

Challenges for Map Symbol Standardization in Crisis Management

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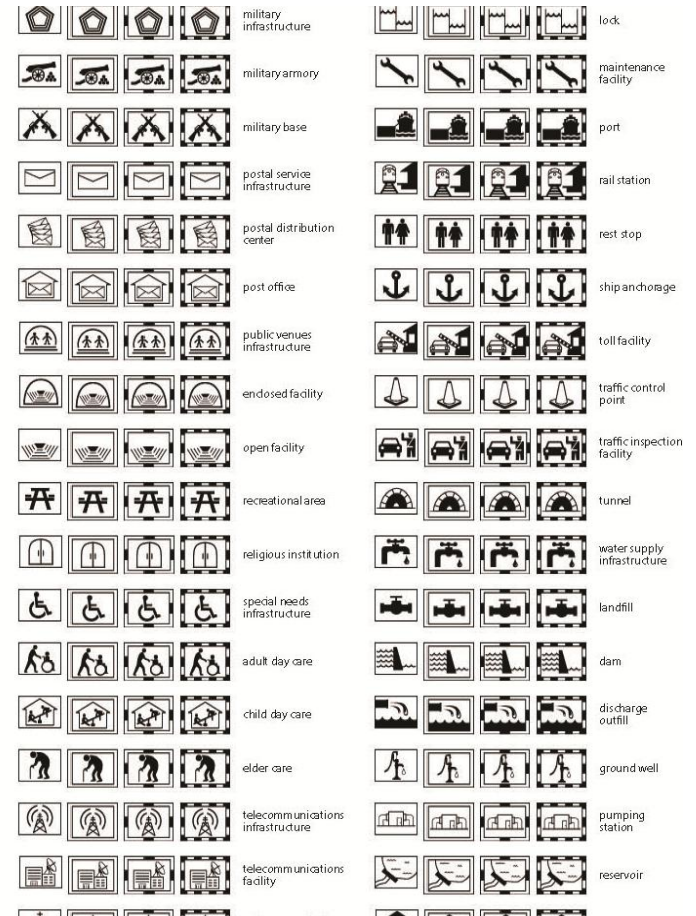
GeoVISTA Center



DEPARTMENT OF
GEOGRAPHY
COLLEGE OF EARTH AND
MINERAL SCIENCES

Outline

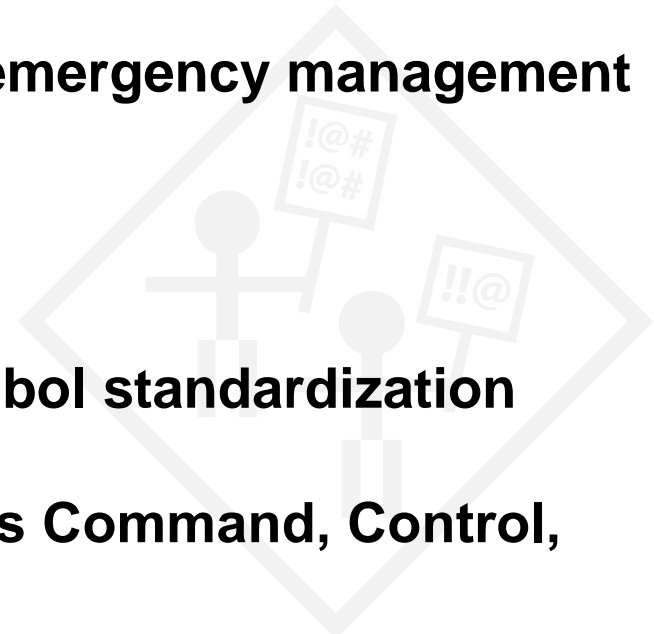
- Motivation
- Approach
- Needs Assessment Results
- Process
- Challenges & Future Work



Motivation



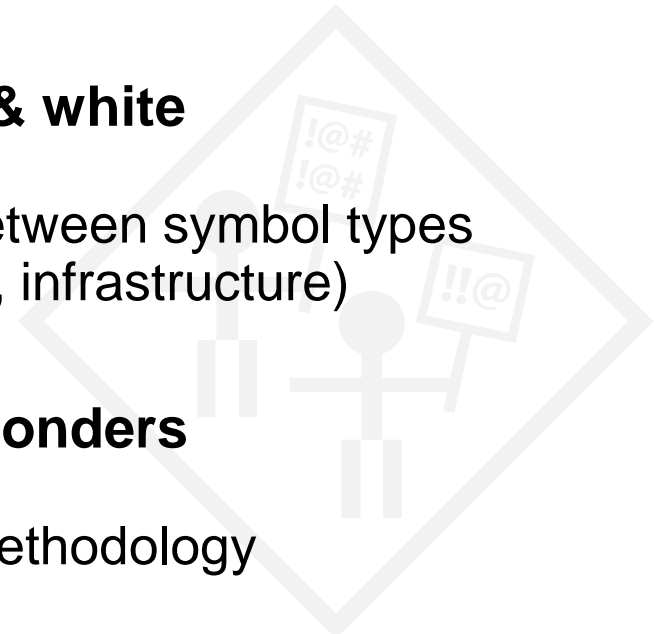
- **Diverse DHS organizations produce or use maps daily**
 - Audiences range from geospatial analysts to general public
- **No consistent set of map symbols used across DHS**
- **ANSI INCITS 415-2006 intended for emergency management mapping**
 - Poorly adopted by practitioners
- **Objective: Develop process for symbol standardization**
- **Sponsored by DHS S&T Directorate's Command, Control, and Interoperability (CCI) Division**



ANSI Standard



- **Point symbol set designed for emergency response**
 - Goal was to facilitate common situational awareness
- **Federal/state/local stakeholders took part in the process**
- **Symbols designed to work in black & white**
 - Outline shapes used to distinguish between symbol types (incidents, natural events, operations, infrastructure)
- **Evaluation conducted with first responders**
 - Made use of an “accept” or “reject” methodology



ANSI Standard



ANSI INCITS 415 point symbology standard for emergency mapping - Federal Geographic Data Committee Homeland Security Working Group

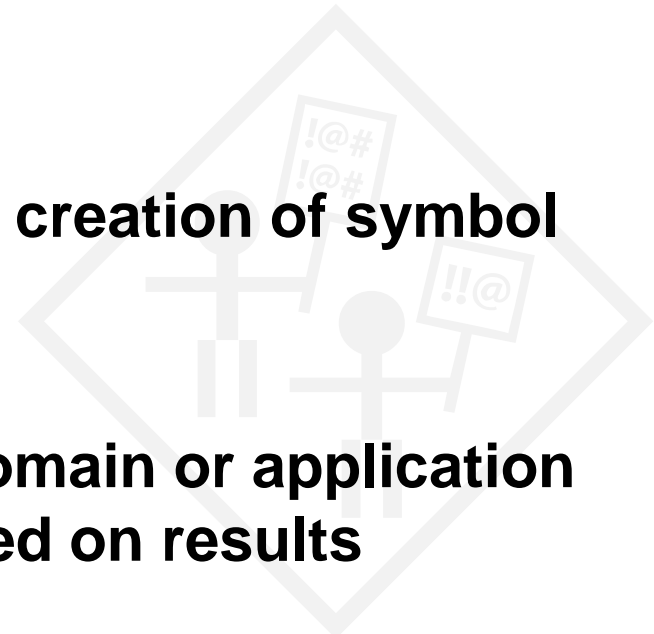
INCIDENTS		NATURAL EVENTS		OPERATIONS		INFRASTRUCTURE	
civil disturbance incident	flammable gas	after shock	emergency medical operation	law enforcement operation	food retail	natural gas facilities	airport
civil demonstrations	flammable liquid	avalanche	EMT station	Bar, Alcohol, Tobacco, Firearms & Explosives	grain storage	nuclear facilities	bridge
civil displaced population	flammable solid	earth quake epicenter	ambulance	border patrol	banking finance & insurance	petroleum facilities	bus station
civil rioting	non-flammable gas	landslide	medical evacuation helicopter station	customs service	ATMs	propane facilities	ferry terminal
criminal activity incident	organic peroxides	subsidence	health department facility	Drug Enforcement Administration	banks	government site infrastructure	helicopter landing site
bomb threat	oxidizers	volcanic eruption	hospital	Department of Justice	federal reserve bank	military infrastructure	lock
bomb	radioactive material	volcanic threat	hospital ship	FBI	financial exchanges	military armory	maintenance facility
bomb explosion	spontaneously combustible	drizzle	medical facilities not patient	police	financial services other	military base	port
looting	toxic gas	drought	pharmacies	prison	commercial infrastructure	postal service infrastructure	rail station
poisoning	toxic and infectious	flood	biological sensor	secret service	chemical plant	postal distribution center	rest stop
shooting	unexploded ordnance	fog	chemical sensor	Transportation Security Admin.	firm manufacturers	post office	ship anchorage
fire incident	air incident	hail	intrusion sensor	US Coast Guard	firm retailers	public venue infrastructure	toll facility
hot spot	air accident	inversion	nuclear sensor	US Marshals Service	hazardous material production	enclosed facility	traffic control point
non-residential fire	air hijacking	rain	biological sensor	sensor operation	hazardous material storage	open facility	traffic inspection facility
origin	marine incident	sand dust storm	chemical sensor	biological sensor	industrial site	recreational area	tunnel
residential fire	marine accident	snow	intrusion sensor	chemical sensor	landfill	religious institution	water supply infrastructure
school fire	marine hijacking	thunder storm	nuclear sensor	intrusion sensor	pharmaceutical manufacture	special needs infrastructure	landfill
smoke	rail incident	tornado	radiological sensor	nuclear sensor	superfund sites NPL	adult day care	dam
special needs fire	rail accident	tsunami	agriculture and food infrastructure	agriculture and food infrastructure	toxic release inventory	child day care	discharge outfall
wild fire	rail hijacking	bird infestation	agricultural laborer icon	agricultural laborer icon	educational facilities	elder care	ground well
hazardous material incident	vehicle incident	insect infestation	animal feedlots	college university	energy facilities infrastructure	telecommunications infrastructure	pumping station
chemical agents	vehicle accident	microbial infestation	commercial food distribution center	schools	generation stations	telecommunications facility	reservoir
corrosive material	vehicle hijacking	reptile infestation	farms ranches	energy facilities infrastructure	telecommunications tower	telecommunications tower	storage tower
hazardous when wet	explosive	rodent infestation	food production center	generation stations	telecommunications tower	telecommunications tower	surface water intake

*yellow highlight = symbols changed in latest release, green highlight = new symbols in last release

Basic Approach



- **Survey use of ANSI symbols and other point symbols across tasks and components within DHS**
 - Interviews (narrow audience)
 - Online survey (wider audience)
- **Develop a repeatable process for creation of symbol standard(s)**
- **Test the process on a selected domain or application area, refine tools & methods based on results**



Needs Assessment



Interviews



- **Conducted 14 interviews with map producers and users in various DHS missions**
- **Audio recordings for 10, written notes for 4**
- **Formative study using semi-structured format**
- **Question foci:**
 - ANSI Standard
 - Critical Incidents Related to Symbology
 - Technical / Organizational Challenges
 - Map Examples Provided by Participants
 - Ideas for New Symbol Standard Process



Results: ANSI Standard

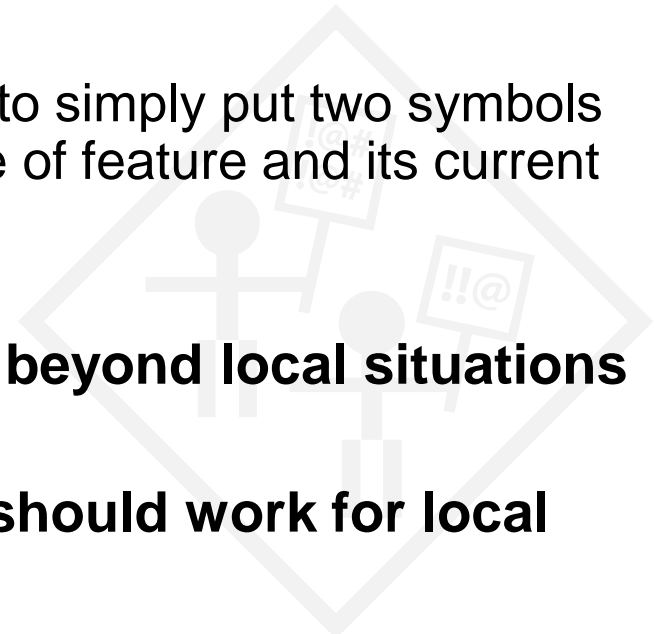


- **Standard not used by most participants**
 - Only FEMA / IICD use a small subset of the symbols (nobody using the complete set)
- **Lack of use is not related to technical constraints**
 - Minor problems using fonts, etc... seen as easy to fix
- **Key reason is poor match to missions/information customers**
 - Participants only use the symbols from the set that could be considered in common use (hospital “H”, airport, etc...)

Results: ANSI Standard



- **Many of the symbols are too intricate and difficult to parse without explanation**
 - Especially symbols that attempt to mix together information from a type of event happening to a type of infrastructure
 - One participant suggested it's easier to simply put two symbols next to each other to indicate the type of feature and its current condition
- **The ANSI symbols do not scale well beyond local situations**
- **Participants assume ANSI symbols should work for local responders**



Results: Key Design Issues



- **Some label every symbol put on maps by default, adding to clutter issues**
- **Some are applying different meanings apart from the standard**
- **Outline set (damage levels) does not match all mission types, and few data sources provide such details**
- **Different groups assign common colors (red, green, etc...) to conditions that do not match the ANSI standard**
- **No participants are required to design for b/w**

Map Example Feedback

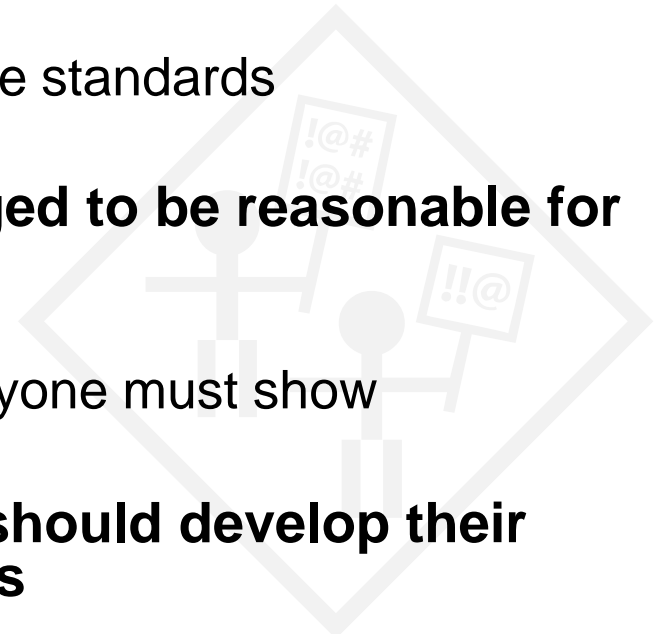


- **Many maps are thematic / analytical in nature and symbols must co-exist with a range of additional data**
- **Web mapping tools are becoming more important than printed matter**
 - Systems include iCAV, DHS Earth, eGIS, HSIN
- **Few participants can provide examples of instances in which they needed to transform output media substantially (e.g., to a phone)**

Symbology Development Process



- **Key issues are organizational, not technical**
 - Must involve all groups that generate and use maps in the process of developing symbols templates
 - Need mandates for standard creation and application
 - Need training materials to disseminate standards
- **A single common symbol set is judged to be reasonable for only a small subset of features**
 - E.g., for basic infrastructure that everyone must show
- **Participants suggest that divisions should develop their own standards and share with others**



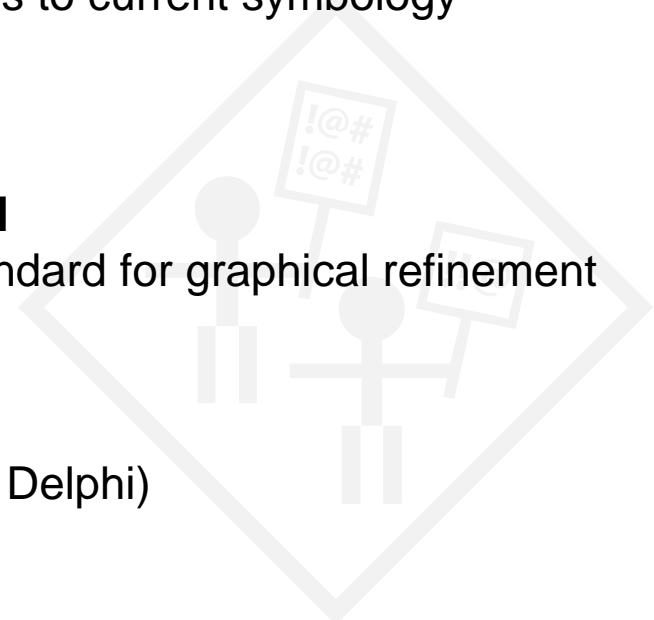
A New Standardization Process



Standardization Process




- **Distributed, web-based activities through a customized Drupal site**
- **Phase 1: Needs Assessment**
 - Review current symbology, identify new symbol needs, problems with current symbols
- **Phase 2: Initial Standard Development**
 - Develop symbol categories, vote on changes to current symbology
- **Phase 3: Standard Refinement**
 - Discuss, refine & vote on final categories
- **Phase 4: Implementation & Quality Control**
 - Test new symbology in exercise, submit standard for graphical refinement by cartographers
- **Methods feature**
 - Round-based discussion & voting (modified Delphi)
 - Card-sorting activities (using websort.com)
 - Anonymized participation

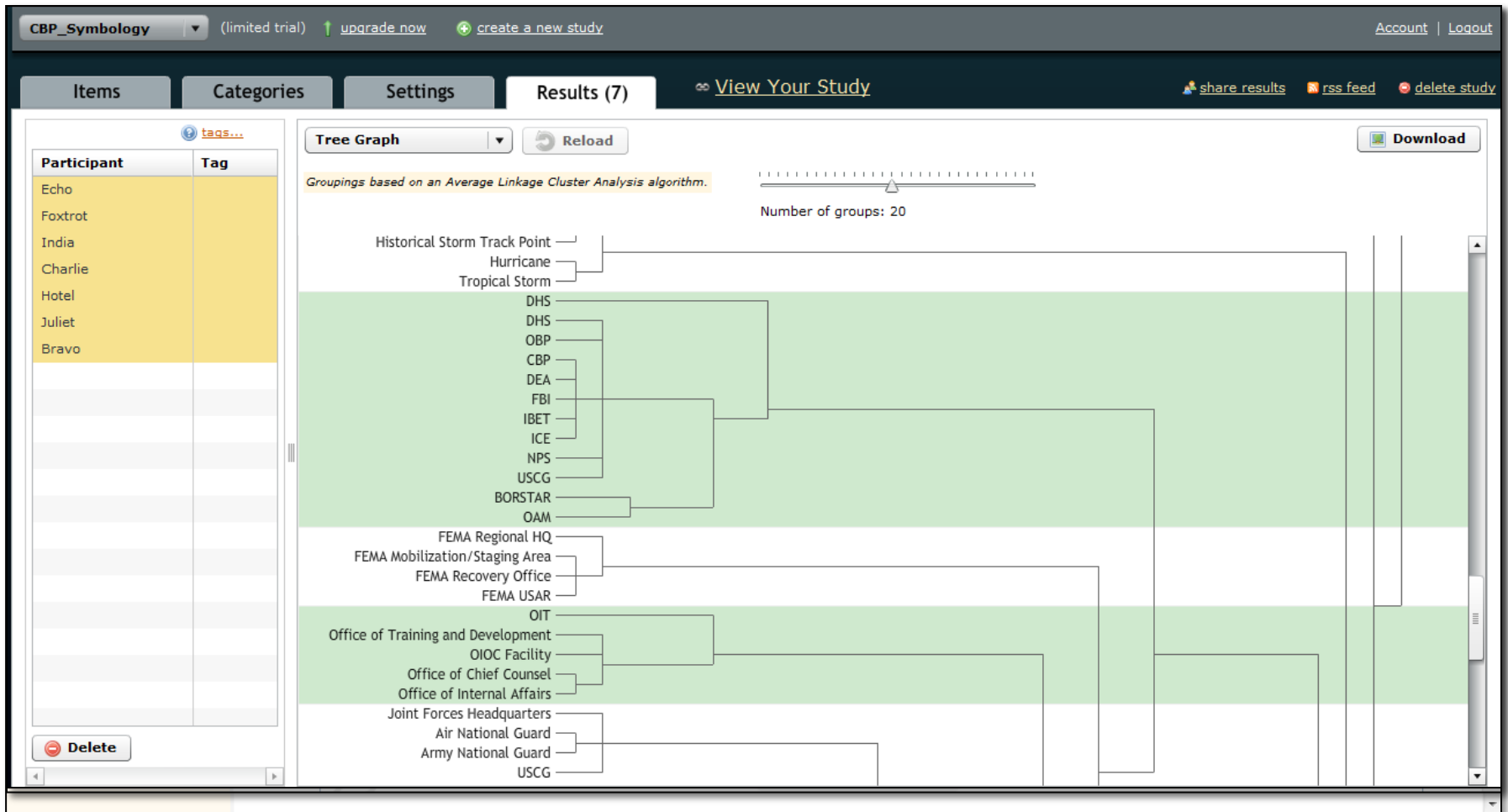


Process Testing



- **7 participants from Customs & Border Patrol**
 - **All are part of the CBP GIS/Mapping unit**
 - **Testing from mid-February to early March**
 - **Each round designed to last approximately 1 week in duration**
 - **Activities moderated by Justine Blanford and Robert Roth**
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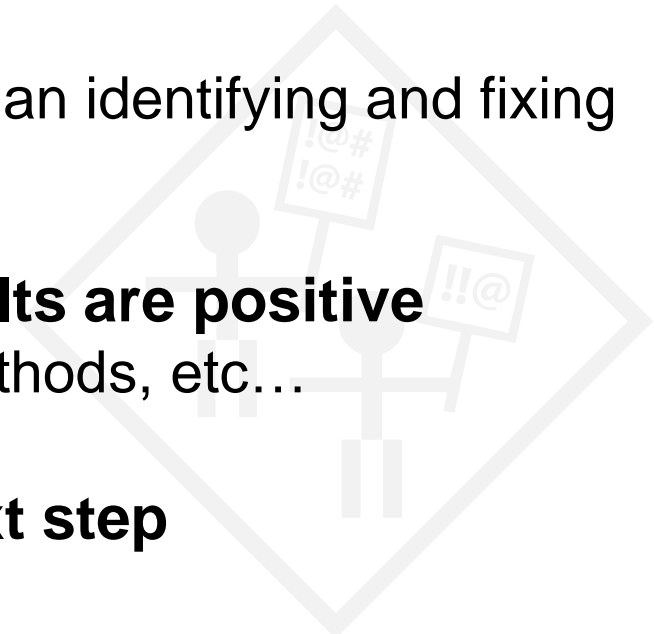
Process Testing



Preliminary Results



- **Participants identified 56 symbol issues**
 - new symbols, duplicate symbols, symbol definitions, symbol designs
- **Multiple rounds of card sorting resulted in a six-category standard**
 - this activity required more effort than identifying and fixing other symbol issues
- **Participant feedback survey results are positive**
 - usefulness, time commitment, methods, etc...
- **Implementation/testing is the next step**



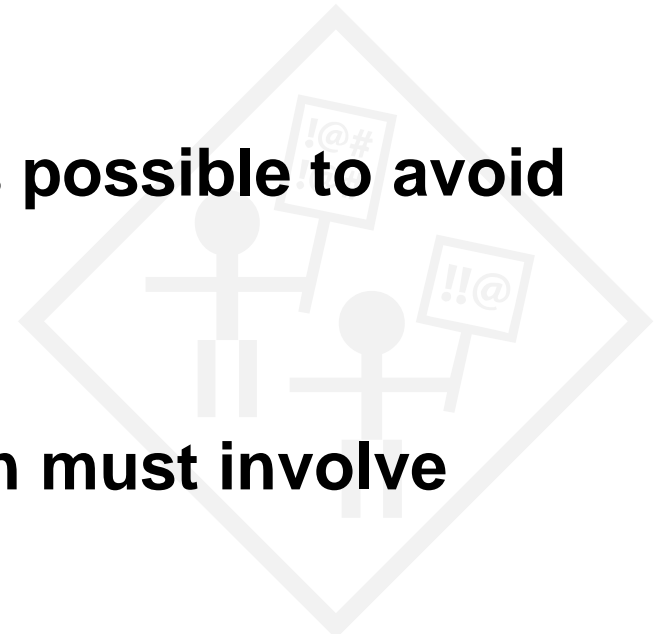
Challenges & Opportunities



Challenges & Opportunities



- **Symbols must support a wide range of mission needs beyond basic emergency response**
- **Symbols must support wide range of output formats and map scales**
- **Symbols must be as simple as possible to avoid interpretation issues**
 - Able to be hand drawn?
- **The process of standardization must involve mapmakers *and* map users**



Challenges & Opportunities

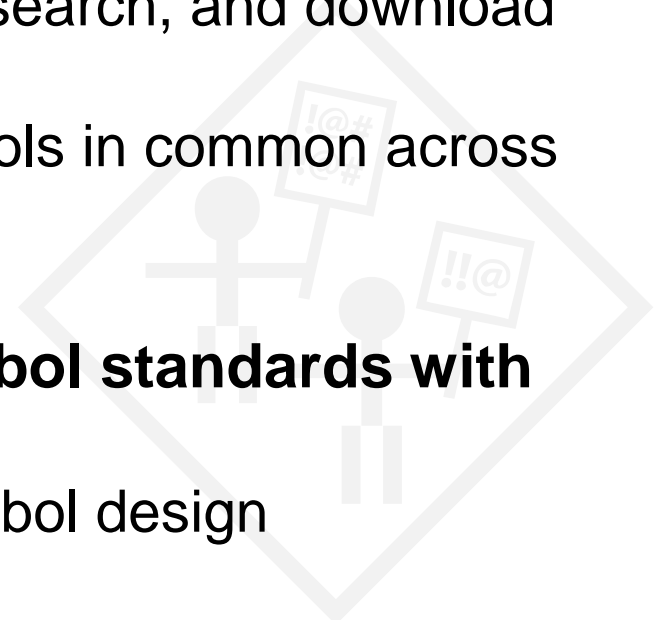


- **Symbol categories can be as important as the symbols themselves**
- **The ability to see a map from one's preferred perspective is important during an emergency**
- **De facto symbol standards can be used to shape development of new formal standards**
- **Organizational structures must be implemented to foster the development and use of symbol standards**

Future Work

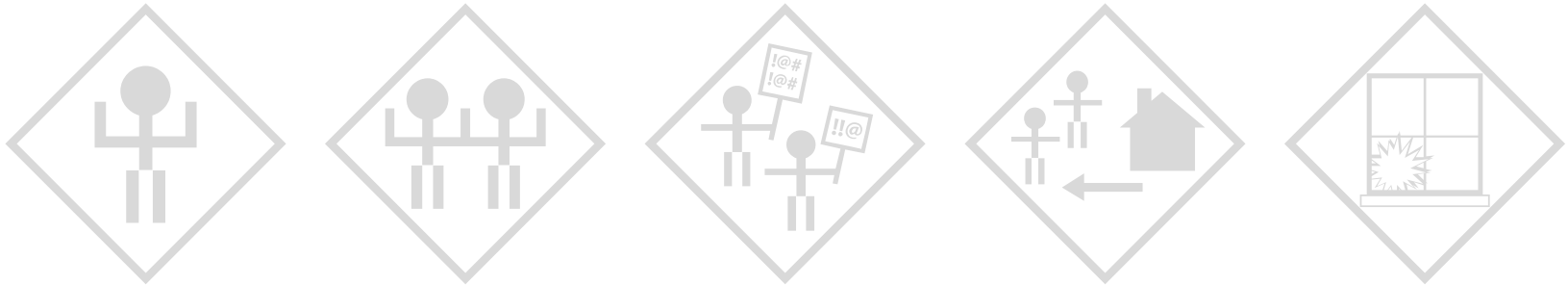


- **Complete process with another group**
 - Operational Center, FEMA
- **Create an on-line Symbol Store**
 - Place for users to upload, share, search, and download new symbology
 - Will also allow us to identify symbols in common across DHS mission areas
- **Determine ways to integrate symbol standards with Virtual USA effort**
 - Including a focus on dynamic symbol design



Thanks for your attention!

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