Visual Standards for Southern California Tsunami Evacuation Information: Applications of Information Design in Disaster Risk Management

Claudine Jaenichen[(✉)] and Steve Schandler

Chapman University, Orange, CA, USA
`jaenichenstudio@yahoo.com`

Abstract. Community participation and reaction during evacuation is rarely an individual and isolated process and the outcomes are systemic. Ineffective evacuation information can easily attribute to delayed evacuation response. Delays increase demands on already extended emergency personal, increase the likelihood of traffic congestion, and can cause harm to self and property. From an information design perspective, addressing issues in cognitive recall and emergency psychology, this project examines evacuation messaging including written, audio, and visual presentation of information, and demonstrates application of design principles and the role of visual communication for Southern California tsunami evacuation outreach. The niche of this project is the inclusion of cognitive recall of visual presentations of information based on quantitative data of a 4-year cognitive recall study that included over 300 participants as the driving influence in how the messaging was developed, distributed to the community, and formal design decisions were made. The outcome of this work feeds into a current project, Visual Standards for Tsunami Evacuation Information, an open-source tool for communities to create and self-sustain tsunami evacuation information specific to location. The project will act as a hub that provides a "starter kit" for community decision-makers and emergency management that are hoping to create cohesive and branded tsunami evacuation information in place for their city and counties.

Keywords: Design patterns · Design philosophy · Design thinking · Design/evaluation for cross-cultural users · Education/training · Information design · Design for disaster planning · Emergency management · Mapping · Wayfinding · Wayshowing · Cognition · Public education

1 Introduction and Background

Emergency management departments in the United States distribute informational and instructional messaging to its residents and communities before an evacuation is required in hopes to make the population "information aware" and therefore more prepared [1]. Emergency management is a public authoritative agency interconnected

with agencies responsible for the safety, response, recovery, and preparedness protecting "communities by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters." [1]. Local departments are funded and regulated at the county, state and federal level.

Claudine Jaenichen is a graphic designer who is also certified emergency medical technician and member of Santa Barbara Sherriff Search and Rescue. In 2005, she decided to investigate the role of design in emergency evacuation procedures.

The specific focus of evacuation information centers in its systemic and capacious variables. Evacuations require different cognitive processing of information due to the unpredictable onset of stress and sudden sense for protection of self, family and property. In a national collection of over 20 official outreach material on evacuation preparedness used for hurricane, flood, and tsunami, the implementation of a map as the main visual infrastructure to communicate messaging was used. The majority of the maps were repurposed roadmaps or inundation maps originally intended for internal emergency planning. The maps were inconsistent in the use of visual variables, amount of graphic density, symbology, semiotics, and severe qualities in legibility and usability.

There are currently no guidelines, regulations, or methodology that include stakeholders in the process of developing and evaluating these maps and their messages. Nor is there data to support that materials are being understood, are memorable, or useful. A problem in conveying evacuation information using a "map" as the main visual infrastructure is assuming the skill set necessary in map reading. An individual will need the following skillset in basic map reading and comprehension; (1) how to use a legend or key; (2) how to determine orientation of the map to physical space; (3) understand meanings of color, texture, and symbols; and (4) how to determine self location to destination in order to create a route. Maps can be confusing to read and dense with information. They can also be authoritative and can imply that the user must understand the map instead of the map being developed to understand the user's needs.

Ineffective evacuation information can easily attribute to delayed evacuation response and communities not evacuating at all. Evacuation behavior and decision-making is rarely an individual and isolated process and responses become systemic. Ineffectual behaviors increase demands on an already extended emergency personal, increase the likelihood of traffic congestion, and harm to self and property. Evacuation materials need to be developed with the inclusion of emergency cognition and disaster psychology. The ability to problem-solve, make rational decisions and recall information becomes vulnerable when confronted by urgent situations. Processing information during high levels of stress contribute to information overload, tunnel vision, temporary cognitive paralysis, and forms of denial. Tunnel vision is associated with extreme stress and exhaustion in which primitive tasks become central to cognitive processing and problem-solving capabilities are limited. Temporary cognitive paralysis, such as when people "freeze", is also associated with people experiencing

dramatic shifts in cognitive demands as a result of an abrupt change in the environment. Even though panic is not a likely response in evacuation behavior these cognitive phenomena effects how a person receive and retains information. Variables that contribute to cognitive paralysis include limitation of reaction time, perception of danger to self, and previous training or experience. This is especially true if people do not receive instructions and evacuation information until the time of evacuation is required. Findings from the 2012 FEMA National Survey found that 92% of respondents received their information from the media with the top three sources from local television, national television, and radio. Emergency management departments in Southern California are consistent in relying on these sources, including the web, for evacuation information. Media sources are problematic for two main reasons; (1) they are audio reliant, which data from our study demonstrated was the lowest performing outcome in information recall; and (2) information is usually distributed or accessed at the time of impact providing new information on a population already in distress.

In other related work, airline safety cards share the same objective of informing emergency procedure using visual communication to air passengers. Jaenichen collected international safety cards to assess them in the same way she assessed evacuation maps. She found more unity and cohesion in messaging and use of visual variables across all local and international airlines. A major contributor is having a governing body that dictates and regulates how emergency and safety information is presented. The Federal Aviation Administration's Office of Airport Safety and Standards and National Transportation Safety Board requires that all airlines flying into the United States comply with their regulations. Airline safety cards demonstrated more consistency in their use of symbology, iconography, and text in a cross-cultural environment. Success can also be attributed to repetition when passengers fly regularly. Repetition allows for people to develop and improve a cognitive framework for emergency procedure helping to memorize a cadence and rhythm of information. Relating this work to evacuation material Jaenichen developed a syntax for visual communication that could be universally applied to tsunami evacuation preparedness outreach.

2 Methodology

2.1 Context

The U.S. Geological Survey (USGS) and the California Geological Survey (CGS) provide geologic and seismic expertise to local and government offices that include inundation maps for the purpose of emergency planning. These maps are for "local governmental agencies [to] use these new maximum tsunami inundation lines to assist in the development of their evacuation routes and emergency response plans". Yet, Jaenichen found a number of these maps were used in its original format, or slightly altered, for public outreach. The presentation of these maps have serious issues in readability, scale, labeling, and graphic density for a person who does not have, or should have, experience in topology or geographical map reading. When one of these

maps from a public outreach brochure was tested in Santa Barbara, comprehension and cognitive recall failed by 100% early in the study and was excluded from further testing.

2.2   Cognitive Recall Study

To map or not to map—this was the first question to ask before a redesign would be explored. In 2011, Jaenichen approached Dr. Steve Schandler, director of Chapman University's Cognitive Psychophysiology Laboratories, to systematically evaluate evacuation material and improve the quality of content and recall of information by going into the community and testing materials. To date, they have data from over 300 participants in the control group at Chapman University and 100 participants recruited from the communities of coastal cities including Santa Barbara and San Clemente (the evacuation information was directly relevant to participants in these cities, resulting in a study group that was highly motivated to learn the information). Jaenichen and Schandler tested 3 different presentations of information; written, audio, and visual (e.g. map). All participants were evaluated for corrected vision and hearing, educational level, literacy level, and general health status.

Participants served individually in one study session, followed 24-h later with a phone call interview. One third of the subjects were given the visual redesign evacuation map; one third received a written description of the same movement routes; and one third was presented with a digital audio recording describing the same movement routes. They either had 4 or 2 min to review or listen to the material. Immediately following the presentation of the information, the subject completed a 15-question multiple-choice test regarding the information that was presented. Twenty-four hours later the subject was contacted via telephone and completed another test regarding the information presented in the first session. The review period was determined by the average time people spent looking at direct mail marketing because the scenario and distribution of the proposed campaign will mimic how people retain information without cognitive impairments.

Across all groups and both review periods, the visual (map) presentation of information produced better retention (less forgetting) of information from Day One to Day Two.

2-Minute Review Period: For all information types, Day One and Day Two recall were greater for the community sample suggesting higher motivation for persons most affected by the evacuation information. Compared to the other information forms, the greatest recall scores were associated with the written presentation of information. However, compared to the visual (map) presentation, proportionally less written information was recalled during Day Two. Auditory information presentation was associated with the greatest reduction in information retention from Day One to Day Two.

4-Minute Review Period: Increased information review time increased recall for each information type. This was exactly what was predicted. The recall superiority of the visual (map) presentation of information remained, indicating that its effectiveness is

due more to the information type than due to the time allowed to evaluate the information. The increased processing produced more permanent storage of the information. Compared to written information, the auditory information presentation also benefitted more from the increase in review time.

In summary, the written presentation of evacuation information resulted in the greatest immediate recall for both groups. However, visual presentation produced the most stable recall across the 24-h retention period. This is particularly significant in trying to initiate a preparedness campaign prior to a disaster event so at the time an event occurs, experience with the information would have already made a cognitive imprint reducing the amount of learning new information under stress.

2.3   Design Principles and Wayshowing

During an evacuation, learning is already compromised by anxiety. Because evacuation information is given under levels of stress, recalling information reduces the ability to process and learn new information. Jaenichen and Schandler revised the map by simplifying it down to only relevant layers of information. They formulated length and levels of components (e.g. compositional space and hierarchy) and use of visual variables. This approach was particularly critical for the continuity and application of other tsunami evacuation campaigns to be used in other coastal cities. The redesign prioritized a distinct clarification between foreground and background information driven by "wayshowing" principles. This approach changed the main visual infrastructure from a geological, topology, or road map to assimilating the more commonly recognized diagrammatic public transportation map.

In 2005, Mollerup [2] coined the term "wayshowing", derivative of the term "wayfinding" originated by Lynch [4] from The Image of a City in 1960. Mollerup suggested that in order to assist in wayfinding, principles of wayshowing is needed. Maps are static forms of communication relying on the reader to decode the information, finding out where they are on the map, navigating the space, and determining which routes are relevant. By approaching the map from the perspective of the user, information takes an active role indicating directions for movement and instructions. Formal decisions of visual variables included conventions already used by public transportation in southern California, including what Jacques [5] defined as *visual verbs*—presentation of arrows—which made the maps less static and effectively communicated directions and instructions for movement.

Texture
Texture creates visual noise, a vibration or disruption, of the composition causing the eye to move towards that noise. When used sparingly, texture can help with calling attention to significant areas on the page. Texture was used to create noise indicating possible road closure due to inundation. The use of high-contrast "checker" texture was used to cause disruption in order to make potential closures on major routes and highways a priority top-level read (see Fig. 1). The Orange County Transportation
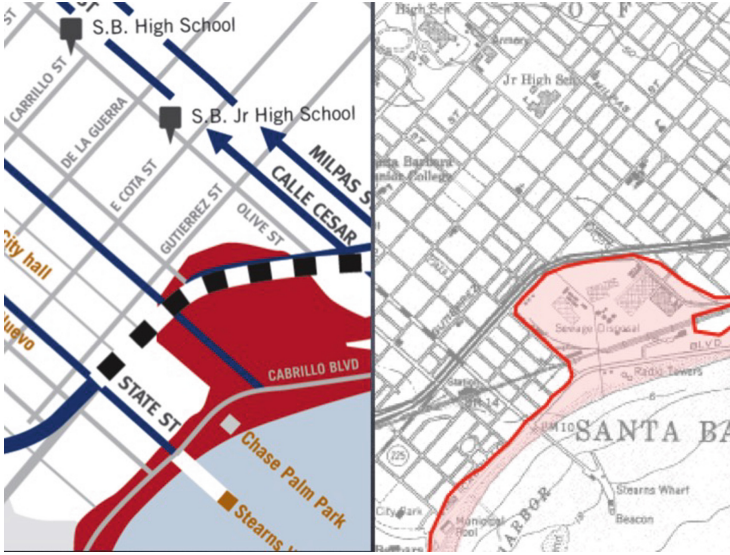
Fig. 1. The first map uses texture intentionally to bring attention to areas of importance. The second map shows when too much texture is used, there is no place for the eye to settle.

Authority currently uses this texture for possible route closures on bus maps syncing the conventional meaning of this pattern to the tsunami maps.

Another texture used in cities with military or natural preserved restricted areas was a crosshatched pattern. Crosshatches, made from patterns of "x", represent the idea of "fencing-off", restricted, or "do not enter (Fig. 2)."

Fig. 2. Cities like Coronado, San Diego, have significant military bases not accessible to the public. A crosshatch texture is used to signify this restricted area.

Standardizing visual guidelines for tsunami information still allows for political, organizational, governmental, and individual flexibility for the need of each city. In Santa Barbara, emergency management designated an area that would be immediately impacted during a tsunami evacuation, not by the inundation zone itself, but the congestion that would follow an evacuation. Not every city has needed this visual variable, but when needed, diagonal lines is the standardized texture for this specific communicative message (Fig. 3).
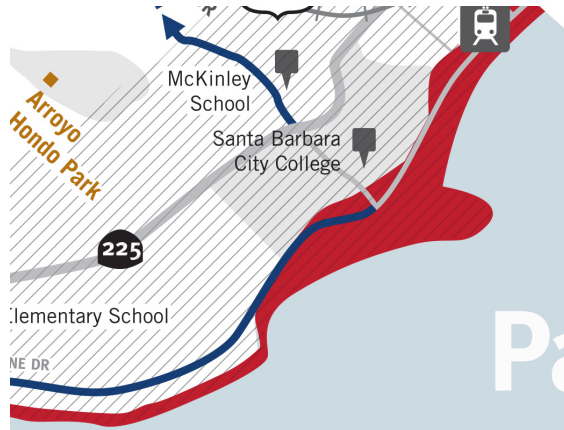

Fig. 3. Some cities designate a "high warning" area reflected here as diagonal lines.

Three more visual variables using texture indicate a form of a route; rail, path, and beach entry seen in Fig. 4 below.

Fig. 4. From left to right: parallel strokes represent beach entry; thin line with hatch pattern represent a rail/train route; and shorter dash lines represent walking or biking paths.

There is a total of 6 visual levels using texture seen in Fig. 5 below.

Fig. 5. From left to right: restricted area, high warning area, route effected by flooding, train or rail route, walk/bike path, beach entry

Density: Color and Stroke Weights

When developing a color and stroke weight palette, we accounted our analysis of the original evacuation materials we reviewed and the inconsistent variations of density. Density is the visual presence of an overall page. Color and stroke weights are attributes to page density. A bad example of a very dense page reliant on color and strokes is the Texas evacuation map seen in Fig. 6 below. Many maps Jaenichen and Schandler reviewed had varying degrees of unsupported page density with no clear function.
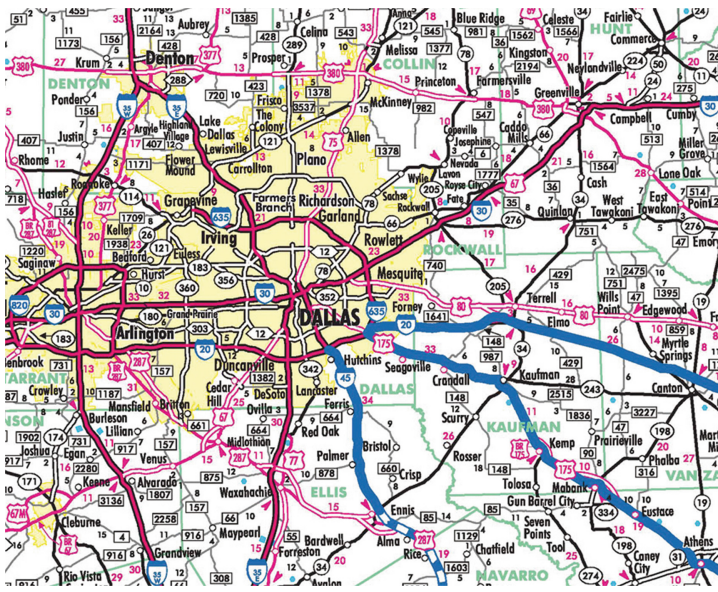

Fig. 6. Map source: Texas division of emergency management, Houston

Their approach to color was based on defined functions—they would not add color or change variance without this rule. We reviewed color semiotics and conventions established in the area. All evacuation routes are indicated as blue. The California Department of Transportation had already officially "branded" the color blue by

implementing tsunami evacuation route and evacuation site identification signage throughout coastal cities (see Fig. 7). Although using blue for the tsunami evacuation routes could be confused with flood direction or movement of water rather than safety routes—because the symbolic meaning between signified, water, and signifier, blue, is iconic—they felt confident that the convention of evacuation route had already been well-too established with coastal communities to flip its meaning.

Fig. 7. State of California - Department of Transportation (2007)

They relied on the conventional meaning of red for the inundation area—associated with meanings such as emergency exit signs, fire (fire trucks, extinguishers, etc.), emergency room signage, emergency call and stop buttons, and the American Red Cross. In Fig. 8 below, "flooding" is indicated in red and the evacuation route in blue.
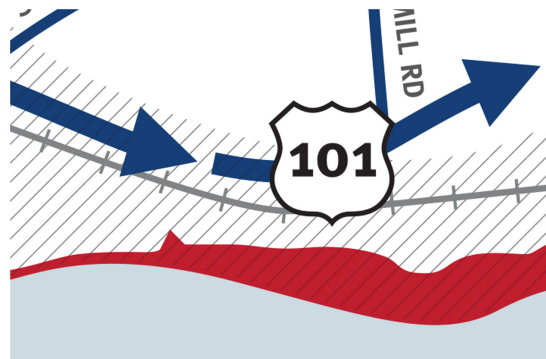

Fig. 8. The red represents the inundation area, whereas the blue is coded for the evacuation route based on the color code already established by the Department of Transportation's tsunami evacuation route signage. (Color figure online)

A third color, gold, was used for landmarks functioning as spatial orientation devices. The remaining neutral color palette, screens of black, functioned as background and foreground control, providing levels hierarchy and priority of information (Fig. 9).
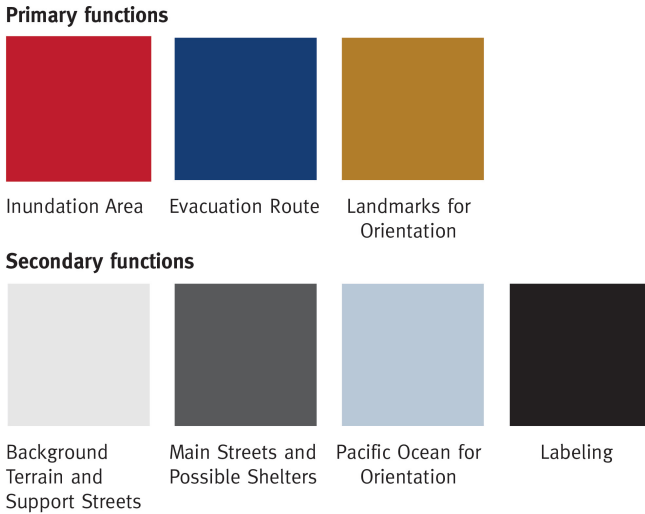
Primary functions

Inundation Area   Evacuation Route   Landmarks for
                                       Orientation

Secondary functions

Background   Main Streets and   Pacific Ocean for   Labeling
Terrain and   Possible Shelters Orientation
Support Streets

Fig. 9. There is a total of 6 visual levels using color. (Color figure online)

Stroke weights play a role in density, not only in their own representation on the page with its mark and color, but also how they layer and interact with one another. Joseph Albers [6], author of *Interaction of Color* and *Color Theory*, explains that the negative "white space" in between elements is an actual graphic element. The unintentional negative space created by intentional visual variables influence design principles such as composition, tension, tangents, and overall legibility. Stroke weights and color were only added when its function were clearly defined (Fig. 10).
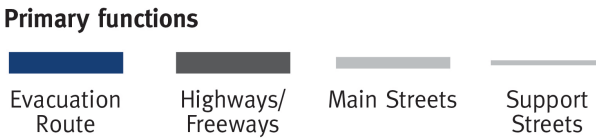
Primary functions

Evacuation   Highways/   Main Streets   Support
Route   Freeways   Streets

Fig. 10. There is a total of 4 stroke weights.

Typography

One of the most important revisions Jaenichen and Schandler negotiated was content. Major cuts were made in the amount of information in existing evacuation material. They identified relevant streets, landmarks, and routes, removing any other "visual noise" that was too specific for the public's use. A great deal clutter was removed as seen in Fig. 11 below.

A disciplined typographic approach was established into 5 levels of hierarchy. The following list of information was given a consistent type size, use of caps, and color in every map they have produced. The order is from the most prominent, foreground information, to lower level, background information:
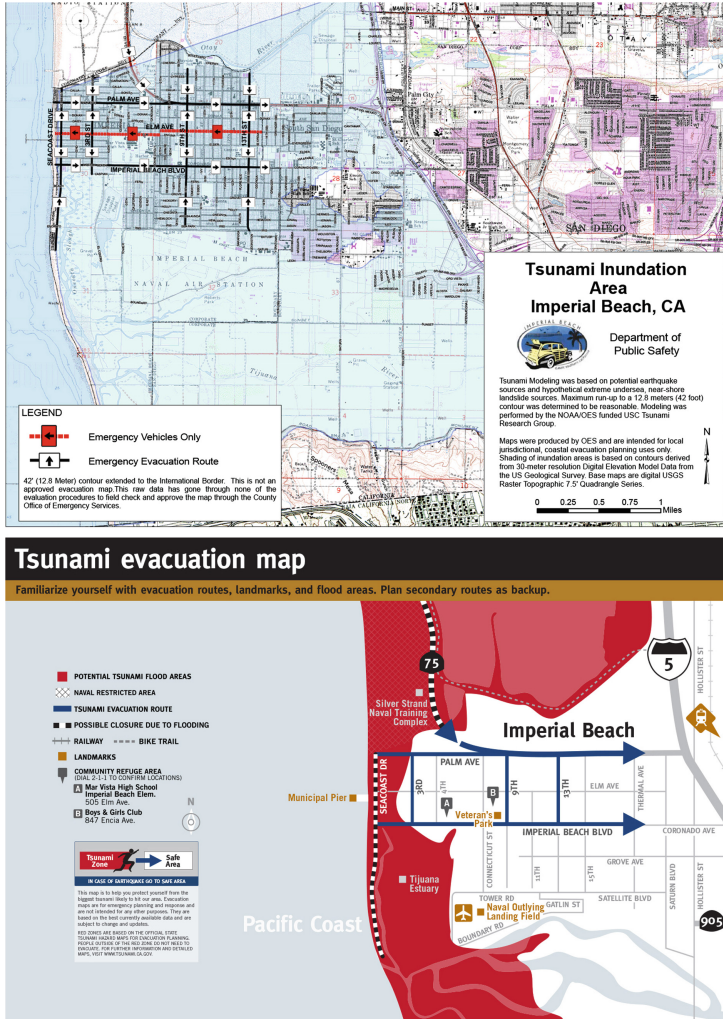
Fig. 11. The first map used by Imperial Beach was dense and full of competing visual noise. The second map demonstrates how our revisions improved legibility revealing and usable and relevant information intended for the public to use.

(1) Identification of the city represented.
(2) Identification of neighboring cities and major highways for spatial orientation.
(3) Names of landmarks, including train stations, hospitals, parks, tourist sites, and in some cases, well known residential areas known to the people who live in the city.
(4) Street names and highways of evacuation routes
(5) Other smaller, but relevant, street names needed in order to connect to the major evacuation routes

They used Meta, a humanist sans serif designed by Erik Spiekermann [7] and released in 1991, because of its cleanliness and legibility. In some cases, the typeface had to be legible at 7 points and Meta's subtle inclusion of serifs helped shape words the same way serif typefaces do.

Editing the amount of information was also a significant and successful negotiation in reducing text when applied to the content of brochures mailed out to residents and businesses in the inundation areas. They re-stylized the writing using direct conversational (e.g. using "you", "your", etc.) throughout the material to be more specific and direct in instruction and what was being asked of the reader (see Fig. 11).

Other information, such as the legend and safety message required by California Geological Survey, was included and Jaenichen and Schandler were given flexibility to revise the language and design to match the visual guidelines that fit their approach (Fig. 12).
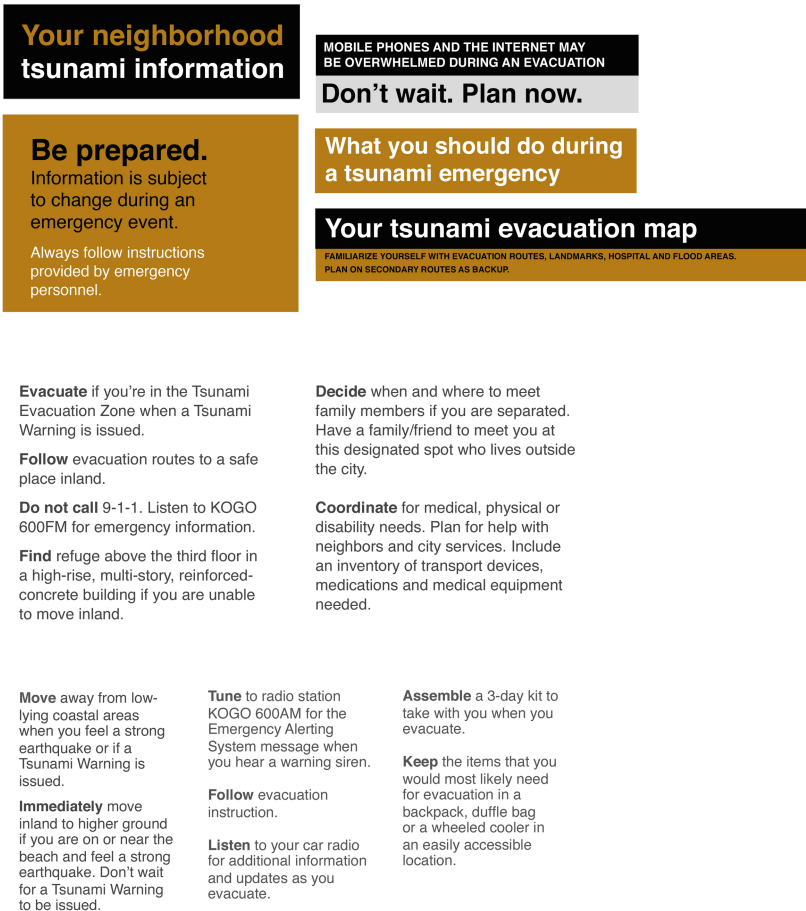

Your neighborhood
tsunami information

Be prepared.
Information is subject to change during an emergency event.

Always follow instructions provided by emergency personnel.

MOBILE PHONES AND THE INTERNET MAY BE OVERWHELMED DURING AN EVACUATION
Don't wait. Plan now.

What you should do during a tsunami emergency

Your tsunami evacuation map
FAMILIARIZE YOURSELF WITH EVACUATION ROUTES, LANDMARKS, HOSPITAL AND FLOOD AREAS. PLAN ON SECONDARY ROUTES AS BACKUP.

Evacuate if you're in the Tsunami Evacuation Zone when a Tsunami Warning is issued.

Follow evacuation routes to a safe place inland.

Do not call 9-1-1. Listen to KOGO 600FM for emergency information.

Find refuge above the third floor in a high-rise, multi-story, reinforced-concrete building if you are unable to move inland.

Decide when and where to meet family members if you are separated. Have a family/friend to meet you at this designated spot who lives outside the city.

Coordinate for medical, physical or disability needs. Plan for help with neighbors and city services. Include an inventory of transport devices, medications and medical equipment needed.

Move away from low-lying coastal areas when you feel a strong earthquake or if a Tsunami Warning is issued.

Immediately move inland to higher ground if you are on or near the beach and feel a strong earthquake. Don't wait for a Tsunami Warning to be issued.

Tune to radio station KOGO 600AM for the Emergency Alerting System message when you hear a warning siren.

Follow evacuation instruction.

Listen to your car radio for additional information and updates as you evacuate.

Assemble a 3-day kit to take with you when you evacuate.

Keep the items that you would most likely need for evacuation in a backpack, duffle bag or a wheeled cooler in an easily accessible location.

Fig. 12. Example of mastheads and copywriting using direct conversational style in brochure that was mailed to residents

Walking Sign Systems

Santa Barbara, Coronado, and Marina del Rey have major foot and bike traffic and are especially populated with tourists and people who do not know the city well. We explored a walking sign system that would address the populated tourist areas and help this demographic make decisions in an area that may be unfamiliar to them. For example, if someone was on the pier in Santa Barbara and an evacuation order was given, signage would indicate that walking 5 min to safety would be better than retrieving a car in a parking lot that is further away and in the direction of the potential inundation area.

We require that maps included in the walking sign system be aligned in a heads-up position and that the placement and unique orientation will correspond to the direction the user is facing (see Fig. 13). We conducted walk-throughs of pedestrian traffic areas

Fig. 13. Example of heads-up positioning for a walking sign system in Santa Barbara and Huntington Beach

and identified areas where signage would benefit decision-making in the event of an evacuation. Due to limited budgets, we were required to use kiosks or sign posts that were already in place.

Print vs. Web

Web is the most cost effective and efficient mode of information from the perspective of emergency management. Changes can be uploaded instantly with no limitations in the amount of content. There are major problems relying on virtual information whether distributed before a tsunami event or during. Research continues to support that sudden influx placed on telecommunications will most likely overwhelm infrastructure. Technology is an invaluable resource, but limita-tions must also be acknowledged. A report written by Townsend and Moss [8], Telecommunications Infrastructure in Disasters: Preparing Cities for Crisis Communication (2005), sheds light on the increasing concern of relying on technology for communication distribution:

> The breakdown of essential communications is one of the most widely shared characteristics of all disasters. Whether partial or complete, the failure of telecommunications infrastructure leads to preventable loss of life and damage to property, by causing delays and errors in emergency response and disaster relief efforts. Yet despite the increasing reliability and resiliency of modern telecommunications networks to physical damage, the risk associated with communications failures remains serious because of growing dependence upon these tools in emergency operations.

This investigation by Townsend and Moss revealed 3 causes of failure that is still relevant today; (1) physical destruction of network components; (2) disruption in supporting network infrastructure; and (3) network congestion. FEMA's tips for communicating during an emergency (2014) emphasizes the need to have charged devices with advanced knowledge of an event, but this excludes disasters that are unpredictable and devices need infrastructure to function.

Even though people are encouraged to learn about evacuation preparedness, they do not volunteer to do so prior to evacuation. A person must volunteer to access virtual community outreach. Jaenichen and Schandler surveyed L.A. and Orange County residents in 2009 and 86% of those surveyed did not know what to do in case of an evacuation and 80% would not how they would be notified. Emergency management spends a lot of energy on community outreach, including online and social media presence. Websites such as Ready.gov and TsunamiZone.org are valuable resources of information and Jaenichen would be interested to measure how many people from the public visit these sites and how they use the information. Until then, she has advocated for an "information confrontation" approach to distributing information, similar to direct-mail marketing campaigns. Aside from consumer-targeted marketing, these direct-mail pieces also come from city utility agencies. People spend an average of 2-min reviewing the relevance of direct-mail information before making the decision to either save or discard the material. This interaction places evacuation information in front of people so they take responsibility to confront the material. Reoccurring and

repetitive cadence of mailings (at least annually) is also critical so information begins to build a cognitive framework. Fire drills and airline safety demonstrations are good examples of successful repetitive exercises. Below are examples of the final printed formats where all the visual and text variables are combined into its final intentional messaging.
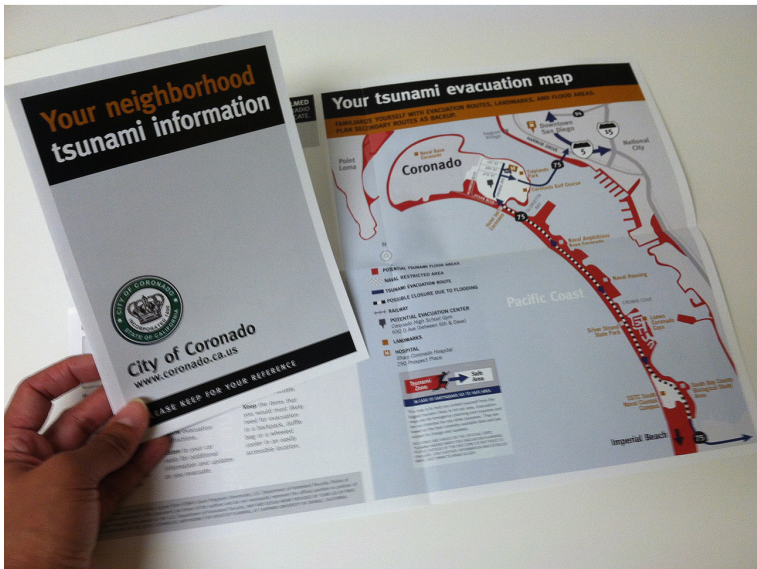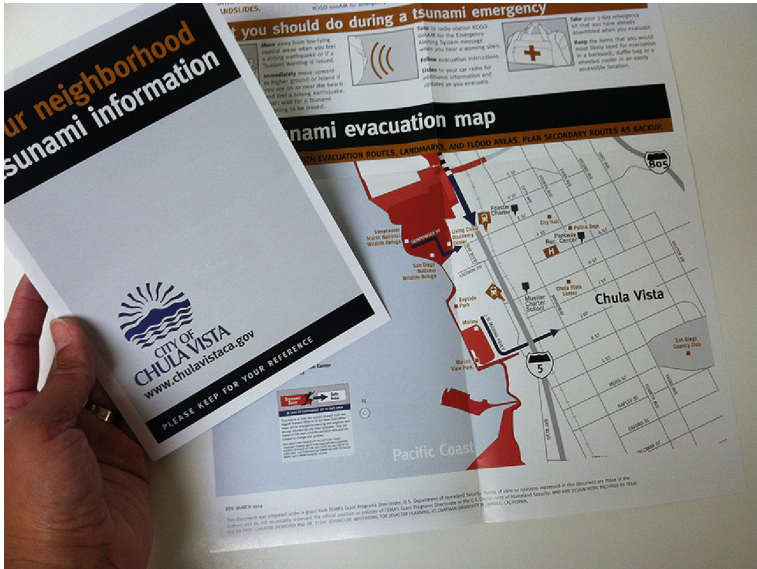
3   Implementation

Since 2011, this project has generated interest from the Emergency Management community, California Geological Survey, and invitations to present at the National Evacuation Conference, the California State Emergency Management Conference, and

California State Tsunami Steering Committee meetings. Jaenichen has also been invited to be a permanent member of the CA Tsunami Steering Committee, not only demonstrating the relevance of our work, but also the role of design in civic service and the significance of design principles in safety and health risk communication. Below are examples of completed redesigns for tsunami evacuation instructions.
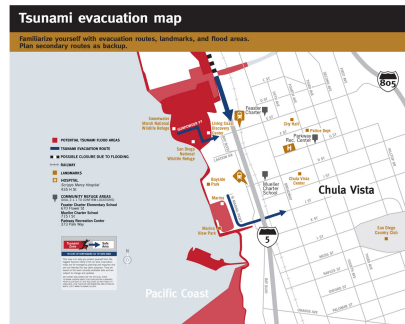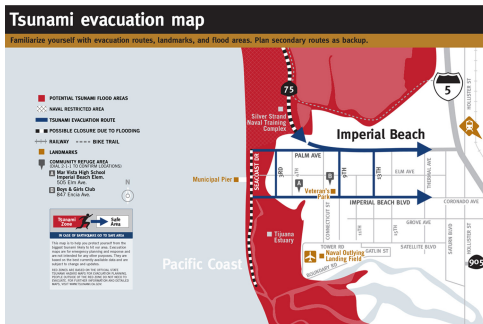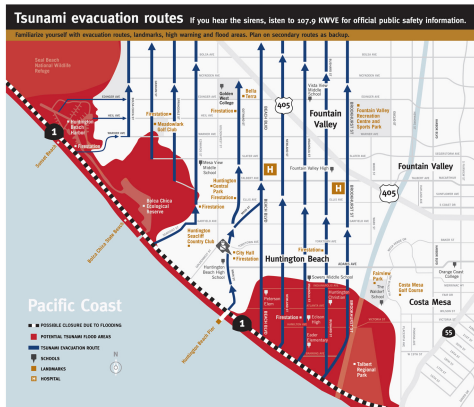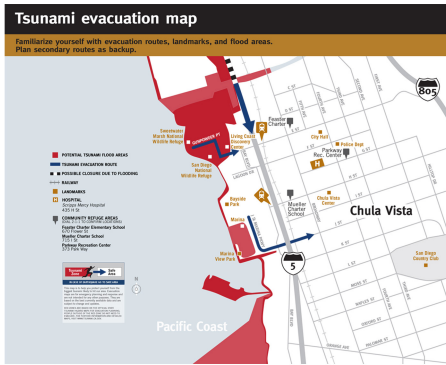
To date, we have completed work for 23 coastal cities in Southern California for San Diego, Los Angles, and Orange Counties including, Santa Barbara, Huntington Beach, Carlsbad, City of San Diego, Coronado, Chula Vista, Del Mar, Encinitas,

Imperial Beach, National City, Oceanside, Solana Beach, Venice, Marina del Rey, Harbor City, Long Beach, Santa Monica, Malibu, El Segundo, Hermosa Beach, Palos Verdes Estates, Redondo Beach, Rancho Palos Verdes, and Manhattan Beach. Within the established design standards, flexibility is necessary to meet the individual needs and politics of counties and cities.

4   Future Work

Because of this work, Jaenichen has reached out to a global network of scientists, designers, and design thinkers creating Design Network for Emergency Management (DNEM). DNEM is an international think tank that consists of experts from five of the world's seven continents. The core group specialize in diverse fields such as design, research, science, emergency planning, and policy. By encouraging quality research, collaborations, and applications of design and design thinking in the specialized area of emergency planning, DNEM will build a stronger body of universal knowledge, credibility, and applications of design methodologies in disaster risk management. DNEM provides transdisciplinary expertise on the applications of design thinking and evidence-based design principles before, during and after emergencies.

The core group of DNEM will work on publishing usability guidelines, Visual Standards for Tsunami Evacuation Information (VSTEI). The purpose of VSTEI is to convey the importance of distributing precise emergency evacuation information, empower city infrastructure and management to feel comfortable implementing VSTEI, and encourage accurate cognitive recall of tsunami evacuation information for residents, tourists, students, commuters, and employees in tsunami risk cities. VSTEI will provide a tool to educate emergency management on the benefits of data-supported design principles when developing and visualizing content for the public. Emergency planners will be able to create and distribute tsunami evacuation and preparedness information that is coherent, cohesive, and memorable.

The Governor's Office of Emergency Services (CalOES), U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA), and United States CA Geological Survey (CGS) has endorsed VSTEI. VSTEI will be a resource hub for emergency management as they develop tsunami evacuation information for their community and will provide guidelines and tools that are cohesive, visually "branded," and State-endorsed.

References

1. FEMA. Guide to Emergency Management and Related Terms, Definitions, Acronyms, Programs and Legislation (2008). https://training.fema.gov/hiedu/docs/terms%20and%20definitions/terms%20and%20definitions.pdf
2. www.fema.gov. 2012 FEMA National Survey Report (2013). https://www.fema.gov/media-library-data/662ad7b4a323dcf07b829ce0c5b77ad9/2012_FEMA_National_Survey_Report.pdf
3. Mollerup, P.: Wayshowing: A Guide to Environmental Signage. Lars Muller Publishers, Switzerland (2005)

4. Lynch, K.: The Image of the City. The M.I.T. Press, Massachusetts Institute of Technology, Cambridge, Massachusetts, London, England (1960)
5. Jacques, B.: Semiology of Graphics: Diagrams, Networks, Maps. The University of Wisconsin Press, Wisconsin (1993). Trans. William J. Berg
6. Albers, J.: Interaction of Color. Yale University Press, New Haven (2006)
7. Erik Spiekermann is an information architect, type designer (FF Meta, ITC Officina, FF Info, FF Unit, LoType, Berliner Grotesk), author of books and articles on type and typography, and founder of MetaDesign—Germany's largest design firm with offices in Berlin, London and San Francisco
8. Townsend, A.M., Moss, M.L.: Telecommunciation Infrastructure in Disasters: Preparing Cities for Crisis Communications (2005). www.nyu.edu/ccpr/pubs/NYU-DisasterCommunications 1-Final.pdf