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Lessons Learned Information Sharing

TREND ANALYSIS

Full Scale Exercises and Real World Events: Analysis of 2007 – 2012 Tornado After Action Reports

June 20, 2013

TREND

The Lessons Learned Information Sharing research team selected and analyzed 32 tornado after action reports (AARs) published between 2007 and 2012 to develop this Trend Analysis. Eighteen of the reviewed AARs refer to full-scale exercises (FSE) while fourteen focus on response and recovery operations following a real world tornado event. Core capabilities identified as areas of improvement that the team focused on during this review include:

- Critical transportation
- Community resilience
- Environmental response/health and safety
- Mass care services
- Mass search and rescue operations
- Operational communications
- Operational coordination
- Planning
- Public and private services and resources
- Public information and warning
- On-scene security and protection
- Training

2007-2012 Tornado Fatalities and Damage Cost

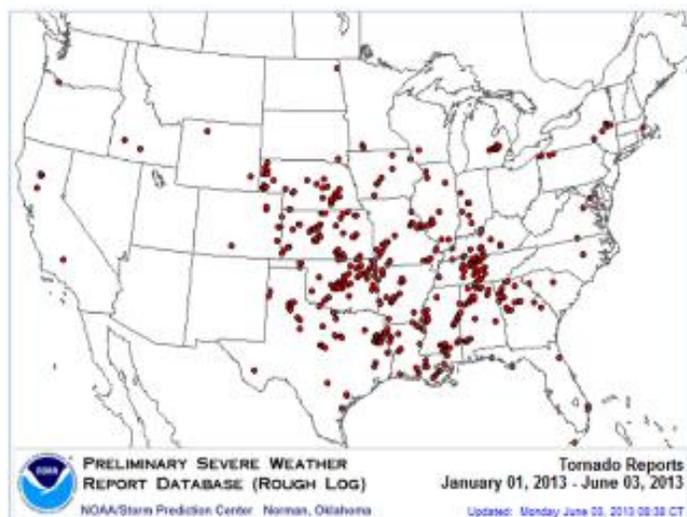
YEAR	Tornado Fatalities	Damage (million \$)
2007	81	1,407.52
2008	126	1,865.6
2009	21	584.89
2010	45	1,134.57
2011	553	9,492.95
2012	n/a	n/a

(Source: NOAA NWC)

The analysis of this AAR sample shows that FSE participants and emergency personnel responding to a tornado may experience some similar issues and challenges. The findings described in this document can help emergency management and response organizations prioritize limited local resources to best prepare for the impact of tornadoes.

DESCRIPTION

The [Meteorology Glossary](#) defines a tornado as, “a violently rotating column of air, pendant from a cumuliform cloud, and often (but not always) visible as a funnel cloud.”



According to the National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), tornadoes are "[Nature's Most Violent Storms.](#)" Tornadoes can be one mile wide, produce wind speeds in excess of 200 mph, stay on the ground for over 50 miles, and cause devastating damage. The U.S. experiences approximately 1,200 tornadoes each year, which cause an average of 60 fatalities and 1,500 injuries. (Appendix A includes additional information on tornado-related fatalities)

NOAA NWS uses the Enhanced Fujita Scale (EF Scale) to categorize tornadoes. This scale is based on wind speed and level of damage associated with each tornado.

There is no national tornado season as regions experience increased tornado potential at different times of the year. Tornadoes can occur at any time, any day of the year throughout the United States. However, according to [NOAA National Climate Data Center](#), they occur most frequently in Florida and in the "Tornado Alley," in the south central U.S.



ENHANCED FUJITA SCALE	
	Wind Speed (MPH)
EF-0	65-85
EF-1	86-110
EF-2	111-135
EF-3	136-165
EF-4	166-200
EF-5	over 200

AAR Sample

The LLIS team analyzed a sample of 32 AARs from both exercises and real world events to develop this Tornado Trend Analysis. The 14 real world tornado AARs focus on, among others, the 2007 Greensburg, Kansas, tornado; 2008 Iowa summer storm and tornado; [2011 Joplin, Missouri, tornado](#); and 2011 Mississippi tornado outbreak.

The 18 FSE AARs selected for analysis supplement real world reports as these exercises were realistic, complex, and resource-intensive. According to the [Homeland Security Exercise Program](#), "FSEs are usually conducted in a real-time, stressful environment that is intended to mirror a real incident...The FSE simulates reality by presenting complex and realistic problems that require critical thinking, rapid problem solving, and effective responses by trained personnel."

By reviewing and comparing these two sets of AARs, the LLIS team was able to identify issues experienced by emergency personnel during both tornado exercises and following real world tornado events.

EF5 Tornadoes

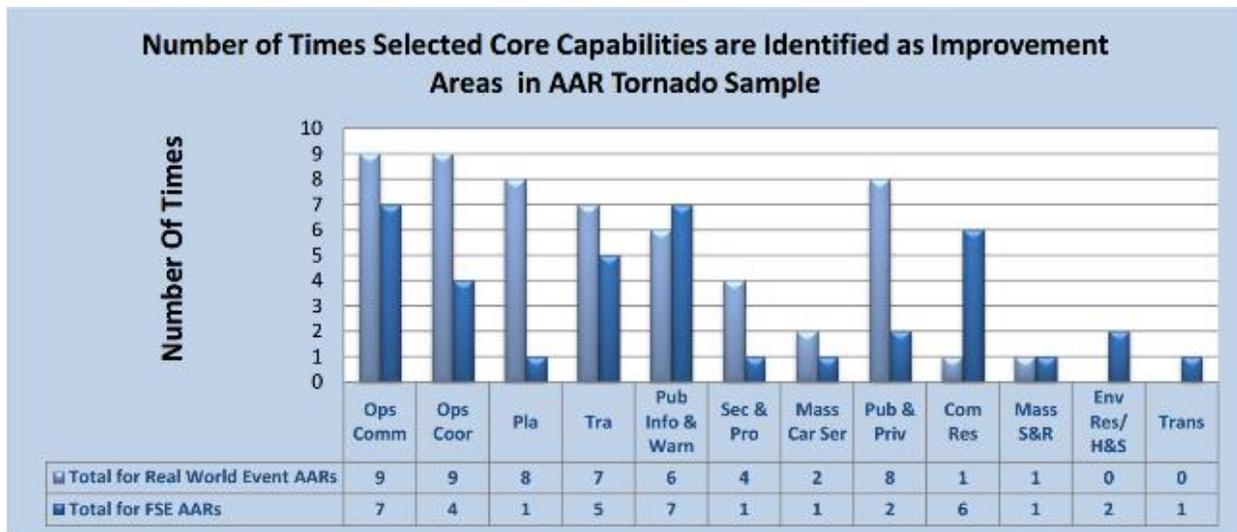
Greensburg, Kansas: On Friday, May 4, 2007, a 1.7-mile-wide tornado hit the city of Greensburg with winds in excess of 200 miles per hour. The tornado caused 11 fatalities and 60 injuries, and destroyed nearly 100% of Greensburg's buildings within 20 minutes of impact.

Joplin, Missouri: On Sunday, May 22, 2011, a tornado struck the city of Joplin, Jasper County and Newton County in southwest Missouri. With winds in excess of 200 miles per hour, the 3/4-mile-wide tornado cut a 6-mile path through central Joplin. The tornado caused 161 fatalities and approximately 1,300 injuries. Thousands of structures were destroyed or damaged, from single family homes to large public buildings, including St. John's Regional Medical Center. For additional information please refer to [The Response to the 2011 Joplin, Missouri, Tornado Lessons Learned Study.](#)

Trend Analysis Results

The table and graphs below display the number of AARs listing each area for improvement.

Areas for Improvement List	Number of AARs Listing Area for Improvement		
	18 FSE AARs	14 Real World AARs	Total for 32 AARs
Operational communications (Ops Comm)	7	9	16
Operational coordination (Ops Coor)	4	9	13
Public information and warning (Pub Info & Warn)	7	6	13
Training (Tra)	5	7	12
Planning (Pla)	1	8	9
Community resilience (Com Res)	6	1	7
On-scene Security and Protection (Sec & Pro)	1	4	5
Mass care services (Mas Car Ser)	1	2	3
Public and private services and resources (Pub and Priv)	2	8	10
Environmental response/health and safety (Envi Resp/ H&S)	2	0	2
Mass search and rescue operations (Mass S&R)	1	1	2
Critical transportation (Trans)	1	0	1



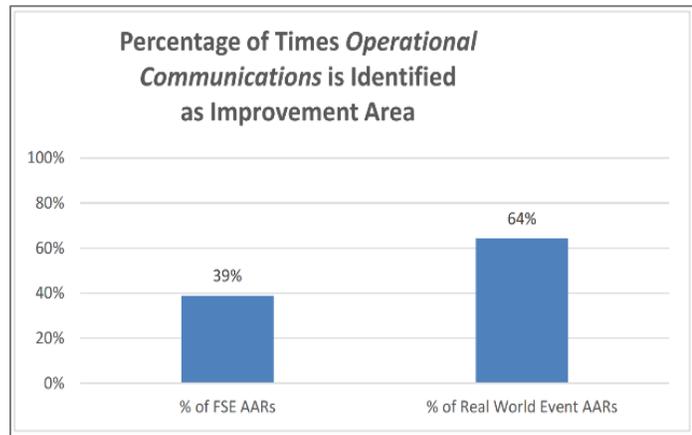
AAR recommendations

The LLIS team further reviewed the 32 AARs to identify available recommendations that could assist jurisdictions in addressing these areas for improvement. The team found that Operational Communications, Operational Coordination, Planning Training, and Public Information and Warnings were the areas for improvement that incorporated the most relevant recommendations. Examples of these recommendations are listed below.

Operational Communications

FEMA describes [operational communications](#) as the capability that ensures “the capacity for timely communications in support of security, situational awareness, and operations by any and all means available, among and between affected communities in the impact area and all response forces.”

Sixteen AARs identified operational communications as an improvement area for participating or responding organizations during a tornado FSE or response operations to a real world tornado event. Many of these AARs focused on having correct and routinely updated call lists to reach out and coordinate with response leads and other personnel as well as with schools, hospitals, nursing homes, businesses, and other appropriate partners.



Recommendations listed in these AARs include:

- Routinely update internal and external partner contact lists for the Emergency Operations Center and Dispatch.
- Repeat and confirm orders as well as properly follow dispatch procedures for accountability and tracking purposes.
- Improve coverage, spectrum, or equipment limitations with additional equipment.
- Complete an analysis of what communications each community currently uses and begin to consider moving to a regional system that allows the towns to consolidate systems. On a local basis, determine what resources need updating to allow for better interoperability with outside agencies.

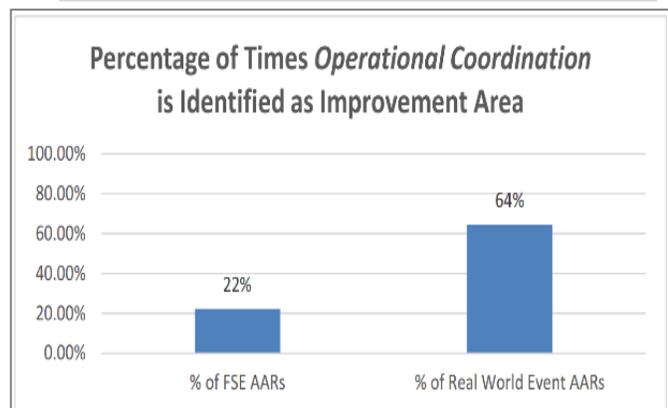
Operational Coordination

[Operational coordination](#) is meant to “establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities.” Thirteen AARs report that operational coordination represented an area for

The [2012 National Preparedness Report](#) describes operational communications and operational coordination as areas of national strength. The report states:

Operational Communications: “Government partners around the country have established flexible and interoperable communications capabilities built on sound plans and tested through exercises and real-world events.”

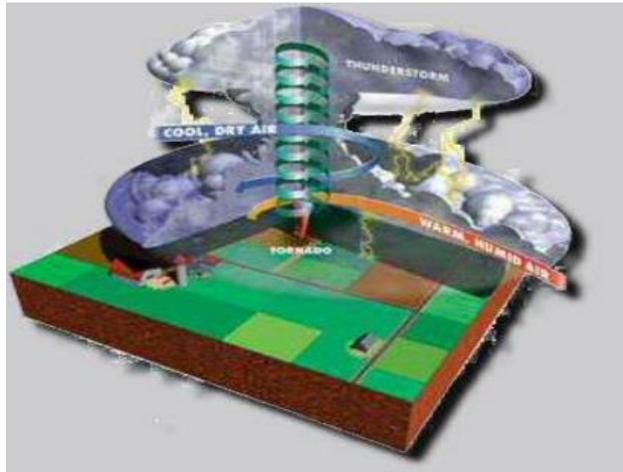
Operational Coordination: “The National Incident Management System (NIMS) provides a common doctrine for incident management, allowing the whole community to use shared language and principles.”



improvement during a tornado response or an exercise. For instance, some AARs noted that incident command was not properly established.

Recommendations in these AARs include:

- Provide the incident commander with a ICS Form 201 to inform the creation of an Incident Action Plan that can be quickly distributed to the appropriate responders
- Ensure exercises have appropriate representation for testing interactions across agencies
- Modify systems to allow for tracking of required information
- Review current policies and procedures, and update coordination SOPs



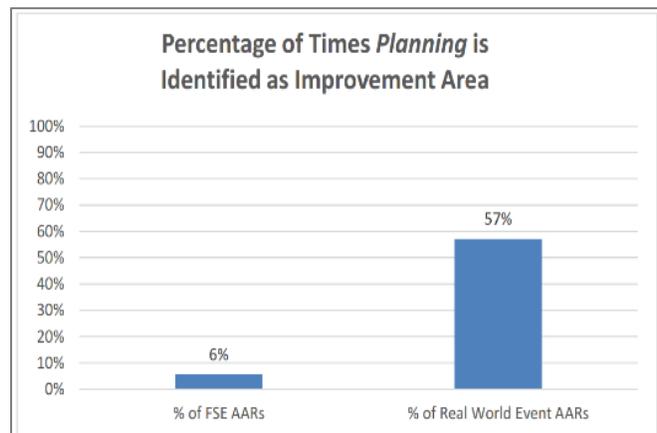
Source: [Maryland Emergency Management Agency](#)

Planning

FEMA describes [Planning](#) as, "Conduct a systematic process engaging the whole community as appropriate in the development of executable strategic, operational, and/or community-based approaches to meet defined objectives." Several AARs state that coordinated, advanced planning among agencies did not take place prior to an FSE or a tornado response. In addition, in some cases planning during a response or an exercise was delayed or not effective due to unclear mission, limited operational guidance, and/or lack of specialized personnel.

Recommendations include:

- Develop an interagency planning group that will hold daily meetings to identify 36 hour+ issues and develop incident objectives for inclusion in upcoming Incident Action Plans
- Maintain multiagency representation and participation in the Planning Section
- Develop Planning Section
- SOPs and operational guidance that includes activation criteria and mission description



Training

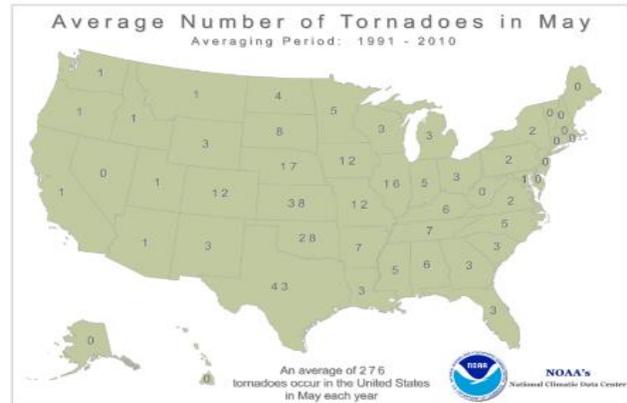
Issues related to lack of or limited training is mentioned in 12 out of the 32 AARs. These AARs specifically list communication system training as well as training focusing on procedures and roles.

Training-related recommendations include:

- Train operators on communications equipment, procedures, and systems
- Develop user guides
- Train personnel on NIMS, ICS, and their EOC functions
- Conduct training that addresses staff turnover issues

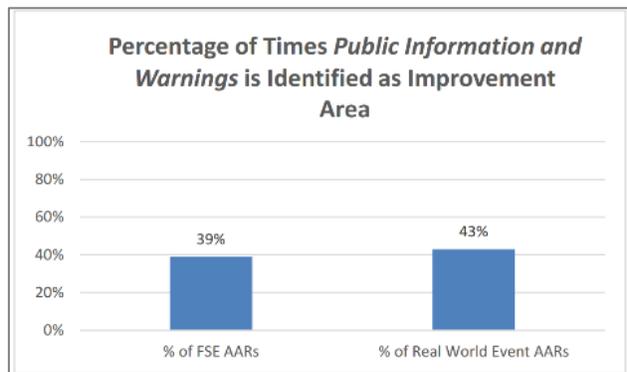
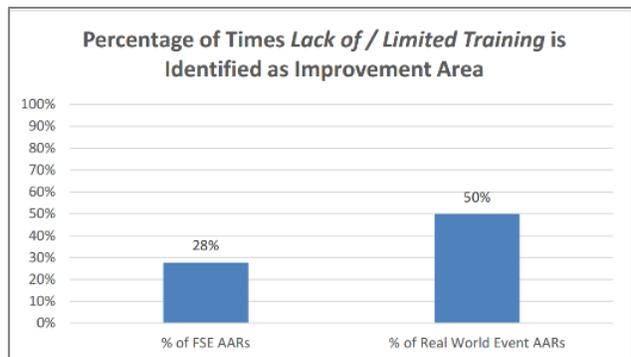
Public Information and Warning

The [NWS Storm Prediction Center \(SPC\)](#) in Norman, Oklahoma, is tasked with issuing timely and accurate watches and forecasts related to tornadoes and other extreme weather events. The SPC issues these watches when weather conditions are favorable to tornado development. Early warnings allow emergency managers and responders to provide essential information to the public, deploy staff, and prepare for emergency operations. Multiple AARs noted that local warning systems could not be used to reach and alert entire at-risk communities. In addition, the analysis found that, in many cases, warning system activation was a time consuming process.



The AARs included the following recommendations, among others, related to these issues:

- Review activation criteria and protocols for sirens and other alert systems to ensure timeliness, FCC compliance, and coordination.
- Routinely test and replace equipment. Validate that alerting systems reach the appropriate audiences at the appropriate strength, or that alternate communications are also in place.
- Educate the public on reliance and effectiveness of outdoor and indoor warning systems.
- Maintain severe weather points of contact, agency officials, and news media notification lists. Routinely coordinate with respective need-to-know agencies and public safety officials to coordinate radio frequencies and obtain essential phone numbers, and email addresses.



APPENDIX A

2007-2012 Tornado Fatalities

According to the NWC Office of Climate, Water, and Weather Services' [Natural Hazard Statistics](#):

- 2012: Data not available
- 2011: There were 553 fatalities in 2011; 236 (43%) died inside a permanent home while 147 deaths (27%), were in unidentified locations, and 112 (20%) were in mobile homes (which usually accounts for the most fatalities. Alabama and Missouri recorded the highest number of fatalities for the year (245 and 158 in each State).
- 2010: There were 45 fatalities in 2010; 19 people (42%) died inside of mobile homes while 11 (24%) died in permanent homes. Mississippi recorded the highest number of fatalities (13), followed by Ohio, Arkansas, Missouri with 7, 6, and 5 each.
- 2009: There were 21 tornado deaths in 2009; 12 people (57%) died in a mobile home while 5 (24%) died in a permanent home. Oklahoma recorded the highest death toll with 8 fatalities, followed by Arkansas and Missouri with 3 each.
- 2008: There were 126 tornado deaths in 2008; 55 people (44%) died in mobile home while 43 (34%) died in a permanent home. Tennessee recorded the highest death toll with 31 fatalities, followed by Arkansas and Missouri with 21 and 19 each.
- 2007: There were 81 tornado deaths in 2007; 51 people (63%) died in a mobile home while 16 (20%) died in a permanent home. Florida recorded the highest death toll with 21 fatalities, followed by Kansas with 21 fatalities.



(Source: [ReadyWisconsin](#))

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ABOUT THE LESSONS LEARNED INFORMATION SHARING PROGRAM

The LLIS program develops and disseminates lessons learned, trend analyses, case studies, and innovative ideas to improve preparedness for the emergency management and homeland security communities. These documents, produced through research and analysis by the LLIS team, support whole community learning and continuous improvement.

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