommunications Service (GETS); 2) Wireless Priority Service (WPS); and 3) Telecommunications Service Priority (TSP). GETS and WPS provide prioritized service for users supporting national security and emergency preparedness/response after disaster events for landline and cell phone users, respectively. The TSP prioritizes participants when they need additional lines or service restoration at any time, not just after disasters.

Standby power is a major issue for the communications industry. Many things need to be considered for standby power, including placement and protection such that it will be functional after a hazard event, permanent vs. temporary generators, and type of generator. Permanent generators can be expensive and require periodic maintenance/testing to ensure they will be operational when needed. Temporary generators, on the other hand, have logistical challenges including accessibility of cell sites, deploying a large number of generators, refueling generators when extended power outages occur, and ensuring coordination between employees. Liquid fuel is most often used for standby power. However, other options such as natural gas have been used in the past. Although natural gas generators were used successfully after Hurricane Katrina, it is important to understand that natural gas is often shut down prior to events to avoid fire or explosions, and therefore it is not the best option if serving critical facilities.

In the breakout groups, we would like feedback on Chapter 8 regarding whether you think there are gaps

[18] Federal Emergency Management Agency (FEMA 2013). Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York. Washington, DC.

[19] Kwasinski, Alexis (2011). Effect of Notable Natural Disasters from 2005 to 2011 on Telecommunications Infrastructure: Lessons from on-site Damage Assessments. 2011 IEEE International Telecommunications Energy Conference (INTELEC).

in the approach or content in the Framework, and how integrating the Framework will impact your disaster recovery plans.

Summary of Mr. Ballantyne's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Chapter 9 focuses on the water and wastewater systems. Many water and wastewater systems are local or regional in nature, rather than national as are some of the other infrastructure systems. Water and wastewater depend on power for pumping, transportation for emergency response and repair, communications for Supervisory Control Data Acquisition (SCADA) systems, and petroleum for standby power.

Water systems are composed of supply, transmission, treatment, pumping, storage, and distribution. All components need to be operable to deliver water to customers. Wastewater, discussed later, has the same components, just in the reverse order.

Water infrastructure systems are vulnerable to a number of hazards. With respect to water supply, groundwater wells are vulnerable to flood contamination (e.g., from oil), and earthquakes which can damage the casing, connecting pipe, and/or power supply. Surface water, such as snow melt or water runoff, can contaminate the water supply as well. Spills or flooding, as seen in Elk River, WV, impacted 300,000 people by contaminating the water supply. Wildfires, as experienced in Denver, CO, and landslides can also cause water contamination.

Transmission systems are vulnerable to earthquakes and landslides. Water treatment plants have been impacted by earthquakes (e.g., Loma Prieta, Northridge) and flooding (e.g., Des Moines, IA). Pumping stations are also vulnerable to flooding inundation and earthquakes. Storage facilities can be impacted by earthquakes, which can cause buckling of tanks (elephant foot buckling), or hurricanes with the combined effects of storm surge and high winds toppling elevated tanks. Distribution pipes can be exposed and damaged by flooding that causes erosion, and earthquakes can cause pipe failure, often at joints, as seen during the Kobe, Japan earthquake.

Wastewater systems are different from water systems since all that is needed for wastewater to function for public health is collection so the system can get the waste away from people. Conveyance systems and pumping stations are used to get the untreated waste to treatment plants. Treatment and discharge are important for environmental issues rather than just functionality issues. All of these wastewater components are vulnerable to flooding and earthquakes. Treatment plants, for example, are located by bodies of water out of necessity, but this is also where they are most vulnerable to flooding and landslides.

The example performance goals [slide 10] are in a similar format to those developed by the Oregon Resilience Plan.[20] Historically, water engineers used judgment to develop performance goals. However, the Oregon Resilience Plan and this NIST project have shifted thinking to the community level where stakeholders, such as businesses, should be involved in establishing the goals based on their needs.

With respect to the regulatory environment, there is little direction at the federal or state levels regarding how to design for and deal with extreme events. There are many codes and standards for buildings and other structures, such as those developed by International Code Council (ICC)[21] and American Society of Civil Engineers (ASCE)[22]. The American Water Works Association (AWWA)[23] and American Concrete

[20] OSSPAC (2013). The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Oregon Seismic Safety Policy Advisory Commission Salem, OR.
[21] International Code Council, Inc. (ICC). www.iccsafe.org.
[22] American Society of Civil Engineers (ASCE). www.asce.org.
[23] American Water Works Association (AWWA). www.awwa.org.

Institute (ACI)[24] have also developed codes and standards for tanks. However, there are no existing codes for pipelines, though there are many guidelines that can be helpful.

A number of examples can be looked at for historic performance of water and wastewater infrastructure. The Great Flood of 1993 inundated the Des Moines, IA water treatment plant, resulting in 12 days without non-potable water and 19 days without potable water. In the Northridge and Kobe earthquakes (1994 and 1995, respectively) there were over 1,000 pipeline failures. As a result, Northridge took 12 days to restore full service; and Kobe took 60 days. More recently, the Christchurch (New Zealand) and Tohoku (Japan) earthquakes resulted in loss of water service for over 40 days.

When determining the anticipated performance of water and wastewater systems, there can be three tiers of analysis. The first tier consists of a high-level approach where expert judgment is used to estimate the anticipated performance for a given hazard event. The second tier uses specific scenarios to help determine and understand where the greatest vulnerabilities exist. AWWA J100 (Standards for Risk and Resilience Management of Water and Wastewater Systems) falls under this category.[25] The third tier includes detailed assessments, which may be necessary for some structures.

In the breakout sessions, we would like your feedback on Chapter 9. We are also interested in discussing foreseen recovery efforts/challenges.

[24] American Concrete Institute (ACI). www.concrete.org.
[25] AWWA (2010). ANSI/AWWA J100-10 Risk and Resilience Management of Water and Wastewater Systems. Denver, CO: American Water Works Association.

4. Afternoon General Session – February 18, 2015

Mr. Cauffman introduced the guest speaker, Dr. Laurie Johnson. Dr. Johnson discussed her experiences with past hazard events and her thoughts on the 75% draft of the NIST Disaster Resilience Framework.

Summary of Dr. Johnson's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Although, the focus of my work in resilience is now largely seismic since I live in California, today I would like to discuss my experiences with different events that have happened in many different parts of the country and around the world.

Grand Forks, ND was impacted by a large flood in 1997. It has a population of approximately 55,000 people. It has about 20,000 households, and is home to the University of North Dakota and Grand Forks Air Force Base. Grand Forks is surrounded by farmland. It is a very flat area with the Red River passing through it [slide 2]. The Red River is unique in that it flows north from Minnesota up to Lake Winnipeg in Canada. The combination of flat land, water flowing north, and snow melt can lead to large flood events as seen in this region several times.

In 1997, there was record snowfall (over 100 inches of snow). In March of that year, forecasts predicted that the flood crest would be 52 feet, the maximum their infrastructure was designed to sustain (49 feet of levees plus three feet of free board or sand bags). Thawing was rapid that year, resulting in water coming quickly. A late season blizzard increased the maximum projected flood crest to 54 feet, the level of flooding eventually experienced. As a result of the flood, about 80% of the city was inundated, and 90% of the residents were displaced for weeks. Unlike New Orleans, water was not pumped out of the area. It took about three days before water began to recede and five weeks before it fully receded. The significant damage from the flood included 9,000 homes (700 severely damaged or destroyed), 11 downtown buildings and 60 apartments burned, and 750 commercial units damaged. Electricity, water, and sewer service were shutdown city wide, and many government buildings were damaged.

There was strong local leadership that facilitated recovery and political buy-in for hazard mitigation after the event. Before and after the flood, strong state and federal partnerships existed with Grand Forks. As a result, the city received adequate post-disaster funding that was well managed. There were also a number of programs aimed at improving resilience, such as voluntary acquisition and relocation, enhanced levee and floodwall system, permanent river greenway, and downtown revitalization. As a result, in April 2009 when the next large flood occurred, it crested at 49.5 feet [slide 7], but there was very limited damage.

In terms of cost, there were losses of $1-2B, for which recovery was funded by local, state, and federal governments. Residents and businesses were displaced for a long period of time in some cases. Although the city received funding, it took almost a decade to implement all the mitigation strategies.

As previously discussed, the Framework uses the PPD-21 definition for resilience.[26] The idea is to bring together multiple ideas, including reducing the impact of hazards, restoring social functions quickly, reducing time and cost of recovery, and breaking the cycle of destruction and recovery. When thinking about community resilience, I also use Maslow's Hierarchy as is done in the Framework [slide 10-11].[27] Engineers, hazard planners, and disaster management tend to think about Maslow's Hierarchy from the bottom-up, whereas social-organizational views tend to take a top-down approach.

For example, the report by the National Academies "Disaster Resilience: A National Imperative" takes a bottom-up approach[28]. They show the base of Maslow's Hierarchy as adopting sound land-use planning practices, and work their way up to the top, which is organizing communities, neighborhoods, and

[26] PPD-21 (2013) Presidential Policy Directive/PPD-21, The White House, February 12, 2013. http://www.whitehouse.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil.
[27] Maslow, A.H. 1943. A Theory of Human Motivation. Psychological Review 50 (4) 370–96.
[28] NAC (2012) Disaster Resilience, A National Imperative, The National Academies Press, Washington D.C., www.nap.edu.

families to prepare for disasters [slide 12].

To be effective in the built environment, the first foundational element is enabling locally meaningful characterizations of hazards and risks. In California, we are fortunate to have statewide mandates for seismic, wildfire, and flood hazard identification delivered to us. This is not done across the nation. Mapping hazards varies across the country and varies by peril. Earthquakes, floods, wildfire, landslides, hurricane-force winds, tornadoes, and other hazard events all have different characteristics which need to be assessed. Currently, there are variations in mapping approach, accounting for uncertainty, mapping scales (regional vs. site-specific), and legislative/policy controls.

The second foundational element is ensuring robust and effective integration of hazard information in public policy. For example, the National Insurance Flood Program is the most robust program available that addresses this element. The report "Managing Land Use to Build Resilience" shows a great example of how hazard information could inform public policies and planning at the local level [slide 17]. These include planning policies, developing regulations, land and property acquisition, building standards, critical infrastructure and public facilities policies, taxation and fiscal policies, and information dissemination. Only about half the states in the US require local comprehensive plans to address hazards [slide 18]. In terms of building code enforcement, there is a wide variation [slide 19]. Some states (e.g., Florida) focus on enforcing building codes, while others (e.g., Texas, Mississippi) do not. FEMA's map showing local mitigation plan status also presents a wide variation in plan status [slide 20]. However, these mitigation plans are highly implemented and approved.

We need to consider expanding the hazard/risk discussion beyond what and how to build a structure to include where to build. Considerations of who pays for detailed assessments and hazard mitigation, and who takes on the risk also need to be taken into account.

Portola Valley, CA is a small town located on a hillside on the San Andreas fault. It is a wealthy community with a high potential for ground movement [slide 23]. There is a lot of awareness in the community about its risks, and thus it has made efforts to become more resilient. Another example of a community working to become more resilient is Central Valley, CA. Its Delta Stewardship Council has been very successful in advocating for resilience. It has developed legislation to provide a more reliable water supply for California and protecting, restoring and enhancing the ecosystem. They have been successful in obtaining large amounts of funding to develop a long-term management plan that includes a multi-hazard analysis, and provides information for water and environmental decision-making.

After a disaster event, the challenge is that capital funding that would normally be expended over a long period of time (e.g., 50 or 100 years) is invested in a very short time period (e.g., 10 years). We refer to this as time compression. For example, after the 2011 Tohoku (Japan) earthquake, local governments were overwhelmed. They are using the two-level concept that includes implementing hard measures to protect against the 100-year event (level 1), and softer measures that protect against a 1,000 year event [slide 26]. This will include raising land and rebuilding homes for flood protection. Many efforts are going into household relocation, land readjustment, and public housing developments.

Canterbury, New Zealand was struck by a series of large earthquakes in 2010-2011.[29] It is located on a fault that resembles the San Andreas, and they have been concerned about the risk of large earthquakes for a long time. The 2010-2011 earthquakes occurred underneath the city. They have an earthquake insurance program that resembles the US National Flood Insurance Program (NFIP). As a result of the earthquakes, there have been hundreds of thousands of claims. This ultimately led the program's re-insurance to state that it would no longer insure the insurance programs in these regions, which caused the government to get involved and develop a land-zoning program. They also developed a buy-out program for areas where there had been significant damage multiple times and liquefaction was becoming a major

[29] CERA (2014). Canterbury Wellbeing Index June 2014, Canterbury Earthquake Recovery Authority, Christchurch, New Zealand.

issue, for example.

New Orleans is entering its tenth year of recovery after Hurricane Katrina. Prior to Hurricane Katrina, New Orleans was already in a state of economic decay. There were 40,000 vacant or abandoned lots out of 400,000. A building repair program was implemented in Louisiana after Hurricane Katrina. However, many people decided to sell or abandon their homes and leave the state adding to the economic decay.

After Hurricane Sandy, New York State is completing a reconstruction program called New York Rising.[30] They are working with NOAA and FEMA, who developed a risk assessment tool. It looks at a number of factors including erosion rates, beach width, shore defenses, protective vegetation, dunes/bluffs, and soils. All of these characterize flood risk. They use these evaluations to prioritize hazard mitigation funding.

The third fundamental element is strengthening governance capacity for community resilience and ensuring its sustainability. The key challenges for urban sustainability/resilience are: 1) Governments are slow to react to existing problems; 2) Cities redevelop too slowly for legislation and regulation to be meaningful; 3) Barriers prevent capitalizing on economic benefits that resilience can bring. To make improvements in governance, we should use three approaches, including traditional governance (e.g., regulation, taxes), collaborative governance (e.g., networks, partnerships), and market-driven governance (e.g., contests and challenges, benchmarking and certification).

Though traditional governance is important, collaborative governance is very important in recovery after a disaster. The goals of collaborative governance are to bring teams together to develop solutions to problems, develop policies, and engage the public in deliberation.

In San Francisco, we have been subjected to some shocks such as the "dot com" bubble, great recession, and housing affordability crisis. However, we have not had many other major shocks since the 1906 M7.8 earthquake and fire. We have many programs and institutions that work in collaboration to enhance resilience directly or indirectly. The SPUR Framework focuses on the existing building stock, which is a big challenge, but other programs focus on seismic hazard mapping and mitigation, climate adaptions, and many other local concerns [slide 40-42].[31]

The NIST Disaster Resilience Framework is valuable as a tool for developing policies at the community scale. It provides an opportunity to improve community-level and risk characterization, land use, and enforcement of building and infrastructure system codes/standards. It leverages the whole community concept and collaboration at a large-scale that includes multi-disciplinary, multi-governmental, and non-governmental partnerships and alliances.

[30] New York State. New York Rising Community Reconstruction Program. http://stormrecovery.ny.gov/community-reconstruction-program.

[31] SPUR (2009). The Resilient City: What San Francisco Needs from its Seismic Mitigation Policies, San Francisco Planning and Urban Research Association. San Francisco, CA.

5. Morning General Session – February 19, 2015

Mr. Cauffman moderated a panel session in which guest speakers discussed past events and the resilience planning efforts their communities are undertaking:

- Mr. Jay Wilson, Resilience Coordinator, Clackamas County, OR
- Dr. Lucile Jones, Seismologist, US Geological Survey
- Mr. Patrick Otellini, Chief Resilience Officer, San Francisco, CA
- Dr. Emily Steinhilber, Assistant Director of Coastal Resilience Research, Old Dominion University
- Mr. Gregory Guibert, Chief Resilience Officer, Boulder, CO

Summary of Mr. Wilson's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

I am involved at the local level and state level with the Oregon Resilience Plan, mentioned in the Framework. Today, I will discuss a recovery effort in our county (the local level). [32]

Where we have heard other discussions specific to flooding, the challenges we faced were actually erosion issues. Historically, multiple events had eroded banks and resulted in repeated damage. However, studies had not been completed to assess the issues. Therefore, we had obsolete flood maps and did not have any scientific facts or measurements of what exactly caused the damage.

This area has a volcanic landscape, which results in areas of risk. Many people lived inside a lahar (historically based mudflows) at the base of an active volcano. It was essential to characterize this so everyone understood the potential risks [slide 3]. We developed channel migration maps that show the history of where the river has been in the past one-hundred years [left side of slide 4] and the hazard risk map [right side of slide 4]. These helped us define a 100-foot buffer zone around the highest exposure zone and will drive the decisions behind policies in the future. The policies' goal will be to limit the level of damage from flooding since we have lost buildings, roads, and other infrastructure systems.

About a year and a half ago, we began a public involvement process with the Home Builders Association, the Chamber of Commerce, and a number of other stakeholders. The process kept the public informed and allowed them to provide input so they shared in the ownership of plans moving forward.

The changing climate will also impact this area. Therefore, we need to use forward thinking to consider the potential vulnerabilities to our communities added by future conditions. The watershed for the Sandy River off Mount Hood in our county is shown here [slide 6]. Currently, it is largely snow driven [white area on slide 6]. The green represents a rain-driven area, and the blue represents a mixture between rain and snow. This all impacts the small area discussed earlier where the flood study is taking place. With the climate projection for 2080 [slide 7], there is a big change in the precipitation. The snow-driven zone will largely recede and the precipitation will come down mostly as rain. This means that volcanic material will be moved by landslides, heavy rain, etc. This has a huge impact on our planning for the future and will impact our policies and decisions.

Planning and policies are very important to the pursuit of disaster resilience, particularly in our county. We are using many applications to try to plan for the future, including risk and hazard maps, emphasizing flood insurance, making land swaps/acquisitions, relocating infrastructure, and understanding our watershed.

[32] OSSPAC (2013). The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Oregon Seismic Safety Policy Advisory Commission Salem, OR.

Summary of Dr. Jones's Remarks

I am a seismologist with the US Geological Survey. In 2014, I worked with the City of Los Angeles on a study to enhance resilience. [33] Los Angeles is one of the largest cities in the US and has the largest port in the US. About 40% of the imports in the US come through the ports in Los Angeles and Long Beach, CA. Los Angeles is a very diverse place with respect to hazards, which include earthquakes, landslides, coastal erosion, and fires which can result in debris flows because the mountains are very steep. However, since we have a coastline that is over 70% cliff in California, our tsunami risk is much smaller than it might be otherwise.

We undertook a multi-hazard demonstration project to bring together a diverse group of scientists, including sociologists, emergency management, and economy. In California (and other parts of the country), we have a lot of science that allows us to understand hazard events, and their potential consequences. However, much of it was not being used. We started working with the community so it could be used to help reduce risk.

We developed a shakeout scenario using a plausible earthquake event (M7.8) to understand what would happen to our infrastructure and community. To engage the community, we held massive earthquake drills so people were prepared and knew what to do if an earthquake did occur. Over five million people participated in the first drill, and it is now an annual drill in southern California.

We worked with a large, multi-disciplinary team to complete the study and understand what we needed to do moving forward. It was decided that making improvements to buildings only would not be sufficient. So, we expanded our work to include telecommunications, water systems, and older buildings. Although this did not cover everything that we would like to do ideally, it would address the greatest concerns.

We worked with cellular service providers in the area, and water systems operators and engineers to understand where potential vulnerabilities/problems could arise. At the completion of the study, we made a total of 18 recommendations – five for buildings, eight for water, and five for communications. There were also many studies that focused on specific areas including ports, highways, hospitals, rail, fire, etc.

Summary of Mr. Otellini's Remarks

When we talk about resilience, it is important to acknowledge that it has become a buzz word that means different things to different people. In San Francisco, we have dealt with a number of earthquakes, including the 1989 Loma Prieta earthquake.

We have several programs in San Francisco that we initiated to make our city more resilient. Our soft-story financing program encourages retrofits of existing buildings such that they will be able to resist large earthquake forces so people can shelter-in-place when an earthquake does occur.

Even before financing programs could be implemented, we needed to spend a significant amount of time reaching out to the community and its stakeholders. These included landlords, engineers, architects, owners/operators, managers, etc. Bringing everyone to the table and getting them to agree on a pathway forward enabled us to push our program forward.

We have also addressed issues such as the difference in how public and private schools have been designed and maintained. Public schools receive public funding and so have been influenced by what the city, county, and state have required. Private schools, on the other hand, have not been regulated to the same standard and hence their buildings often only meet the minimum requirements. The schools now have to complete mandatory evaluations so they can understand their vulnerabilities. This is important to the resilience of San Francisco because when schools are closed after a disaster event, people stay home

[33] The Great California Shakeout. http://www.shakeout.org/california/scenario/

with their children rather than going to work, which ultimately impacts the economy negatively. Therefore, this is a huge potential vulnerability.

San Francisco is vulnerable to more than just earthquakes. Given its location, it could also be impacted by sea level rise. As previously mentioned, I am the Chief Resilience Officer in San Francisco. However, the Chief Resilience Officers job is not to be an expert for every hazard and infrastructure system. Rather, it is to serve as a conduit to learn from other experts and communities that can help address problems.

Although there are a lot of technical aspects to consider in addressing resilience, the social dimensions are very important and really define the purpose of the physical aspects of the community. San Francisco is a part of the Rockefeller Foundation's 100 Resilient Cities initiative, which has two stages. Stage 1 was identifying and understanding the vulnerabilities of our community. Stage 2 is focused on implementation of strategies to reduce the impacts associated with these vulnerabilities. Over the next 6 months (Phase 2), we will work with our stakeholders to develop many tasks for implementation. One goal in San Francisco is to keep 95% of our population in the city after an earthquake. This is because there is really nowhere else to go and, thus, we want to make sure they can shelter in place. Overall, our resilience program is not just about protecting life, but improving quality of life when hazard events do occur.

Summary of Dr. Steinhilber's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Old Dominion University (ODU) is working with Hampton Roads, VA on an intergovernmental pilot program.[34] Hampton Roads has a planning district commission with 17 counties, such as Virginia Beach, Norfolk, and Williamsburg. It is fairly diverse economically as it has federal employers (e.g., Norfolk Naval Station), tourism industry, and the Port of Virginia.

Located on the coast, the primary concern in the area is sea level rise, which increases the risk from storm surge, tides, and flood inundation. This chart [slide 4] shows that the observed sea level has increased over the past century and is projected to increase substantially over the next century. And as you can see from the various projections, there is a lot of uncertainty in how much the sea level will rise. However, the one commonality of the projections is that it will increase.

The Intergovernmental Pilot Program was formed around the mission of using a community approach to address sea level rise and resilience planning by June 2016. The planning organization is intended to coordinate sea level rise preparedness and resilience planning between Federal, state, and local government, and the private sector. Furthermore, this organization was formed to engage the public and take their perspectives into account in the planning process. There are a number of key partners at each level. These include the National Security Council at the White House, Departments of Defense, Environment, and Transportation, National Aeronautics and Space Administration (NASA), the Port Authority, Virginia Coastal Policy Clinic, City of Norfolk, City of Virginia Beach, etc.

The structure of the organization is shown here [slide 7]. A Steering Committee leads the organization, overseen by an Advisory Committee and Federal Liaisons. The Steering Committee oversees a number of working groups, including those for land use, infrastructure, and civic engagements. There are also various subgroups that address challenges such as outreach, green infrastructure, and economic impacts.

The program was kicked off in June 2014 at ODU; the pilot Charter was signed in October 2014. Currently, working groups are developing a work plan and engaging stakeholders to become involved in the process. In March 2015, there will be a workshop to engage the community. In June 2015, we will present the planning template, and then establish the planning organization in June 2016.

[34] Old Dominion University. The Center for Sea Level Rise: Homebase for the Intergovernmental Pilot Project. http://www.centerforsealevelrise.org/

Summary of Mr. Guibert's Remarks

[The slides associated with the following text are located on the NIST.gov website.]

Boulder, Colorado is a prosperous small town with a population of about 100,000. Boulder has a diverse economy with a highly educated workforce, and includes two universities, federal research centers, technological start-ups, and a strong agricultural sector. It is consistently rated one of the best places in the country to live, work, and play. Boulder is also well known internationally for its progressive land use planning, preservation of open space, and dual use for greenways and floodways. It is situated in an arid climate with a steep elevation gradient to the west.

In 2013, Colorado had a major flood that impacted most of the state, including Boulder. In fact, Boulder has the highest risk of flash flooding in the state. It has rapidly changing forest and alpine systems due to the ash borer. We have a year-round wildfire risk. We experienced wildfires in 2010 and 2011 that changed our landscape significantly and, consequently, our flood profile. We are also vulnerable to global economic downturns, and traditional major shock traumas.

As previously discussed, the 2013 flood occurred after the wildfires in 2010 and 2011 that changed our landscape significantly. We received close to the annual average of rain (18 inches) in eight days. This was determined to be a 1000-year rainfall event, but only a 100-year flood event. It was not the level of flood for which we had planned. The flooding cut off access to mountain communities along six of seven canyons, caused $300 million in private property damage, and $27 million in municipal property damage. However, only $14 million of the damage was reimbursable, so the losses were huge.

We learned a number of lessons as a result of the flood. For example, although green infrastructure is important and FEMA provides credits in their rating system for making improvements to green infrastructure, these types of reconstruction projects are not reimbursable. Ground water intrusion was an unforeseen issue that we are still encountering today. Transportation fragility is impacted by the open space boundary. Furthermore, transportation impacts mutual aid and trauma care. There is a need for flexible municipal staffing and financial mechanisms. Having local governments reinforce the core principals of know your neighbor, have a plan, and know your risk to their residents is important so things go as smooth as possible if a disaster event does take place. Another concern is that even though the public can become very focused on making improvements immediately after a disaster takes place, they can become burned out and return to their attitudes from before the event occurred.

Boulder has been using progressive land use planning and floodplain management for over 30 years. We are now expanding these concepts to include additional social and economic dimensions. We are also incorporating resilience concepts into the next update of the Boulder Valley Comprehensive Plan and Human Services Master Plan.

Boulder is developing a resilience strategy as part of the Rockefeller Foundation's 100 Resilience Cities Global Campaign. This will contain a number of specific initiatives to become more resilient. The Rockefeller Foundation wheel [slide 7] for their 100 Resilient Cities initiative shows there are many components to consider in a community, and they all need to be considered when thinking about resilience. As a part of this, we have a Chief Resilience Officer, technical partners, and a peer cities network to learn from around the world.

In Boulder, we are coupling resilience with existing community priorities. We have an aggressive focus on lowering carbon use. We are developing plans to insulate ourselves from the energy market, as well as making local foods safe, and secure so that we can maintain our community identity.

6. Breakout Session #1: Chapter 2 of Framework – Social Aspects of Resilience

Each breakout session was divided into two sessions: One the afternoon of February 18, 2015 (2:30-5:00 pm) and the other on the morning of February 19, 2015 (10:15 am – 12:00 pm).

At the beginning of the first breakout session, the facilitator led participant introductions. The authors of the chapter, Drs. Erica Kuligowski and Liesel Ritchie, then gave a high-level overview of the chapter and goals of the breakout session. Once introductions were complete, the facilitator asked participants to review the tables in Chapter 2 that address links between social institutions and the built environment. While reviewing the tables, participants were asked:

1. *Does the chapter cover these linkages in an appropriate manner?*
2. *Is the information organized in a way that makes sense? Is it easily understood?*
3. *Any additional examples to add?*

Participants felt that most linkages listed in the chapter were appropriate, and the chapter was generally well structured, but did suggest some changes to the document. The group felt the chapter should discuss the role of the scientific community and ad hoc organizations. This discussion quickly led into the next question:

> *How do the social institutions depend on each other to function (especially during disasters or as part of disaster planning)?*

The group spent time considering the various social institutions and their reliance on one another. Table 1through Table 3 list the dependencies of ten social institutions:

- Family/Kinship
- Economic
- Education
- Scientific
- Government
- Belief Organizations
- Healthcare
- Community
- Information
- Ad Hoc Organizations

Participants stated the family depended on local businesses to be operational so they could go back to work after a disaster event (Table 1). Furthermore, the family institution depends on many other social institutions to remain functional, including CSOs, healthcare, information, and government agencies. The economic institution relies on education to support continual growth and evolution, and families to provide employees and customers. The education institution needs government and healthcare to ensure students can attend school without compromising public safety. The scientific community also relies on government and the economic sector for research funding, which in turn helps government and industry make more informed decisions in the future.

Government relies on information and media to disseminate information to the public, both on a daily basis and in the aftermath of a disaster event (Table 2). Belief organizations need families and neighborhoods to serve a purpose through meetings and other activities. They also often rely on ad hoc organizations in the aftermath of a disaster event to provide logistical support and resources for recovery. Healthcare is one of the most important social institutions in a community and is often relied upon by many other social institutions following a disaster event. However, healthcare also needs belief organizations to back the need for vaccination of children and procedures to improve public health. CSOs rely on accurate information to reach out to families who are in need of assistance and help them.

Information, as seen in Table 3, relies on sources to be able to disseminate information to the public. These sources may be the scientific community, government, healthcare, or others. Ad hoc organizations need support from at least one of the other social institutions to validate them to the public. As discussed throughout the breakout session, the social institutions were not prioritized because they all serve different functions but are dependent on each other to remain operational.

Table 1. Workshop Input: How Family/Kinship, Economic, Education, and Scientific Institutions Depend on Other Social Institutions

Family/Kinship (1) • **Neighborhood connections**	**Economic (2)** • **Econ development** • **Institutions** • **Workforce** • **Buyer/supplier/goods/services** • **Workforce**	**Education (3)** • **Formal** • **Informal** • **Skill Development** • **Continuing**	**Scientific (4)** • **Informed/expert influencer**
Family needs local businesses to operate when they return home	Economy needs education to support new development	Public safety officers need to be seen by primary grade kids	Science should/ can drive info
Some people rely heavily on CSOs to provide basic daily services • CSOs, healthcare, information, government agencies	Local businesses need family to return to stay in business	Education needs gov't to include new disaster / resistant education standards	• Informed influencer • Need process to access documents, plans and community leaders • Media • Government, community, leadership
People need to work/ be productive to foster positive mental health • Individual/Family→ Economic	Economic sector (builders) needs gov't to enforce consistent codes and standards	• Education-CSO Gov't, Families, Etc. • Need info to identify disturbed individuals	Informed (science-based) information links to government to make better decisions
Families rely on information and ad hoc to make decisions about how to take action post event	Businesses need workers and workers need housing, link to kinship	Education needs information to share info about closings, openings, etc.	Scientific- informed influence should be based on measurable information • Scientific → Info
Families need information to release stress to allow them to work/assist	• Businesses need supplies & customers • Government facilitates consumer access via transportation networks		Scientific community needs government for funding research
Elderly and shut-ins need healthcare and CSOs	Workforce needs healthcare to maintain operation, goes both ways		
Neighborhoods need government to feel secure	Community's economy relies on stable families/neighborhoods for workforce and consumers		
• Families depend on local business for food, needs • Belief of families community	Need reliable info from trusted sources to take proper action during and after disaster		
Family needs education for ▪ Disaster Drills ▪ New Information (schools →home)	Workers need info on getting kids in a crisis		
	Direct sectors of business- industries to work with one another to share resources		

Table 2. Workshop Input: How Government, Belief Organizations, Healthcare, and Community Institutions Depend on Other Social Institutions

Government (5) • **Agencies** • **Local/regional**	**Belief Organizations (6)** • **Religious** • **Interest Based** • **Civic**	**Healthcare (7)** • **Public** • **Rx** • **Portable/ at home** • **Mental health**	**Community (8)** • **Community serving organizations** • **Public sector leaders** • **Spark plugs**
Government relies on information dissemination through media and social media	Belief orgs need tight knit families and neighborhoods to ensure attendance at meetings, events and disseminate information	Healthcare needs generators (relies on local business)	Community serving organizations rely on info to reach/access families with service needs
Government needs families and community serving organizations to maintain a quality of life/ community normalcy	<u>Belief organizations - Info</u> • Rely on the information to get to members and move toward action	Healthcare- belief organizations • Belief organizations need to back need for vaccination	Community services need ad hoc to supplement their resources and assets
Government depends on strong community and belief organization to implement plans/share info • Belief organizations • Community • Government • Info	Belief orgs provide moral, social and interactions for families	Healthcare and public health need government in order to provide a single and trustworthy voice about public health communications and health-related risks (think CDC and health department) • Healthcare needs government	Communities need non-resilience social connections to activate after disaster
Local government (police) to help people through traffic and get them home safely in case of power outage	Belief organizations need government to provide roles that support recovery	Healthcare needs community services to deliver care in the community	CSOs need access to accurate information and context
Local gov't needs to inform families about school closures, hospital closures, and pharmacy closures. Family used to link information to education, healthcare, info	Belief organizations need ad hoc to increase personnel and resources and assets	Healthcare relied on trust with belief organizations to deliver services	
Government needs trust/buy-in from scientific community and belief organizations to maintain legitimacy	Belief organizations and community serving need to coordinate with each other and healthcare to manage cord/volunteer efforts	Healthcare and comm. Serving triage, refers, work in coordination to maximize efficiency	
		Home-based patients need back up resources to help meet their needs • Healthcare • Individuals • Information • Local business	
		Healthcare needs government to implement policies that reduce health risks during and after a disaster event	

Table 3. Workshop Input: How Information and Ad Hoc Institutions Depend on Other Social Institutions

Information (9) • **Packaging/purpose** • **Media** • **Social**	**Ad Hoc (10)** • **Virtual** • **Flash mob of care/attention**
Media and social media depends on tight-knit families and neighborhoods to share and distribute information • Information • Family/kinship	Ad hoc organizations. Provide access to localized resources and info in a low organization overhead way • Government agencies • Family • Media
Information (media) needs education to have disaster/resilient) literate society	Ad hoc need info to link partner with comm. Service and gov't, etc….
Media needs scientific, government, and healthcare to provide credible information to the world	Ad hoc needs validation from one or more other groups

7. Breakout Session #2: Framework Chapter 3 – Community Resilience

The facilitator led introduction of all participants. Then chapter author, Mr. Chris Poland, delivered a brief overview of the chapter and outlined the goals of the breakout session.

The facilitator then led the group conversation, asking:

1. *Communities are different – What kind of long-range plans do communities have? Where should resilience plans go?*
2. *On a day to day basis, how do you see this plan assisting your local government/communities? How do you work with them on disaster resilience? Who is involved?*

The participants listed a number of types of plans (Table 4) that would align well with resilience plans, such as disaster plans housed in emergency management offices. Participants felt implementation of the Framework could benefit the community through economic development. In terms of logistics, they believed a number of approaches could be used. For example, risk management could drive policies, or a local government leader could be the focal point leading resilience efforts.

The group then shifted its discussion to Framework integration into existing planning strategies. Specifically, participants were asked:

1. *Based on the information we've provided about the Framework, what do you think are the best approaches and/or strategies for integrating it into your near- (0-5 years), mid- (>5-10 years) and long-term (>10 years +) planning for disaster resilience?*
2. *How will integration of this Framework benefit your planning efforts and responses during disaster events?*
3. *What impacts could integration have in the near-, mid- and long-term? (not just disaster response, but economic, social, other).*
4. *What do you foresee as challenges to integration of the Framework into planning?*

The group identified both strategies and challenges for each of the timeframes (Table 5). In the near-term, participants felt the Framework could be used to apply for grants, support economic development, and work with stakeholders in the design phase of projects. However, participants also discussed that the Framework needs to be vetted and endorsed to be successful and, therefore, the product needs additional marketing. In the mid-term, participants suggested that planning for public outreach and policy development in the aftermath of a disaster event should take place so the community knows how to move forward in a structured way when a disaster event does occur. Participants stated that in the long-term, communities could work to develop and more in-depth plans to become more resilient.

The group then discussed the Executive Summary and provided feedback. Participants were asked:

1. *Did the Executive Summary leave you with a clear initial understanding of the Framework? What stuck with you?*
2. *Is there a clear call to action?*
3. *Is there anything in the other chapters that is necessary to round out this summary?*

As shown in Table 6, the group felt the Executive Summary clearly stated the difference between resilience and mitigation. However, they also felt that many improvements could be made. Participants suggested emphasizing the need to understand the community and built environment. They also suggested the Executive Summary be shortened and a Call for Action developed.

Table 4. Workshop Input: Framework Integration at the Community Level

Framework Integration – Community Level –			
Types of Plans/Offices Focused on Resilience	**Benefits and Logistics**		
Disaster Plans (live with emergency management) • i.e. Local Emergency Planning Committee (LEPC), Evacuation Plan		Market Risk: • Management policies as a driver -> for land use • Mitigate social/ political cost	Driven By: ▪ Industry / Commerce Association
Risk Management: ▪ Lack of political power of planning whereas risk management has an economical language			Liability of Permitting
Plan Integration in South FL • Comp. plans • Land to use plans • Mitigation • Recovery • Post recovery • Redevelopment plans	Community Safety Element- ▪ San Francisco General Plan - Supervisor's Approved	Have local government executive serve as the focal point leading the resilience efforts so that departments take it seriously	• Resilience • Planning Live with City • Administration/ Executive
• Natural Hazard Mitigation Plan (NHMP) - City of Portland			Economic development interests as supporters (How?)
• Recovery- Redevelopment • Public Advisory Committee			Department of Commerce Economic Development Administration (DOC EDA) • help, build, enable communication
Codes and Standards (S. FL)			• Urban community business drives • Office of Economic and Workforce Development (OEWD) to consider economic resilience to disasters/cc

Table 5. Workshop Input: Framework Integration Strategies

Framework Integration – Strategies –					
Near-Term (0-5 years)	**Challenges**	**Mid-Term (>5-10 years)**	**Challenges**	**Long-Term (>10 years)**	**Challenges**
• Economic development • Marketing opportunity	Framework is a public policy matter. • You will get more leverage if it is vetted and endorsed.	Focus on legal and economic liabilities for local government (and tax and service implications)		Long-term planning brings vision to what needs to be accomplished – fresh water example in VA Beach	
Leverage of advocacy groups to common goal	Challenge: • Don't do (or build) the way we have in the past	"Backroom" development of public outreach plan and policy points for discussion ready to go when disaster hits.	Challenges: • Do <u>real</u> outreach that is inclusive and allows policies to be flexible	Managing expectations. • Political=Public • It's a marathon →	
Apply for grants		Resilience with personal brilliance (integration)		Engage communities throughout to enculturate resilience across political "dynasties"	
Consider various insertion points – different for every jurisdiction		Consider ways to fast-track "resilience" projects as part of planning			
This is a community planning effort, comparable to comprehensive planning, Capital Improvement Plan (CIP)		Promote strategy through National Associations: National Governors Association (NGA), National Electric Manufacturers Association (NEMA), National Association of Counties (NACO)			
Work with stakeholders with projects and integrate resilience into design and construction			Plans are public statements of vision and goals. They are actualized through specific projects undertaken by many stakeholders. Local governments control only a small part of implementation		
Create executive-level focus to steer departments to seriously consider resilience	Challenge: • Organizational inertia associated with long-term employees	Participatory budgets glue communities and voices on how to spend money			
Public comments and input to welcome all perspectives	Challenge: • Get to know your 'client'. Align with local professionals	Leverage previous positive solutions to improve resilience			

Table 6. Workshop Input: Stakeholder Input on Executive Summary

Executive Summary					
What Worked	**Recommendations**			**Additional Information**	
It's clear – shows difference between mitigation and resilience	Audience – write to executive staff of local office	Emotional + Financial buy-in	Executive Summary: • Invitation to learn what this Framework means to them	Define – What is a cluster in this Framework	Add: Natural Infrastructure • (pg.3 last paragraph)
Good paragraph on disaster resilience planning on top of page 3 • Highlight it via a side bar	Length: • Shorter=Better	Need further focus on saving lives and livelihood through resilience	Marketing matters – it needs a call to action	Context: The length of recovery – what is it? (Cedar Rapids: 7 years)	Return on Investment (ROI)? This is important upfront to users
Section on 'Understanding Your Community and its Built Environment' is great - needs more focus (end of page 3)	Use of appendices	Worth discussing Disaster vs. Community Resilience?	Executive Summary vs. Introduction – need to be intertwined further?	There is focus on Ch. 2 in the summary • What about other chapters?	
	Need a call for action before the Executive Summary	The Story needs to engage	Web-based engagement tool (Q's) to help user understand their role in resilience	Need to mention Human-caused disaster examples	

8. Breakout Session #3: Framework Chapter 5 – Buildings

The facilitator led participant introductions. Next, the chapter author, Mr. Robert Pekelnicky, delivered a brief chapter overview and outlined the goals of the breakout session.

The facilitator then led the conversation of the group by asking:

1. *Based on the presentations this morning about the Framework and draft chapter for the Buildings sector, what do you like about the Framework (e.g., approach to recovery time)?*
2. *Are there additional elements that should be considered? How implementable is the Framework?*

The group had a very active discussion of what they liked and felt was missing from the Framework (Table 7). Participants responded positively to the acknowledgement that the built environment supports the social and economic aspects of a community. Many participants also supported the approach, including bringing all stakeholders together and using a hazard-independent process rather than the typical engineering process. The group also listed a number of items they felt were missing from the Buildings Chapter (e.g., addressing issues pertinent to small communities, encouraging improved codes and standards, and discussing differences in building occupancy classes). Participants felt the Framework could be implemented if it were marketed well to communities and used best practices and case studies to demonstrate ease of implementation.

The group was then asked:

> *Based on the information we've provided about the Framework, what do you think are the best approaches and/or strategies for integrating it into your near- (0-5 years), mid- (>5-10 years) and long-term (>10 years +) planning for the Building sector disaster resilience?*

Table 8 shows the many near- and mid-term strategies suggested to implement the Framework. In the near-term, participants felt identifying and understanding constraints would be essential. For example, in the Commonwealth of Virginia, the state operates by the Dillon Rule, meaning that communities cannot adopt standards that are stricter than those of the state without Commonwealth approval.[35] Participants also identified building support and advocacy for the resilience planning process as a key concept early in the process if the process is going to be successful. In the mid-term, the group felt establishing a plan for continuous improvement to achieve resilience once the initial planning process is initiated was important. Furthermore, the group felt that linking other programs (e.g., Leadership in Energy & Environmental Design [LEED]) with resilience would be helpful to get it off the ground and promote longevity.[36] This process includes working with FEMA on the Community Rating System (CRS) to receive CRS points for implementing and achieving resilience.[37] In the long-term, participants believed it was important to get other industries involved in the resilience planning process (e.g., insurance, real estate appraisers). Participants thought involving these other industries would lead to incentives for critical facilities to be designed/strengthened such that they resist greater loads.

[35] Fairfax County, VA. Dillion Rule in Virginia. *http://www.fairfaxcounty.gov/government/about/dillon-rule.htm*.
[36] US Green Building Council. LEED. http://www.usgbc.org/leed.
[37] FEMA. Community Rating System. https://www.fema.gov/community-rating-system.

Table 7. Stakeholder Thoughts on Framework and Potential Implementation

"What I Like"	Gaps/What's Missing in the Framework	Framework Implementability
• The Framework supports social and economic environment (multi-faceted) • It encourages bringing all stakeholders to the table – government, community organizations, and the design/construction profession/industry • The process is thoughtful and hazard independent that looks beyond just the engineering • It incorporates the idea of an active vs. passive approach (e.g., active vs. passive fire protection systems) • The Framework is comprehensive in scope that recognizes interdependencies • The Framework embodies realistic challenges that were articulated by the plenary speaker (e.g., requiring different methodologies depending upon the governance for resilience Framework implementation) • The Framework's intent as a tool for conversation and discussion for decisions on implementation at the community level • The use of the hierarchy of human needs/social metrics • The Framework is adaptable to a particular community's needs and specific hazards • The Framework looks not only at quantitative resilience metrics, but also qualitative elements • NIST focus on (pre-disaster) planning for resilience, mitigation design and not "after the fact" (post-disaster)	• Best management practices need to play a prominent role in the Framework; focus on disaster types and include as addendum • Framework needs to spell out specific code actions (for implementation) or provide standards as a prescriptive model • More attention needs to be paid to smaller community issues; it needs to address the issue of limited capacity and resources • Framework needs to address the idea of working with State uniform building codes to allow for increased code requirements (e.g., In Virginia, communities are precluded from adopting higher standards unless the Commonwealth says it can) • Framework needs to include disaster specific references for code-plus building • Framework needs to include a recommended approach for prioritizing actions to close current vs. needed gaps • Framework needs to address idea of increasing resilience through design improvements vs. only looking at increased hazard levels • For wind design, the Framework needs to address damage to the building envelope (and not Main Wind Force Resisting System). • Framework should be organized vis-à-vis the economic capacity of the community • Framework needs to address the different short-term economic interests of different classes of buildings. For example, box-store buildings are not intended to have a long service life, and are often designed to only meet minimum code requirements. • Framework needs to go further to define next step of recommending design standards above code for different classes of buildings with the idea that they would be voluntarily adopted • Use of 100-year mean recurrence interval for flood (hazard) is not correct; it is annual probability of flood in any one year • Framework needs to include information on costs • Framework needs to provide greater emphasis on the fact that minimum building code design does not equal resilience. • Routine, expected and extreme events need to be better defined (e.g., relating to defining the return periods in years) • Framework should convey consensus on resilient design practices and recommendations; should not be one industry's opinion • A review of ASCE 41 is needed; concern expressed that it has flawed seismic ground motion characterization for (use in) design • Framework does not protect public safety because it doesn't consider impacts from max. potential earthquake source	• In order to enhance Framework implementability, it will be important to make the document easily acceptable and understandable for communities to use (streamline the document, write in layperson terms) • There needs to be a marketing component to the Framework, especially when it is released. It will be important to compel communities to use the Framework. • Including best practices and case studies that demonstrate Framework implementability will be important • Marketing and financial barriers need to be overcome in order to implement the Framework • Include checklists/flowcharts for communities to use as a "go-by" that demonstrate how they can accomplish resilience (at specific performance levels) • The individual Framework elements need to be cohesive and the Framework needs to be used holistically; it shouldn't be a matter of picking and choosing select parts, rather communities need to be compelled to use the Framework in its entirety • For Framework implementability, there needs to be consideration for a community's capacity and the expertise required to plan for and achieve resilience. To the extent that there are incentives provided to communities for planning and achieving resilience via the Framework will be important. • Decisions regarding the use of the Framework need to be made at the local level (grass roots/community based). Additionally, considerations for incentives need to be made to enhance implementability at the local level. • The Framework should include a model incentive legislation (policy/ordinance) to encourage community participation in plan implementation (more examples, go-bys, checklists). • If achieving resilience through use of the Framework becomes mandatory, that decision needs to be made at the community level. • Overall, the Framework is a good tool; the challenge will be how to compel communities to use the tool. Incentivization vs. punitive will be important ("carrot vs. the stick").

Table 8. Workshop Input: Strategies for Implementing Framework in Near-, Mid-, and Long-Term

Near-Term Integration Strategies	Mid-Term Integration Strategies	Long-Term Integration Strategies
• Assess the inventory of building stock within the community • Early on, develop clear language (in the form of a communications plan that is focused on the community with its interests in mind) to communicate the degree to which a community can be safer, stronger if resilience is achieved; as part of this communications approach needs to also describe realistically the expected performance needed (by a community) to achieve resilience. It will be important to use common language so that communication between different stakeholders can happen efficiently in the planning process. • Identify building industry stakeholders and invite them into the process early on (e.g., Building Owners and Managers Association [BOMA], NAHB [National Association of Home Builders], American Institute of Architects [AIA]) • Consideration needs to be given to streamline the permitting process early on. This will identify ways in which planning processes can be integrated with the resilience planning process. • The process needs to be transparent at the onset; one way to encourage integration is establishing a process by which information can be shared (across planning processes) • Understand the challenge of constraints in Dillon Rule states; early on, establish a mechanism to allow local code changes. Identify additional laws/building codes that would not allow for stricter, more resilient standards. • Establish an education and marketing campaign beginning with the local technical professionals, followed by political leaders, and lastly the public • In addition to assessing the building stock, need to identify data needs and gaps to plan for and achieve resilience through plan implementation (a degree of measurement/evaluation will also be achieved by identifying the data needs) • Identify hazards unique to communities and identify hazards to a community's building clusters and dependencies; assess consequences of disaster event; communicate hazards to stakeholders and prioritize options to prepare and plan for resilience • Advertise new building requirements with a community/jurisdiction; rewrite the NFIP and address (insurance) affordability • Lower the substantial damage threshold/cumulative damage requirements as an incentive to consider resilient approaches	• Establish a plan for continuous improvement to achieve resilience (once the initial planning process has been initiated within a community) • Pilot resilience plan implementation (in a community or communities with different characteristics) to test the systems/mechanisms a community has identified to achieve resilience (focus on integration with other planning processes). • Conduct research to refine knowledge about hazards of interest and best mitigation practices for buildings. • Link LEED and other systems with resilience and mitigation strategies (identify specific ways in which the linkages can take place through research) • Once the resilience plan has been developed, identify funding sources at private, city, state, federal level and opportunities with non-profits. • In the mid-term, once voluntary resilience programs have been implemented, mandate requirements by local jurisdictions (local community needs to buy into and implement the mandatory approach) • Implement a guaranteed fast-track permitting process for building upgrade projects • Achieve resilience by retrofitting buildings at the city block scale, and not widely separated locations (avoid the quilt-patch approach to resilience – look at it more holistically) • Need to consider strategy for using resilience as a catalyst to strengthen and retrofit existing building stock and new construction that is built to higher standards • Consider working with FEMA on the Community Rating System to receive CRS points as a result of achieving resiliency • Need to ensure that the Framework links the science to achieving resilience. It should also link economic savings for retrofit and renewable energy (to achieve resilience) • Incentives play an important role in achieving resilience and it needs to be accommodated in the strategy (example of Los Angeles tax holiday for businesses that retrofit buildings)	• Integrate other industries (e.g., insurance, real estate, appraisers) into the resilience planning process • Concern was expressed that the long-term should not be longer than 10 years (too long of a timeframe to plan for and achieve resilience) • Identify critical facilities and their ability to be repurposed as a "super-robust" buildings (for earthquakes); there needs to be an incentive for designing super buildings

9. Breakout Session #4: Framework Chapter 6 – Transportation Systems

The facilitator began the breakout session by leading introduction of all participants. After completing introductions, the chapter authors, Mr. Ted Zoli and Dr. Erin Ashley, gave a brief overview of the chapter and outlined the goals of the breakout session.

The facilitator then led the group conversation by asking:

1. *How do you envision using the Framework?*
2. *What elements of the Framework will help you use it in planning and resilience efforts?*
3. *What other elements should the Framework address?*

The group listed their thoughts by stakeholder group (Table 9). For example, participants felt community leaders could use the Framework to help develop a community resilience plan, assess their community's resilience, identify critical assets, and prioritize their assets. Participants also found the Framework's examples helpful to provide context and illustrate potential options/strategies for becoming more resilient. The group did feel community leaders would benefit from additional information about which resources are publically available to increase knowledge and assist in decision-making.

The group was then asked:

1. *What vulnerabilities or challenges have you experienced during disaster events due to dependencies or interdependencies with other sectors?*
2. *What steps have you taken to work with other sectors on dependencies and interdependencies?*

Participants had good input regarding interdependencies with other sectors (Table 10). They discussed the challenge related to reliance on gasoline to operate vehicles. However, participants noted that the transportation system may also be needed to deliver gasoline from a refinery in another state to a local gas station. One strategy to mitigate this potential problem is to use the Strategic Petroleum Reserve. However, the transportation system must be functional to facilitate fuel delivery. Participants also noted that the intermodal transportation is important to consider. For example, bridge failures can cause disruptions to roadway transportation, which can impact the demand for trains, subways, and waterways.

After discussion of interdependencies with the transportation sector, the breakout group was asked:

1. *How does the transportation sector define near-, mid-, and long-term community planning?*
2. *What are the best approaches and/or strategies for integrating the Framework into sector planning for disaster resilience for each of these terms?*
3. *What impacts and benefits could integration have?*

The group agreed that in the transportation sector, near-term planning would range from 0-5 years, mid-term from 5-25 years, and long-term for more than 25 years in the future. Participants felt integrating the Framework in the short-term would be best achieved by integrating the concepts with other existing plans (Table 11). Participants also believed the Framework could be used as best practices in identifying strategies for resilience. These uses would result in many benefits to communities, including improved decision-making during disasters and blue-sky events and updated response plans. In the mid-term, participants felt the Framework could be used to develop a long-term financing strategy, and understand how emerging practices are changing the way transportations systems function. This use would result in benefits such as identifying and managing risks to the system as well as response strategies. Long-term, the group felt the Framework could be used to examine business disruptions due to transportation mode failures; and advanced best practices could be used to limit/overcome disruptions to the transportation system.

The breakout group was then asked:

1. *What do you foresee as challenges to integrating the Framework into community planning?*
2. *What strategies do you recommend for overcoming these challenges?*

Challenges the group anticipated fell into three categories (Table 12): Compelling messaging, funding, and complexity of transportation system. When discussing the challenges of messaging, participants felt that different types of users of the Framework would need different messaging to compel them to use the document. One suggested strategy to overcome this and other challenges was making the economic case for Framework implementation. With respect to funding, the main concern was identifying a source to develop and implement a disaster resilience plan. To alleviate the funding challenges, participants believed that prioritizing the appropriate resources based on an acceptable level of risk would be one way to become more resilient over time. The group also pointed out that the transportation system itself is very complex, with constantly changing user-behavior, which could impact Framework relevance. Since states are often in control of their transportation systems, their different policies could also create disconnects. Participants suggested collaboration between states and other stakeholders as the best strategy to overcome these challenges.

Table 9. Workshop Input: Uses of Framework and Needed Elements

Stakeholder	Uses	Positive Aspects	Gaps
Owners and Operators (incl. engineers and consultants	• Data modeling for cyber infrastructure • Anticipatory governance; can reorganize to be able to anticipate risk and respond to incidents • Conduct risk assessments and determine mitigation steps (e.g., preplacement of assets, identify alternate delivery strategy)	• Use of the Framework will drive the collection of new data; used to make informed decisions	• Include safe-to-fail approaches, not just fail-safe practices; each represents different thinking, which owners/operators will need to consider
Community Leaders	• As a reference for talking about resilience; need communities to implement • Help small communities develop a disaster resilience plan; assess resilience, identify critical assets, prioritize • Develop interdisciplinary urban planning, land use, transportation practices	• Use of the Framework will help implement a systematic approach to address resiliency • Case studies and the conceptual model included in the Framework will help provide context and illustrate options for action • The Social Aspects chapter will help tie physical assets to sociology and community needs	• Include additional information about which resources are publicly-available to increase knowledge and enable decision-making (e.g., bridge and pipeline data, assessment tools)
Policymakers	• Serve as a Framework to guide national transportation policy related to resilience, which trickles down to the community level • Plant the idea in their heads about resilience and the need for contingencies for failure		
Academia	• Identify gaps or needs for future research that would better enable application of the Framework • Educate students and promote broader systems-level thinking		• Develop credit requirements to incorporate disaster resilience into urban planner and engineer degrees (note: this may fall within in Framework implementation rather than the Framework itself)
Regulators	• Support the planning and execution of the audit process by keeping up with current trends and practices		
Multiple Stakeholders			• Specific consequences of various hazards and the factors that increase the resiliency of the system • Graphic to illustrate various modes of goods shipment, to show the complexity of the system and alternate options and impacts

Table 10. Workshop Input: Challenges of and Approaches to Overcome Interdependencies

Sector	Challenges	Approaches
Economy – Supply Chain, Logistics	• Disruptions in the transportation system impacts communities (often multiple) as local businesses provide manufactured goods (e.g., auto parts, construction materials); economic data (e.g., for bridge or rail failures) is needed • Local businesses will need to identify alternate shipping methods (e.g., rail, barge, truck, combination thereof) • Modern business practices, such as just-in-time inventories, yield system dependencies, especially for perishable goods	• NIST economic analysis may be good data to reference in the Framework, either as an appendix or a stand-alone document • Communities should identify their "perfect storm" and make decisions accordingly
Positives about Dependencies		• Consider dependencies a positive; add resilience by adding dependencies and redundancies
Power/Energy	• Gasoline is needed to enable travel by vehicle; there is a reliance on refineries in other states and the transportation system to get the product to market	• The use of the Strategic Petroleum Reserve may be a good solution; however, the transportation system still must facilitate delivery of fuel
Communications	• Need access to telecommunications services and ensure redundancies in systems • Internet capabilities are needed to run intelligent transportation systems (e.g., cameras) and to inform the public of incidents and alternate routes (e.g., through social media)	• Identify synergies by coupling transportation with communications; one example is clearly communicating where crews should be sent for restoration of services • Technology and social media help provide situational awareness to decision-makers and the public, and enable smart decisions about alternate routes and a reduction of stress on the transportation system
Buildings/Facilities	• Buildings themselves are not a dependency; the public will want to travel to specific activities housed in the building	• Design buildings to enable shelter-in-place to reduce the need for evacuation and reduce stress on the transportation system
Water/Wastewater	• Water is needed for fire suppression throughout the system, particularly at airports	
Intermodal/System	• There are no small bridge failures; impacts will be widespread • Traffic congestion impacts local communities (e.g., evacuation and response capabilities) • Transportation functionality is required to ensure access to the incident site; secure areas, such as utilities, are an added challenge	• Look at international examples / case studies on bridges and the impacts on inspections • Policymakers should balance the desire for urban density with the need for access by responders, evacuation routes, and hospital transport • Review the Chilean earthquake example regarding the use of international standards in construction; look at how old versus new constructed acted during the quake
Political/Bureaucracy	• Federal agencies with jurisdiction over transportation are stovepiped and are often disconnected with decision-making needs of local officials • With the transportation system spanning multiple jurisdiction, the differences between states (e.g., policies, laws, resource availability, collaboration) is a challenge	• Incentivize building-in resilience into the system; consider intermodal approaches and use federal grant funding

Table 11. Workshop Input: Best Strategies for Integrating Framework into Transportation Sector Planning

Planning Phase	Near-Term Planning (0-5 Years) Capital Planning	Mid-Term Planning (5-25 Years) Planning Horizon	Long-Term Planning (>25 Years)
Approaches and strategies for integration	Align needs with other plans and requirements, and secure funding (federal and state) • Transportation Improvement Program • Surface Transportation Program (STP) under Moving Ahead for Progress in the 21 Century Act (MAP-21) • Climate adaptation	Assess progress on integration of the Framework • Data gathered • Lessons learned • What worked/didn't	Examine business disruptions of modal failures
	Develop an initial awareness, communication, and education campaign • For communities and universities (grant recipients) • Available funding streams		
	Establish project priorities given limited budgets	Develop a long-term financing strategy	
	Use the Framework as best practices in identifying financing strategies for resilience	• Look toward the emergence and use of new technologies and impacts on system • Discuss/consider/take into account how emerging practices are changing the way the system works	Implement advanced practices: • Accelerated bridge construction • Use of strategic corridors and co-location of sectors with transportation network
Impacts and benefits of integration	Connect strategic transportation planning taking place on the federal level to the community level		
	Better connections of federal programs to communities		
	Strategic review of needs/solutions can lead to the development of new mutual aid agreements		
	Self-funded entities (e.g., toll operators) can lead resilience practices due to ease of project funding		
	Improved decision-making during disasters and on blue-sky days	Identify and manage risks to the system; identify alternate response strategies	Encourage informed decision-making
	Discussions about economic impacts can yield closer collaboration between transportation and economic development offices		• Influence long-range state transportation plan • Use of Department of Transportation (DOT)-maintained database
	Identify/engage new/additional stakeholders: • Metropolitan Planning Organizations (MPOs) • Owners/operators within the system • Businesses relying on the system serve as advocates		
	Take advantage of the strategic discussions to update response plans, e.g., evacuation and shelter-in-place	Transportation system must support community's response strategy	Encourage discussions of impacts on coastal communities
		Enable rapid-recovery using pre-set equipment and materials	

Table 12. Workshop Input: Challenges to Implementing Framework and Strategies to Overcome

Category	Challenge	Strategy
Compelling messaging	Different models of users mean there is a need for different types/levels of messaging to be applicable to the most stakeholders	Make the economic case for implementing the Framework
		Identify ancillary benefits of resilience
	Framework should be clearly disaster-agnostic and focus on impacts to the built environment	Talk about benefits to network performance and mobility and prioritizing investments
	Need to clearly explain how the Framework is compatible with other Frameworks and plans (e.g., resilient cities, United Nations [UN])	Identify sector-specific specialists to work with the chief resilience officer; will be an advocate for the sector and identify dependencies and interdependencies
	Need to clearly explain how communities can implement the Framework, and get their buy-in	Develop a national repository of best practices, case studies, and resilience plans for communities to access/use
		Include specific steps in the Framework as potential options for implementation
	Need to identify a local champion(s), especially cities without a resilience officer	
	How do communities battle complacency and encourage development of a resilience plan?	
Funding	Need to identify a funding stream to develop and implement a disaster resilience plan	Determine the accurate level of risk and allocate funding to buy down that risk
		Prioritize sources and allocation of resources, e.g., from gas tax, pay for use
Complexity of transportation system	With ever-evolving transportation system user behavior, how does the Framework remain relevant and help communities stay ahead of the curve?	The DRSP will play a key role in ensuring the Framework remains relevant and helpful; the right stakeholders must be at the table: • FEMA • Users of the system • Resilience officers • Local businesses • State DOTs • Policymakers / politicians
	What technologies, behaviors, and threats haven't stakeholders thought of yet and developed plans for? How does the Framework enable these discussions?	
	How does the Framework account for complexities in interoperability between transportation and other systems	
	Each state (and communities) will view and act on resilience differently; how does this impact/drive mutual aid agreements, DOT decisions, and funding?	Encourage state-to-state collaboration to agree on common elements of the Framework
	Political and bureaucratic issues permeate transportation system decisions about priorities, funding, etc.	Encourage collaboration (e.g., federal agencies, state leaders, private industry)

10. Breakout Session #5: Framework Chapter 7 – Power and Energy Systems

The breakout session began with the facilitator leading participant introductions. Next, the chapter authors, Mr. Scott Tezak and Mr. Stuart McCafferty, provided a brief overview of the chapter and outlined the goals of the breakout session.

The facilitator then led the group conversation of the group by asking:

1. *What challenges have you experienced in past disaster events due to interdependencies with other sectors?*
2. *What are the key Framework components with respect to the energy sector and how could the Framework be used by the energy sector?*

Table 13 lists participant input during this discussion. When discussing past experiences of interdependencies with other sectors from the electric power perspective, gasoline and transportation were two of the most important interdependencies, based on participant experience. After a disaster event, gasoline was described as "gold" because many people will pay large amounts for gasoline for back-up power and vehicles. Transportation is also important to the energy sector because repair workers need to access sites where failures have occurred. To overcome some interdependency problems experienced in the past, the participants listed several potential solutions, including developing inter-utility working groups and using incident command systems.

The group felt the Executive Summary should capture the fact that electricity is now considered a necessity and understanding the interdependencies and energy needs of different sectors drives the need for energy resilience planning, continuous improvements, and hardening. The participants also pointed out that new technologies are already being introduced to the grid and are enhancing the resilience of the energy system. The participants envisioned using the Framework as a tool to help with code development focusing more on the importance of resilience. It was also felt that it was useful to understand interdependencies, prioritize scheduling of activities, and understand efforts/needs of other sectors.

The group was then asked:

1. *What are the challenges to implementation of the Framework and ways to address these challenges?*
2. *What are the foreseen benefits of implementing the Framework?*

The group felt that getting buy-in from stakeholders and communities would be the greatest challenge for implementing the Framework. Participants felt the best strategy to overcome this challenge would be to educate stakeholders and communities with business case arguments, including benefits to the economy, commercial sector, and health sector. When discussing the benefits of implementing the Framework, group responses fell into three categories: 1) During disaster events; 2) During day-to-day operations; and 3) Other benefits. As shown in Table 14, participants felt that implementing the Framework would result in a more resilient system in which fewer disruptions occur. Implementation could be beneficial since it could help shift the mind-set of building and rebuilding. Furthermore, the Framework may also encourage innovation that would result in more cost-effective methods of implementing resilience strategies.

Participants were then asked:

1. *How does the power sector define near-, mid-, and long-term community planning?*
2. *Best approaches/strategies for implementing the Framework in the power sector planning for disaster resilience for each term?*
3. *What impacts could implementation have in each term?*

The group agreed that the near-term would range from 1-2 years, mid-term would range from 3-5 years, and long-term would range from 10-20 years. The group felt that near-term strategies for implementing the Framework in the energy sector included incorporating hazard assessments into the planning process,

improving relationships with contractors and suppliers, and establishing a team to initiate the process (Table 15). These near-term strategies could result in reliability improvements, synergy with other teams, transparency, and partnership building.

In the mid-term, participants considered community buy-in important for implementation. Furthermore, the group felt that rate case studies could be used to measure the additional cost and determine the benefits associated with those costs. As a result, these studies could lead to outcomes that help make the case for resilience planning in the longer-term. In the long-term, using the Framework to influence regulatory issues would lead to increased resilience in the energy sector.

Table 13. Workshop Input: Interdependencies Impacting Energy Sector and Envision Use of Framework

What challenges have you experience during disaster events due to interdependencies with other sectors?	What steps have you taken or should be taken to work with other sectors?		What Key Elements of the Power sector should be high-lighted in the Executive Summary?	How do you envision using the Framework?	What specific elements of the Framework will help you with resilience efforts?
Gasoline is GOLD! You will pay anything for gas- backup power, transportation	Communications priority listing	Inter-utilities working together (working groups)	Technologies are "quickly" being introduced to our grid and are enhancing energy resiliency	As a tool to help with code development- convince legislators, regulators, various boards of the importance of resilience. Benefits- financial, safety, recovery from the unavoidable disasters	Clarify role industry in creating a common resiliency plan
Communications as it relates to pre-planning	FLEX strategies (nuclear plants)	Incident command system	Electric sector exec summary • Electricity is now considered a necessity and understanding the interdependencies and energy needs of different sectors drives the need for energy resiliency planning, continuous improvements hardening and recovery	Advising utility clients (who we design generation/transmission/distribution assets) that this is a proactive approach to improved service	Formalize systems analysis application to treatment of facility-specific interdependencies
Notification/warning system benefits in common and response strategies • E.g. Weather warnings, seismic warnings	FEMA Planning	State emergency management agency	Emergency water should have standby power facilities for a max of 2 weeks, not 72 hours	As a tool for developing and executing security and resilience assessment capacities to support community and regional steady state planning and post-incident recovery efforts	Performance expectations internal and external

What challenges have you experience during disaster events due to interdependencies with other sectors?	What steps have you taken or should be taken to work with other sectors?		What Key Elements of the Power sector should be high-lighted in the Executive Summary?	How do you envision using the Framework?	What specific elements of the Framework will help you with resilience efforts?
Getting to damaged areas to repair systems	DHS- Office of Infrastructure protection has a division (sector outreach and programs division) that builds stakeholder capacity and enhances CI security and resilience through voluntary partnerships that provide key tools, resources, and partnerships. Division operates council and stakeholder engagement mechanisms	Pre-communication with transportation access-control and transportation damage supporting	Expected performance & gaps	For discussion on design basis criteria for increasing resiliency of our power grid. Higher structural requirements, more money	Using the performance matrices to determine if the company is meeting the expected recovery time Provision of several scenarios for disaster resilience, which needs technical researches
Drought at Atlantic Island and the water supply was all contaminated by sea water, water had to be transported to the consumer by trucks	Water/wastewater coordinate well with electricity/energy sector • Pump stations • Potable water		Clarify role of utilities in relationship to community	How to use Framework? • Understand dependences • Prioritization and scheduling of activities • Measure resiliency for community • Understand priorities, timelines, and efforts involved in other sectors • Understand gaps in codes and standards	Add a section on how community advocate can work with regulator to push Framework elements
Transportation access				Using Framework to show upper management the importance of resilience. And ask, "Should we consider extreme events?"	It would be interesting to see a discussion on new, innovative, funding mechanisms to finance resilience
Design criteria variations (codes interdependencies) between and within sections					An outlook for where energy infrastructure will be in 5, 10, 20 years and how that relates to resiliency.

What challenges have you experience during disaster events due to interdependencies with other sectors?	What steps have you taken or should be taken to work with other sectors?		What Key Elements of the Power sector should be high-lighted in the Executive Summary?	How do you envision using the Framework?	What specific elements of the Framework will help you with resilience efforts?
Cellular communications especially key enabling/disabling technology after disaster events (e.g., Peaking, or plan for less availability)					GAPS, external standards guides
					Understanding community metrics and performance goals for recovery and resilience (expectations vs. capabilities)

Table 14. Workshop Input: Challenges, Strategies, and Benefits of Implementing Framework

Challenges to implementing the Framework in community planning	**Strategies to overcome these challenges?**	**How will implementation of the Framework benefit…**		
Buy-in • (Did you get it)	Educate with business case arguments	**Your planning efforts and responsibilities during disaster events?**	**Day to day operations?**	**Other benefits…**
Stakeholder buy-in	Articulate the benefits of resiliency economic, commercial, health	Realize your investment	More "normal" days	Other benefits: • Efficient improvements
Change Management is always a challenge • Buy-in at ▪ Exec ▪ Management levels ▪ Staff ▪ Is this even a good idea	NIST product	Consistency and continuous improvement across the country • Process improvements	Effects of all events will be minimized- economic, societal, etc.	Other benefits: • More innovative
Management acceptance	Regulatory support	Framework can give a clearer focus in planning (useful constraints that would other-wise be treated arbitrarily)	A peace of mind- as prepared as possible	
Challenge: • Overcoming community resistance based on the cost of resilience implementation	Education, education, education…	Conducting targeted research and analysis on critical infrastructure security and resilience issues such as infrastructure financing and resilient design	Resilient corp. culture	
Getting management buy-in	Awareness Cost/benefit analysis	Having a more resilient system	Less disruption	
Different criteria for each cluster			Change of mind set, resilience and demand	
Funding for resilience additions (savings on the back end though) But may not cost more to add resilience				
Regulatory				

Table 15. Workshop Input: Strategies for and Benefits of Implementing Framework

Near-, mid-, and long-term community planning – Generation, Transmission, Distribution Could Vary	Approaches/strategies for Implementing the Framework		Impacts	
Near (N) 1-2 Years	Incorporate formal hazard assessment into the planning process	Need a responsible team/committee/div to institute/initiate (people infrastructure, put in place)	Reliability improvements	Short term impacts: Not really much if you look for quick wins- use existing short-term plans and simply identify resilience benefits. Don't change plans, but start the thought process
	Relationships with suppliers, contractors	Community and regional support	Cost: Set up resilience team Benefit: Synergy with other teams	Raises awareness and shows commitment with (potential) least cost
	As part of Normal OPS Planning within utilities consider resilience "Quick wins" and include in annual reports to regulatory commissions	Planning to replace aged structure and electrical equipment to increase reliability	Getting upper management to buy into the Framework	Transparency and partnership building
Mid (M) 3-5 years	Availability of supplies • Master agreements • Local supplies	Community buy-in	Improve economic growth	Becomes part of planning process and requirements • Better awareness and products
	When evaluating new grid modernization technologies, include formalized assessment against Framework. Include in vendor trade study analysis. Put in requirements	Vendor resilience ratings and relationships in place • Trial proof-of-concept projects	Costs: Expect some added cost for proof/concepts Benefits: Clear basis to implement resilience at no cost increase in projects	Calibrate company's Framework
	Submit rate case request to initiate projects	Regulators could require it as part of rate case		
	Adding readiness in the system			
Long (L) 10-20 years	Integrate successful test case lessons learned and scale to several projects • Advocate/leadership • Improve Framework implementation • Enhance public image	States and local governments could tailor to their specific environment and community priorities and needs	Improve resilience	Tailored, very specific, localized Frameworks • Much better resiliency • Common understanding and goals • Nirvana
	Regulatory issues (environmental, etc.)	Just do it	Identify fatal flaws	Increased resiliency in system
	Planning that includes resiliency goals vs. demand only	Interdependencies	Costs: No added costs for resilience Benefits: Realize vision-success expert, public image enhancement	

11. Breakout Session #6: Framework Chapter 8 – Communication and Information Systems

The breakout session began with the facilitator leading the introduction of all participants. After introductions were complete, the chapter author, Mr. David Mizzen, gave a brief overview of the chapter and outlined the goals of the breakout session. Mr. Mizzen asked how many participants had read the 75% draft of the Communications and Information Systems Chapter. About three-quarters of the participants indicated they had read the chapter.

The discussion of the chapter began immediately after Mr. Mizzen's remarks. The facilitator began the conversation by asking:

> *What are the best mitigation and/or recovery strategies for integrating the Framework into communication sector planning for disaster resilience for each of these timeframes?*

The breakout group identified mitigation and recovery strategies used on an ongoing basis, along with strategies that could be used in the intermediate (3-5 years) and long-term (5-7 years) to limit damage to the communication infrastructure system in a future hazard event. Most strategies identified (Table 16) were categorized as ongoing because service providers work in a competitive business environment where technology is constantly evolving and efforts to maintain service are paramount to address increasing consumer expectations.

After discussing mitigation and recovery strategies, participants were asked to discuss their experiences with interdependencies with other infrastructure sectors. Specifically, participants were asked:

1. *What steps have you taken to work with other sectors?*
2. *What are some potential approaches/strategies for working with other sectors on disaster interdependencies?*
3. *What are the challenges?*

Participants focused discussion on identifying dependencies of the communications sector on other sectors and potential solutions (Table 17). The primary dependencies included access to cell sites (i.e., transportation) and external electrical power. However, participants also listed water for cooling and chillers and dependencies between various types of communication systems as concerns. In terms of strategies to overcome interdependencies with other sectors, the breakout group listed several key concepts, including working with Emergency Operations Centers (EOCs), power utilities, and other communication service providers to take advantage of the different system (e.g., one-way vs. two-way communication systems). Participants also felt it was important to note that service providers have many strategies to overcome failures and want to be told what the problem is rather than which solution to use.

After this discussion, the facilitator led discussion of how the group envisioned using the Framework and what elements should be added to make it more useful:

1. *How will integration of this Framework benefit your planning efforts and responses during disaster events?*
2. *What elements of the Framework will you use?*

Participants felt the Framework would be useful to initiate a pilot study with a local government, prioritizing traffic after disaster events and helping communities understand communications needs for access, fuel, and security to restore services when a disruption occurs. The group felt the Framework could be a tool to collaborate with municipalities and understand the interdependencies between sectors. Participants also felt a number of elements were missing from the Framework (Table 18), including acknowledging that the communications industry cannot go to taxpayers for cost relief. The group's biggest concern was including a completed performance goals table for the communications sector. Although the table was clearly labeled as an example, the group feared a regulatory body would see the table and try to enforce those performance goals on service providers, which may not always be realistic.

Table 16. Workshop Input: Mitigation and Recovery Strategies Used in Communications Sector

Planning Timeframe and Mitigation/Recovery Strategies						
Ongoing, continuous	Education on prioritization options e.g., TSP	Exercise/ simulations, more specific is better	Capacity planning, lifecycle management and ongoing network upgrades required to be competitive naturally drive resiliency	Education/ collaboration	Cap-ex plan integration	Battery backup for phones
	Communication with community	Drills	Success based capital	Communities must collaborate with each other and larger efforts so we standardize resilience efforts to the greatest degree possible	Preplan mobile resilience Deployments across vendors	Business Impact Analysis (BIA)
	Disaster preparedness, message/ communication	Joint Drills across public safety (i.e. Transport, Telecommunications and Energy [TTE] Councils)	Demand is a changing condition which begets resiliency	Disaster recovery institute (example)	Sustaining capital, keep the lights on	Introduce internally BDC and within National Communications Center for Communications (NCC)/Information Sharing and Analysis Centers (ISAC)
	Intersection with public notification systems	Joint Drills with other industries	Fiber technology that requires less active devices to maintain service (less power)	Defined Disaster Resilience plan, team, structure, that are trained ICS	Sales interactive on requirements to drive forecasting	
3-5 Years	Hardened network • Appropriate backup power batter/ generator 3-5 yrs.	Disaster profile capacity plan, evacuation routes, hotspots • 3-5 yrs.	Resource sharing, mutual aid	Prioritization of drills plan in advance not cheap		
5-7 Years	Standards	Micro-grids	Heterogeneous, disaster level communication • Wifi • Wireless • Landline • First aid • 5-7 yrs.	D2D-device to device communications • 5-7 yrs.	New Technology	

Table 17. Workshop Input: Challenges of and Strategies to Overcome Interdependencies

Interdependencies			
Vulnerabilities/Challenges		**Approaches/Strategies**	
(Dependencies) Cascading is a dynamic process controlled by how much storage (e.g. energy) there is on site	Inclusion "EOC" utility paradigm	Existing critical infrastructure team engagement	National coordinating center, Gov't/Industry coordination
Access	Data on homes/neighborhoods destroyed	State what your problem is- not what solution you want!	National council of ISAC's cross sector coordinating council
Regularity relief	Depend on each other! (Backhaul) communications	Safeguard IA strategy	• Relationships=communications • Alliances, forums
Power issues	Inter-modal dependencies and opportunities	State and local EOC	Seat in power company or EOC or direct connection to power company representative
Implications of true dependencies (e.g. power-communications (why not improving power? Comm.-power power) (power dependencies on public comm. is minimal)	Streamlining with Environmental Protection Agency (EPA) regulations (i.e. Generator permits)	National Cybersecurity & Communications Integration Center (NCCIC) Supervises SCADA and other agencies	Alternative comm. Strategies to alleviate congestion
SCADA Industrial/power transportation controls dependent on communications	Water for cooling and chillers		
Inter-community communications depend heavily on public communications - need diversity	Scaling 911		

Table 18. Workshop Input: Envisioned use of Framework and Needed Elements

Framework Feedback				
Envision using the Framework		**Useful Elements**	**Lacking Elements**	
Design and instantiate pilot study with a local government	Prioritization of traffic	Collaboration with municipalities (ideally)	Consumers of communications are price sensitive, the costs they must absorb must be spelled out	New technologies to be included
Framework to be utilized as a guideline/template • Clear terms (i.e. adequate)	Framework will help communities' understand comm. need, access (physical) security fuel, right now some communities are more prepared than others	Better understanding of interdependencies especially energy and transportation	Community metrics not sectors	Targets vs. mandates
Disaster recovery does not equal resiliency	Messaging Frameworks and their use of multiple communities infrastructures	The evolution of networks to meet customer needs often drive resiliency over time, 50 year timeline	Need to guarantee the technology terms	Parallel communication networks (not commercial networks)
Ability to craft/ influence research before mandate		Community planners need more understanding of emergency services available	Communications function is not a brick and mortar building. Document levels toward equipment	Flexible and voluntary
		Standardized expectations with gov't relief agencies	The Framework does not adequately discuss choices comm. users can take to be resilient	Other entities, communication systems' resiliency
		Assess feasibility of Framework for different access networks	Acknowledge that comm. Industry cannot go to public to get cost relief (i.e. taxpayers)	Expectation management
		Messaging Frameworks and their use of multiple communities infrastructures	Use of un-validated performance expectations	Economic impact (national)
			More on: TV and radio broadcasting	Lacking human component or interaction of human processes as a part of the physical infrastructure
				Need more focus on identifying TSP levels of priorities

12. Breakout Session #7: Framework Chapter 9 – Water and Wastewater Systems

The facilitator began by leading the introduction of the participants. Next, the chapter authors, Mr. Donald Ballantyne, Ms. Adrienne Sheldon, and Dr. Kevin Morley, offered a brief overview of the chapter and outlined the goals of the breakout session.

The facilitator then led the conversation of the group by asking:

1. *How do you envision using the Framework?*
2. *What elements of the Framework are most useful for you to use in planning efforts?*
3. *What other elements should the Framework have for it to be most useful? What is missing? What gaps are there?*

The participants' discussion was balanced with a lot of potential uses and suggestions for improving the water and wastewater chapter (Table 19). The group felt the document has many potential uses (e.g., support for developing strategies to restore service, providing a process to develop a work plan, and raising the priority of water and wastewater to a critical level for community resilience). The group also felt the chapter could be improved by adding discussion of the process used to evaluate water and wastewater system resilience and how it impacts community resilience. In addition, participants believed a discussion of cost and time scales (i.e., metrics) should be included in the chapter.

The participants were then asked:

1. *What vulnerabilities or challenges have you experienced during disasters due to interdependencies with other sectors?*
2. *How do you currently work with other sectors on disaster interdependencies? What are potential approaches/strategies for working with other sectors?*

When discussing past experiences with problems related to interdependencies, participants stated that the Hurricane Sandy After Action Report (AAR) identified problems resulting from loss of electric power, fuel, access to sites where failures occurred, coordination, and communication (Table 20). As other breakout groups discussed, one strategy to overcome these challenges is to establish working groups with other utilities in advance of a disaster.

The group was then asked:

1. *What do you foresee as challenges to integrating the Framework into community planning?*
2. *What challenges do various political entities and their potentially different geographical borders pose?*
3. *What are the best approaches & strategies for integrating the Framework into DW/WW sector planning for disaster resilience and community planning?*
4. *How will integration of this Framework benefit: Your planning efforts and responses during disasters? Day to day operations? Other benefits? Economic, social, etc.*

The participants foresaw many challenges in successfully implementing the Framework. Those issues largely focused on cost and resource implication, lack of understanding of difference between resilience and emergency management, and little political motivation (see Table 21). Participants also felt that the interdependencies add a layer of complexity and the question becomes 'who takes the lead?' However, the group discussed many potential solutions to overcome the challenges of implementing the Framework. For example, the participants felt a champion of resilience and continual pressure on local government would help push resilience forward. They also felt that outreach and inclusion of public input would be key to establishing agreeable objectives and gaining support.

Table 19. Workshop Input: Uses and Missing Elements of Framework

Uses		Useful Elements	What's Missing?	
Support strategy for restoring service	Respond to political stakeholder (mayor) and E.O (US Conf. of Mayors)	Stakeholder engagement • There, but what would you get? (In performance goals)	Paint a realistic picture re: expectations for performance goals	Scale issues, metrics such as % customers restored are not totally scalable (e.g., small % of large population is still a significant problem)
Process to develop work plan	From Rockefeller/HUD competition focus on unmet needs/areas of poverty	The matrix showing timelines for levels of service	Cost scale • Improvements and related costs • Also time scale	Developing strategies on competing issues in water services e.g. water quality/supply vs. fire fighting
Use Framework as a reference to help develop agency-specific plan	Value engineering or cost risk analysis or potential failure models	The notion of performance goals is good (different levels)	Missing: process for evaluating water/wastewater system resilience and how system resilience feeds community resilience	Differentiation between regional and community blurred
Prioritize how to develop a hazard resilient network for supporting community resilience	Evaluate awareness on importance of resilience	Gap analysis and timelines desired vs. existing service is good	Roadmap needed: "How to" process to go from where you are to becoming a resilient agency	Organize stakeholders by prioritized groups
Intro to inter-dependency conversations	Guideline for establishing performance goals	The delineation of interdependencies	Purpose based design vs. resilience of design	Is there/should there be a targeted/strategic approach to focus on "building clusters"?
Continuity of operations planning	Basis for integrating design across multiple hazards		Resilience is a never-ending process, think long-term (25, 50, 100 years) as well as what can be done now	Resiliency needs to focus on new and existing: New design standards (e.g. pipelines), existing-corrosion and 75-80% 8" & smaller pipe
How local gov't & supply dist. utilities can provide info/support to public	Setting standards for utility		Likely need to make decisions not to do some things	Push toward "reserve study" approach asset management
Raise priority of DW/WW as critical for community resilience	Integrate into planning process-target partial treatment (not in Framework?)			Water policy issues • Treating water as a "shared resource"- interconnected with other agencies • Identifying "critical customers" • Use of seismic valves
Add concept of triage				

Table 20. Workshop Input: Challenges of and Strategies for Overcoming Interdependencies

Vulnerabilities and Challenges		Approaches/strategies for working with other sectors
Water- fire but they plan separately. Reclaimed for fire? Can we get it?	Firefighting water use following earthquake may be different than what you'd think (more used)	Key customer coordination with PGE (electricity)
• Providing water for firefighting in earthquake (EQ) disaster • Power loss prevents pumping water resulting in service outage and water retreatment	Need to understand emergency response plans from critical customers- e.g. one hosp. has 4 day stockpile for water	Informal exploration of mutual aid between water and wastewater
Water seen as a first responder, raised profile in city		Establish working groups with other utilities in advance of disaster
Getting priority with other utilities		
Different time-based priorities		
Coordination is dependent on a larger organization		
Larger organization may not be well versed on water challenges		
Interstate mutual aid		
Sandy AAR: • Power/fuel • Access-priority • Coordination • Communication		

Table 21. Workshop Input: Challenges and Strategies for Implementing the Framework

Challenges		Challenges to political entities	Approaches and strategies for integrating the Framework		Benefits
• Resources for planning • Cost • Jurisdiction	Difference between emergency mgmt. and resilience not understood	• Identifying need for and implementing interconnections • Determining usefulness of connection locations (doesn't help with portion or all of system services) • Water quality compatibility	Coordinated and consistent public outreach and messaging pre and post disaster	Not just a plan, need ongoing planning	Sustainability is often the same thing as resiliency
The need for seismic resiliency needs to continue to get elevated as a priority (i.e. funding for resources)	No central entity for resiliency to lead efforts/ turn to	• Working together • Who takes the lead?	Operational area and regional water disaster workshops/ summits	Community input to establish acceptable performance objectives (informed by risks)	Resiliency is sustainability through an extreme event
Gaining political attention	In smaller entities, resiliency goes to emergency manager		Champion, constant pressure	Clarification of what a community is	Resiliency should look at all other programs, not just be a program of its own- can be cost free
• Education on system risks and impacts to community (employees and public) • Competing demands systems must address • Integrating resilience with other ongoing programs	Not addressing threat is a decent gamble		Develop action-oriented working groups of key people from key organizations to create plans for response and determine mitigation alternatives to implement in advance	Good social capital means more resilience because of existing connections	
The Framework is an academic/federal construct. Resilience is local so we have a fundamental disconnect	Fragmentation		CROs in the community are possible connector	Need to build relationships between agencies at all levels- elected, management, staff	
Recovery needs water. Scale of a big earthquake overwhelms resources	Rate recovery not supported by PUC's		Need to capture and communicate effects post-event (e.g. pop after 1906 EQ)	Continued scientific support, standards & code development	
Separation of water and wastewater			Understanding your hazard areas and get that information out there (in a policy-appropriate way)	Information sharing	

13. Breakout Session #8: Framework Chapter 10 – Resilience Metrics

The breakout session began with the facilitator leading the introduction of all participants. After introductions were done, the chapter author, Dr. Frank Lavelle, supplied a brief overview of the chapter and outlined the goals of the breakout session.

The facilitator then led the group conversation by asking:

> *What do you think of the goals for community resilience metrics in the draft Framework document (Chapter 10)?*

Participants felt that community resilience metrics must address two questions: 1) How can community leaders estimate the resilience of their community? 2) How do they know if their decisions and investments to improve resilience are likely to make a difference? Participants believed the second question was inherently unanswerable since it is too difficult to measure direct cause and effect.

The group felt many other suggestions about the purpose and goals of resilience metrics were important to include in the chapter. They wanted it to be clear that "this is NOT a cookbook" and there is not a one size fits all metric. Participants believed the first step in establishing metrics at the community level is to develop a baseline that answers: 1) Where are we now? 2) What are our vulnerabilities? and 3) What are the existing levels of health coverage, etc.?

Overall, the process of becoming more resilient and using metrics to quantify the process is a systematic process that occurs continually over time. After developing the baseline, communities need to identify their vulnerabilities, assess their risks, and use metrics to inform decision metrics to limit their risks. The participants felt that it would, therefore, be useful to develop a metric capable of comparing community resilience at different points in time, including assessing how well a community will perform when an event occurs. Furthermore, the group felt metrics should be simple and understandable.

Participants felt communities need help in understanding how metrics can be used to make informed decisions, which may influence the type of metric that is most useful. To ensure metrics are useful, it is important to understand what decisions metrics are used to inform.

The group was then asked:

> *The Framework currently identifies 3 main classes of metrics. What are some critical indicators or metrics in each of these classes that will help community leaders achieve those goals?*

Participants have several ideas for each class of metric (Table 22). When discussing economic vitality, the group identified indicators such as employment rate, housing availability, household net worth, new housing starts, and change in population. To quantify social well-being, the group suggested many indicators including emergency response time, patient waiting time at hospitals, number of natural disaster deaths, migration, availability of child care services, number of bad mental health days, and number of lost school days. Environmental health indicators listed by the group included clean air and water. The group also felt other indicators could be used as metrics for community resilience, including number of electrical disruptions, length of electrical disruptions, and number of telephone calls.

Table 22. Workshop Input: Critical Indicators for Three Classes of Metrics Identified in the Framework

Recovery Time	Economic Vitality	Social Well-Being	Environmental Health (new category)
Addressed by other groups	**Attracting Business & Retaining Jobs** • Employment rate • Missed work days • Availability of multifamily, rental, and low-income housing **Poverty & Income Distribution** • Household net worth, provided by local banks **Tax Base** • New housing starts • Commercial building permits • Change in population • Change in demographics **Economic Sustainability** **Local Services & Amenities**	**Survival** • Number of high-risk emergency response facilities (fire, police, EOC) • Emergency response time • Number of high-risk hospitals • Patient waiting time for hospitals • Emergency response time • Number of natural disaster deaths • Does the community have social media with authority? **Sense of Belonging** • Experience with disaster response and recovery exercises (resilient to what?) • Intergovernmental "connectedness" • Community structure (non-governmental) • Robustness of the social network • Governance capacity • Club/recreation activity participation (e.g. kids soccer, etc.) • Migration (transitory and permanent) **Safety and Security** • Reliable medical services • Reliable water • Availability of child care services • Number of high risk schools • Number of hospital beds and physicians • Access to healthcare, especially non-acute • Use or adoption of model codes and standards (economic/social) • Domestic violence incidences • Number of bad mental death days, e.g. Post-Traumatic Stress Disorder (PTSD) **Growth and Achievement** • Number of school days lost • Education completion rate • School-system function/accessibility	• Clean air and water • Preventing major hazardous materials (HAZMAT) disasters • Environmental sustainability **Others?** • Number of electrical interruptions and length • Number of phone calls, twitter, etc. Number of taxi rides

After discussing indicators that applied to the three classes of metrics discussed in Chapter 10 of the Framework, the group was asked:

1. *Have we over- or under-rated any of the methodologies in the matrix on page 12 in Chapter 10?*
2. *What are the key strengths/weaknesses of any of these or other methodologies?*
3. *For the Framework report itself, how should the methodologies be grouped?*

Although discussion with respect to the metrics included in the chapter was limited, the group did suggest some characteristics they felt were important for any metrics to be used by communities. The group believed that local communities need flexible tools that compare different actions and can be used to prioritize actions. The group also discussed the fact that risk analysis tools (e.g., AWWA-J100) would be useful to communities. Participants felt it would be helpful to include case studies or examples that illustrate how metrics or methodologies have been used to support real-world decision-making.

The group discussed the limits of checklists and their tendency be used simply as a compliance exercise. However, they did think qualitative metrics were acceptable in some cases when impacts are difficult to measure (e.g., social impacts).

14. Breakout Session #9: Disaster Resilience Standards Panel

The facilitator led the introduction of the participants. Next, Ms. Nancy McNabb provided a brief overview of the charter and bylaws, work completed at previous workshops, and outlined the goals of the breakout session.

The facilitator then led the conversation of the group by asking the following questions:

> *Based on presentations today what do you think of the general approach and the effectiveness in engaging Disaster Resilience Standards Panel (DRSP) membership?*

Participants felt more engagement is needed with social/community organizations. The group anticipated greater marketing and incentives would be required to engage industry to become members of the DRSP (Table 23). Furthermore, participants thought that membership should require stakeholder categories to achieve a balance. In developing the DRSP charter and bylaws, the group recommended looking at other codes/processes such as those developed by the ICC, Federal Advisory Committee Act (FACA) and American National Standards Institute (ANSI).

Participants were then asked:

> *In the DRSP bylaws, what procedures should be established for DRSP voting, based on your experience with similar panels – who, what, when and how? See draft bylaws, Section 2.5 for Voting bylaws; and draft charter, Section 1.4.3 for description of Consensus.*

The group provided suggestions for establishing the DRSP based on their experience with similar panels (Table 24). Participants suggested the DRSP follow the ANSI process so no one group would dominate the vote. When a vote occurs, the group suggested the proposal be made available 30 days prior to the vote and that two-thirds of the panel should have to vote "yes" to pass the measure. The group also felt that "no" votes without comments should be void.

In terms of conducting and recording a vote, the group felt the current 75% threshold for a valid vote was too high and should be reduced. The group also suggested the bylaws allow electronic voting to occur because it will be tough to have all votes take place at face-to-face meetings. Furthermore, to ensure stakeholders remain engaged, participants believed that not returning a number of ballots in a row should result in removal from the DRSP.

The group then shifted their focus to the leadership of the DRSP and was asked:

> *In the DRSP bylaws, what qualifiers should be established for DRSP Officers – selection, duties, term? See draft bylaws, Section 2.1.5 for DRSP Officers*

The group believed the leadership should have a broad balance of stakeholders. Some participants suggested the Chair, Vice Chair, and Secretary of the leadership committee be elected to 3-year terms by the panel, with the ability to be re-elected to serve multiple terms (Table 25). However, others felt the terms should be shorter (e.g., 1-year) and should be staggered so there is a continuation of leadership.

The participants were then asked:

> *In the DRSP bylaws, what procedures should be established for DRSP meetings and decision making (Disaster Resilience Standards Panel Coordinating Committee [DRSPCC]) – frequency, meeting place, attendance? See draft bylaws, Section 2.1.7 for Meetings and Decision Making*

The group stated that it was important to ensure the DRSPCC was open and transparent. They agreed that at least two face-to-face meetings should take place each year with no upper limit.

After discussing the terms of the DRSPCC leadership, the group discussed the process by which they should be elected. The group was asked:

In the DRSP bylaws, what procedures should be established for selecting DRSPCC (coordinating committee) members – call for candidates, nominations committee, election? See draft bylaws, Section 2.2.2.1 for Selection of Voting Members; and draft charter, Section 1.1.2 for DRSPCC Membership

As shown in Table 26, the group felt candidates for the DRSPCC should have broad experience that includes at least some knowledge of all stakeholder groups. They believed leadership needed to include thought leaders. The Nominating Committee should consider the technical aspects of the DRSPCC such that it is diverse and inclusive.

The group was then asked questions regarding the draft Framework:

How do you anticipate the Framework being integrated into your community to ensure that it will be useful (considering the scale of your community)?

Participants felt the key to integrating the Framework would be to have a champion (e.g., Chief Resilience Officer) who leads a program that incorporates the concepts in the Framework (

Table 27). However, the group felt marketing would be needed to develop buy-in and advocacy for a more resilient community. Participants also felt that roadmaps or guidance documents would be needed to help apply the Framework.

The group was then asked:

> *What opportunities do you think that the Framework will provide for your community?*

Table 28 shows the responses from participants. The group felt there were several features of the Framework that would allow communities to begin the process of becoming more resilient. Participants felt the Framework would help communities evaluate their current level of resilience, current risks, organize plans, and lead to a better quality of life by understanding how improvements to the built environment tie into Maslow's Hierarchy of Needs.

The group was then asked:

> *What should be the process for documents entering the Resilience Knowledge Base (RKB) – what decision path, what type of documents? See draft charter, Section 1.3.4, Develop and Maintain the Resilience Knowledge Base*

As seen in Table 29, participants felt the RKB could include flowcharts, tools, case studies, etc. Participants agreed that the working group would first approve the documents, followed by the DRSP, through a vote before posting documents to the database.

The group was asked:

> *What opportunities does the Resilience Knowledge Base provide to stakeholders/community?*

The group stated that the DRSP should have a peer-to-peer education effort to promote learning to local government. The group also felt simple tools that could be reviewed or used would be helpful to address the complexity of the problem.

The participants were asked:

> *What do you foresee as the challenges for DRSP implementation to be effective?*

The group stated there would be several important challenges to overcome to implement the Framework, including cost, resource limitations, and lack of urgency (Table 30). Moreover, the group pointed out that resilience concepts need to be marketed and sold to communities to become successful.

More specifically, the group was asked:

> *What guidelines could be developed that would help communities implement the Framework? Solutions to implementing Framework in the form of guidelines…*

The participants' responses were categorized into five different categories (

Table 31): Documents, tools, incentives, online, and other. The group reiterated that including case studies was essential to assist with implementing the Framework. Some participants also suggested developing guidelines for various hazard types that could be used at the local level and would be more applicable to communities in different parts of the country.

Table 23. Workshop Input: Engagement Needs to Form DRSP

What's Missing/What's Wrong	Stakeholder Engagement	References	Formation of DRSP
Speaking to an industry vs. speaking for an industry	Engaging DRSP membership may need greater marketing and incentives	Use ICC Code Change process for development of standards	DRSP could be included within Natural Hazard Mitigation Association (fold in to existing non-profit)
Need to engage greater number of social/community organizations in planning (representation of vulnerable populations)	Engage industry groups and professional associations to recruit members	ICC Model process may be effective with respect to problem/impediment identification	
Need to better overcome/address administrative, jurisdictional, environmental, economic and industry boundaries	Membership should require stakeholder category and subcategory (e.g., • Transportation – buildings • Transportation – rail • Transportation – pipeline…)	ICC model process will prove very cumbersome with regard to problem solution; yet may be best approach for voting etc.	
Missing engaging approach, it will be effective if it includes various sectors and stakeholders. What was missing beyond the community level (i.e., community interaction for resilient nation)	Panel member organization must have at least one active member of a working group with attendance	Model DRSP after FACA – architecture that works! Reference logic and principles	
Standards might be too lengthy/complex for broad adoption; use annexes		Use ANSI process for standards development	

Table 24. Workshop Input: Suggested Procedures for DRSP Voting

When – what's the process	How - recording votes, passing etc.	Who – length of membership etc.
Structure issues or ballot for voting, e.g., who, what, when is at stake if passed impact in advance	With current list of stakeholder categories it will be difficult to get balance – spell out requirement for balance in bylaws	Procedure to identify relevant stakeholders and expectation to vote
Proposal available 30 days prior to announced vote date	Most voting should be electronic	Underserved populations are typically hit first and last by disasters • Underserved need to be captured in vote
2/3 "Yes" required, and "No" answer without comments should be void. All comments addressed and documented before approved.	Bylaws should provide for remote/electronic participation and voting	
Follow ANSI process – ensure no one group dominates vote	Voting should be electronic – web based by all eligible members	
Prior to release and implementations… account for timing • Revisit documents after period of time	Determine how many non-returned ballots gets you kicked off DRSP	
	75% present threshold (current draft wording) is high threshold for valid vote!	

Table 25. Workshop Input: Suggested Qualifications for DRSP Officers

Selection	Duties	Term of Service	Other
Shall have attended previous meetings and have relevant expertise	Keep DRSP officer duties and requirements as broad and open as possible, at least initially • Not too exclusive!	One year term – and may hold multiple positions	Officers draft text fine as is on selection – duties – term
Officers should be elected based on qualifications	Relevant panel stakeholder appointments to the working group chairs and "special" coordinating council members for balance. Or just approve!	Alternate terms so all three don't terminate at once	Looks at National Institute of Building Sciences (NIBS) model
Prior experience suggested: • Chair – 3 years • Vice Chair – 3 years • Secretary – 3 years			Change the title "officer" to "leadership"
Suggest 3 year term – and can be eligible for re-election for multiple terms			
Selection: Voted by membership, but must provide qualifications to be eligible as a candidate			

Table 26. Workshop Input: Electing DRSPCC Leadership

Candidates	Nominating Committee/Qualifications	Other
Coordinating council candidates should be focused on communities, standards, research – focused on goals	Qualifications should be relevant to technical aspects of committee, but be diverse and inclusive	Need to address handling of sensitive information, e.g., city plans, risk analysis, Personally Identifiable Information (PII), classified, controlled! • And Intellectual Property
Coordinating council members should have broad experience base – some knowledge of all stakeholder categories		
Current draft coordinating council at large membership does not include: • Tribal • Underserved • Hazard mitigation/climate adaption • Insurance/re-insurance • Recovery manager These should be considered in addition to those in draft		
Coordinating Council members need to be influencers "cheer leaders"		

Table 27. Workshop Input: Anticipated Integration of Framework into Communities

Organizational Structure	Leadership	Notification/Presentation
Integrate by ordinance developed by Building Dept. or Planning Dept. (or Chief Resilience Officer)	Will need a champion – likely paid staff (e.g., resilience officer)	Need different tracks, i.e.,: • Urban – Small, Medium, Large • Region – Coastal/Inland • Hazard – Hurricane/Quake/Tornado
Need: • Chief Resilience Officer • Educational programs for members of community • Input from community on needs and changes	Initial socialization/buy-in and marketing; must have strong champion/leadership incentives	Guidance documents and roadmaps will be key. Framework should be digestible
Structure in a way that allows local adaption and incorporation, e.g., existing organization/dept., or new entity	May be useful for non-technical leadership/authority to direct technical action to spur conversation and inform the interaction between political/technical/social elements	Make the process open to public participation
State, regional, local… • Governance • Boundaries • Chartering legislation • Elected as appointed	Champion should use dollar based economic approach to "Whole Community" including developers and skeptic	Money is needed to initiate the process at local level

Table 28. Workshop Input: Opportunities Framework will Provide to Community

Opportunities		
It will help us evaluate current resilience level and develop goals for future directions • "Eye opener"	Helps people organize planning and expectations around resilience	It will promote public safety through resilient buildings and infrastructure
Actually look at what risks exist to whom; understand impediments: legal – externality – economics	Greater quality of life – addresses Maslow's Hierarchy of needs for specific community • Needs to be adaptable to community	Scenario development. Envision a disaster before it occurs. "Building Code Ex", stands but not deliverable
Tie to existing community metrics/understanding of success/resilience and add new, e.g., 100 Resilient Cities (100RC)	Expand hazard consideration beyond rules, regulations, laws (Oregon example – erosion zones)	Energy, transportation, water, fire, hospital critical infrastructure as an example • Will spur inter-department discussions
It will encourage recognizing risks, and begin the conversation • Opportunities created	Hopefully the Framework will provide a measurement tool of system (score, scale, etc.); maybe life cycle costing $ over lifetime, or online tool to implement the Framework	

Table 29. Workshop Input: Resilience Knowledge Database (RKB) Content

RKB Decision Process	Content
Documents should be developed by working groups, recommended by standing committee and voted on by organization	The draft text is fine. It just needs to be well organized!
Categorize model ordinance plans, tools, and standards (if from approved agency)	1) All components of the Framework, 2) standards, and the 3) case studies
Develop flowchart/rules, who – what – where – when – why – how, for submittal and acceptance for posting. Both formal rules and informal content/discussions. • See PMI.org and PM.com example	No limit on types of tools: • Existing resources • New documents • Standards and guides • Software (online • Etc… Wiki?
First – working group approve, then Second – DRSP approval	

Table 30. Workshop Input: Foreseen Challenges for DRSP Implementation to be Effective

Resources	Structure	Communications
Many of the requirements that come out of the Framework will require money. Retrofit of building is expensive. Same with lifelines.	Differing resilience priorities among stakeholders due to infrastructure and technology deployed (DRSP barrier)	Need to make scientists and policy wonks knowledgeable salespersons on all aspects of resilience, especially economic • Knowledgeable of costs/benefits
There is a lack of clear economic data		Getting a wide range of stakeholders involved at the DRSP level
Quantifiable approach is needed		This is not UNIQUE (although could be!) • Mindset of "just another committee"
There is a lack of: • Resources • Urgency • Time… consensus process takes time		Thoughtful communications up and down and across for resilience • E.g., DRSP and committees , working groups need to understand this is about people and communities; the social aspects
Money is not a barrier, it is an opportunity • E.g. S. Hallegette World Bank		

Table 31. Workshop Input: Guidelines to Support Framework Implementation

Documents	Tools	Incentives	Online	Other/Scope
• Model ordinance • Model legislation	Lack of urgency • No recent disaster • No need to act Need a guide to estimating probability of future losses – coast	Need much more than "guidelines" need peer-to-peer organized educational effort on common types of resilience	Webcast introducing Framework that is simple, describing importance and value of Framework	Need to overcome anti-regulation, anti-government mindsets; provide ideas to help locals
As many case studies as possible	Resource to determine scale of plausible disaster e.g., tornado – make take whole town or just part of larger town	Risk measurement can lead to International Organization for Standardization (ISO) type insurance schedule. Rating community resilience – leads to consensus	Engage independent film makers to develop YouTube video, e.g., K-cup monster video, to motivate action!	Robust, agreed upon methods to calculate cost/benefit
	Develop guidelines for various hazards that can be used at the local level (model ordinance)	Develop Federal, state, local and commercial financial incentives, e.g.,, greater or lesser grants, insurance savings		Define "maturity levels"
		Detailed scorecard-type tool that measures/reveals communities' ability/capacity to meet resilience expectations • This should be a community and public tool		

15. Closing General Session

Mr. Cauffman led the closing session, inviting a representative from each breakout group to summarize their main points during the two-day workshop.

- The ***Social Context for the Built Environment Breakout Group*** felt there were a few social institutions that should be added to the current draft of the Framework, including the scientific community, information, government agencies, and ad hoc organizations. Participants also felt the tables linking the social dimensions and built environment could be placed into the chapters. Furthermore, the group considered adding case studies or examples to be a valuable activity.
- The ***Community Disaster Resilience for the Built Environment Breakout Group*** felt there were several important strategies that could help with implementing the Framework. These strategies included developing a financing mechanism so communities could understand the cost of not acting, community engagement, participatory budgets (i.e., communities can vote on budgets), and incorporating resilience concepts/plans into existing hazard mitigation plans. The group also felt there would be many challenges to implementing the Framework (e.g., identifying resilience champions in a community, getting political support, and prioritizing gaps). The group felt the Executive Summary clearly defined the purpose of the Framework, but needed "a hook" such as a Call to Action to answer the question "Why should I read this?" Participants were concerned the Framework was long and should be made more accessible. They also suggested developing a web-based tool that could be implemented as part of version 2.0 of the Framework.
- The ***Buildings And Facilities Breakout Group*** liked the fact that the Framework encourages bringing all stakeholders to the table. However, participants did feel that more attention to communities with fewer resources was needed. The group appreciated the discussion of interdependencies between critical buildings and infrastructure sectors. To successfully implement the Framework, the group thought best practices, case studies, model incentives, and checklists would also be useful. To integrate the Framework into existing plans, the group felt pilot programs and incentives were needed, as well as getting other industries (e.g., insurance, appraisers, planners, realtors) involved in the process. The group believed implementing the Framework would benefit communities by bringing all stakeholders to the table and producing positive social and economic return on investment.
- The ***Transportation Breakout Group*** envisioned using the Framework to enable decisions in the resilience planning process and provide a reference to address emerging issues. The group liked inclusion of case studies, but wanted to see more graphics to help explain complex topics, particularly in the transportation sector. Participants noted that the transportation system can significantly impact the supply chain, and has a very complex regulatory environment since there are several different modes of transportation used for people and goods. To integrate and implement the Framework, the breakout group felt a compelling message was needed to sell the Framework to communities, ideally a message that makes the economic case. They envisioned using the Framework to make strategic decisions throughout the transportation planning cycle. However, they noted that the challenge of political influences must be overcome to be successful.
- ***Energy System Breakout Group*** participants felt two of the biggest challenges for their sector were the availability of gasoline and telecommunications. They suggested the Executive Summary note that electricity is now considered a necessity to maintain functionality of other infrastructure systems. The group identified several useful elements of the Framework from the energy sector's perspective including clarifying the role of the energy sector in community resilience, defining expectations, and identifying resilience gaps. Like other breakout groups, the energy group felt community buy-in/support was key to Framework success. The impacts of using the Framework could be cost savings in the long-term when hazard events occur, and encouraging innovation to reduce costs in short-term to enhance resilience of the grid.

- The ***Communication and Information Systems Breakout Group*** felt it was different from all other sectors because service providers are part of a competitive industry. As a result, service providers constantly upgrade their systems to adapt to evolving technology and increasing consumer expectations. The group also believed strongly that communities need to take advantage of multiple methods of communications (wireless, wireline, cable, internet, broadcast), particularly in the aftermath of a disaster when one of those systems may fail or be congested due to high traffic. Participants thought that communities need to work with each service provider to identify their priorities ahead of a disaster event. This communication is necessary because community priorities are not always the same as those of the service provider or utilities.

  Service providers want to work with communities to enhance resilience of their telecommunications systems. They want to work with communities to identify problems and propose solutions to make communities more resilient. Of course, 9-1-1 services are important in every community and participants considered proper Public-Safety Answering Point (PSAP) funding important to maintain functionality. The group also noted that disaster response does not always equate to resilience because a quick fix does not necessarily improve performance in the future. The group was concerned that the communications chapter was long, and the Centerville, USA example performance goals could be enforced by regulatory bodies even though some of the goals were not always reasonable.

- The ***Water and Wastewater System Breakout Group*** felt the Framework could support utility planning efforts and facilitate prioritization/interdependency discussions. The group liked the fact that the chapter highlights the importance of water and wastewater to community resilience and the notion of performance goals using a simple matrix. However, participants felt additional info could be added to discuss cost and time scales and the process of evaluating water and wastewater system resilience. Better coordination for firefighting and water after a disaster event was a special consideration for the water and wastewater chapter. Similar to other breakout groups, the water and wastewater group identified the needs to achieve buy-in from the whole community and to identify a resilience champion as keys to successful Framework implementation.
- ***Community Resilience Metrics Breakout Group*** participants felt metrics should be developed that account for uncertainty. Metrics are not always precise, a fact that models including uncertainty would appropriately address. The group also felt metrics should include the ability to record baseline measurements, be used to inform investment decisions, and help communities monitor their progress in becoming more resilient. Some participants felt a fourth class of metric, environmental health, should be included in the chapter.
- The ***DRSP Planning Breakout Group*** felt members should register by stakeholder category. They also encouraged NIST to look at other similar models, such as ANSI, FACA, and ICC, while formulating the panel. When discussing the bylaws of the DRSP, the group felt it was important to ensure the panel's leadership was diverse, open, and inclusive. Leadership would also have to be qualified to assess and vet working group products.

  When discussing the Framework, the group was concerned that it was long and would need to be made more accessible. The group also recommended that a public relations/marketing strategy be used to educate communities and other about the Framework.

  The breakout group discussed development of a resilience knowledge database. It envisioned that this would contain a method to evaluate benefits and costs, case studies so communities could evaluate options, and resources for decision-makers or rollout plans for public officials. Furthermore, the group discussed development of guidelines that could be used to help communities quickly evaluate their level of resilience, assist with prioritization, and develop a path forward.