Geospatial technology for faster emergency response

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Keeping a port operating is a regional and, in many cases, a national imperative. In 2002, for example, US West Coast ports were shut down for ten days due to labour disputes at an estimated cost to the national economy of US$2 billion per day. In 1995, the Port of Kobe (Japan), then ranked fifth- or sixth-largest port in the world, was destroyed in a massive earthquake. It took two years for Kobe to recover its capacity, and even a decade later its throughput has not recovered. In the meantime the Ports of Busan (South Korea), Shanghai (China) and Kaohsiung (Taiwan) have gained significantly from Kobe's misfortune, and altered the balance of trade between those nations. These examples underscore how critical it is to rapidly resume operations at a port after it has been impacted by human induced or natural, disruptive disasters.

The assurance of business continuity at US ports, given their critical role in the national security and economy, falls under the guidelines of the Federal Emergency Management Agency (FEMA), which publishes a template for creating a Continuity of Operations Plan (COOP). This plan outlines four phases: Readiness and Preparedness, Activation and Relocation, Continuity Operations, and Reconstitution Operations. One of the most frequently asked questions that needs to be answered when preparing a COOP is 'where?': 'where is the damage?'; 'where shall we evacuate staff to?'; 'where is the master valve we need to shut off?'; 'where shall we relocate operations to?'; or 'where will we need to rebuild?'

The question 'where?' is answered with spatial information, usually represented on a map. There is a group of software and data types that help answer spatial questions, generally referred to as geospatial software and data. For ports, these can include geographic information systems (GIS) software, satellite and aerial imagery, and image analysis software, computer-aided drafting (CAD), AIS and radar for vessel tracking, computer-aided dispatch and records management (CAD/RMS) software, command and control (C2) and physical security information management (PSIM) software, computerised maintenance management systems (CMMS), and others. Outside the world of ports, particularly in government service, these technologies are well entrenched and are used in various ways to manage daily operations and emergency operations.

The US government is a significant user of geospatial technologies in emergency management. FEMA, integrated maps, demographics, satellite and aerial imagery were taken within hours after the devastating Moore tornado had ripped a 27km-long and 3km-wide path of destruction in Oklahoma, and exposed them via a web-based GIS map viewer so citizens, business owners and emergency response personnel could assess damage remotely, without risking access to the devastated area. The Department of Natural Resources in Washington State created disaster mitigation plans related to its several potentially active volcanos using geospatial technologies and web portals. In New Zealand after the 2010 Canterbury earthquake, geospatial phone apps were perfected to capture crowd-sourced damage assessment information directly from citizens and relief workers.

Ports have been slow to adopt such tools, mostly due to reliance on local public safety agencies for small-scale emergencies, and state or national agencies for large-scale events. However, there is a growing realisation that ports are best positioned to help first responders and emergency management agencies to mitigate the impact of an event and accelerate the resumption of operations. That is because ports are hives of activity that constitute a low priority to response agencies. The significant movement of people, goods, and infrastructure in ports is principally the domain of the ports and their tenants.

Fortunately, several trends are coming together to help ports begin to adopt these tools and methods in their disaster response, incident mitigation, and business continuity planning. The falling costs of technology, the ageing workforce that stands to retire with all its knowledge of ports, the rising computer literacy of the new generation of staff, and the examples of similar technologies from the public sector, are all helping to accelerate this adoption. This is aided by the US Government's realisation following Super Storm Sandy that port resiliency is a national imperative, and that ports are not only the nation's lifeline, they are its economic engine as well.

Sharing information

The concept of information fusion to support port incident management and emergency response is being pioneered at the Port of Los Angeles in California. For the past five years, staff from planning, maintenance, real estate, police, environment, IT and engineering departments have been sharing spatial data, as well as linking it to other corporate information management systems, using an Esri software-based system named geoPOLA. By using GIS software as an information management resource rather than just a mapping tool, the port is able to integrate data around a common spatial base and answer complex questions posed during times of emergencies, such as the

Top: The Port of Los Angeles is using GIS to integrate data from across the port and is better prepared to respond to emergencies; Bottom left: Incident events are easily planned at the Port of Tacoma in their enterprise GIS application PortView, which integrates aerial base maps and accurate port data; Bottom right: Security staff at the Port of Oakland are able to quickly view live camera feeds from the integrated VMS in their GIS web mapping application PortView.

likely path that a spill will take through the storm drain system.

Creating plans

The Port of Tacoma in Washington has completed the consolidation of several years of effort with GIS into an enterprise-wide system called PortView. The system is based on software from Esri, Latitude Geographics, and NorthSouth GIS, and includes several tools used by port security personnel to plan for emergency events. These tools include functionality for creating evacuation plans, resource deployments for exercises or real events, and notifications to stakeholders regarding changes in traffic patterns and terminal access.

Assessing risk

The Port of Long Beach in California has been integrating multiple real-time technologies such as radar, sonar, AIS, CAD/RMS, and streaming social media around the Esri software platform in a system called Virtual Port. One of its main purposes is to help assess short- and long-term risk to the port using both the analytical and visual powers of GIS. Risk can then be translated into actions, whether using the port's PSIM or VMS (video management system), dispatched to field units, or communicated to regional intelligence agencies.

Ensuring access to information

The Port of Oakland in California has also consolidated geospatial data around PortView, based on software from Esri, Latitude Geographics, and NorthSouth GIS. The port relies on outside agencies for its protection and therefore must ensure that PortView is available even during debilitating disasters. Furthermore, the port shares certain geospatial security data with its tenants and their security personnel, and wishes to ensure that the link is maintained during a disaster. Therefore, it has invested in an always-live replication of its geospatial system in a private cloud, removing the vulnerability inherent in ports that are located in seismic hazard zones, such as Oakland, near San Francisco.

Making decisions during emergencies

Using similar technologies to Oakland, the Port of Stockton, US, has created geoPORTal, its own enterprise geospatial system which contains many emergency and utility map layers. Access to utility data in the GIS-based map viewer is critical for determining which valves to shut off to stem a spill due to a pipe rupture. However, in addition, the port designed the system so that it can also directly feed into the port's Hiplink Mass Notification System and CommandBridge Situation Management System. In this way, all spatially-capable systems benefit from the common base map and related information.

As experience in ports increases, best practices will continue to emerge; more ports will begin to incorporate geospatial processes and data into their efforts to mitigate the impact of events and allow them to resume operations to ensure that cargo capacity can be rapidly restored.

About the author

Captain John Holmes is a marine consultant with over 30 years of experience in positions that include chief operating officer, Fortune 500 executive, and senior-level coast guard officer. He most recently served as director of operations for the Port of Los Angeles. Captain Holmes retired from the US Coast Guard in 2003 following 27 years of service.

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