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Understanding the Keys to Effective Information Management and Situation Display During a Pollution Response

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ABSTRACT 299914:

As technology and access to information increases, so do the expectations by leadership and the public for the highest quality and most current information during a pollution response (USCG, 2010). This demand is essential to the incident's decision-making process and for situational awareness (USCG, 2010, 2011a). The influx of response data generated must be met by savvy teams of information managers who can provide this need in a timely, efficient manner. This process is further complicated by the relationship between government and industry responders, both of whom often have different information management requirements yet need to work cooperatively with the same data (USCG, 2011b).

In this paper, information management common themes, successes, and failure points from three case studies including the M/V Cosco Busan oil spill, the Hurricane Sandy pollution response, and the U.S./Canada CANUSLANT oil spill exercise are discussed. Although these incidents and exercise have significant operational differences, the need for efficient dissemination of quality information remains the same.

INTRODUCTION:

Response success is largely influenced by the ability to meet the simultaneous information needs of field responders, agency leadership, and the public. This is especially important as expectations increase every year in a culture dominated by technology and the desire for immediate access to information. However, responders frequently underestimate information management needs during major responses so these high expectations often conflict with existing response information management practices that are unprepared to meet these demands (USCG, 2008, 2011a, 2011b).

Just over the past decade, information demands have increased and situation displays have evolved significantly. The Hurricane Katrina response in 2005 relied on a vast number of paper maps wallpapering command posts and briefing rooms to create situation displays. It also marked a significant shift in data display platforms as Google Earth became available to responders and the public, heralding a new era of information display and delivery. Five years later during the Deepwater Horizon response, paper maps were limited to discussion pieces within workgroups while Web-based common operational pictures (COPs) were used to address the Unified Command in daily briefings, hosted thousands of layers of response data, and met the demand for transparency by the media and public by giving them access to incident information via personal computers and broadcast television (NOAA, 2010, USCG, 2011a).

In the three case studies below, we review information management practices to examine what worked well and what could have been improved upon in order to assist future responders with effective information flow to ensure timely and appropriate environmental response decisions. We conclude with information management and situational display recommendations that responders can take to any size exercise or response.

CASE STUDIES:

M/V Cosco Busan Response

On November 7, 2007, the container ship M/V Cosco Busan allided with the delta tower of the San Francisco-Oakland Bay Bridge after departing the Port of Oakland in heavy fog. The contact with the bridge resulted in a gash in the ship that punctured two fuel tanks releasing 53,500 gallons of intermediate fuel oil into the San Francisco Bay (NTSB, 2009).

A Geographic Information System (GIS) Unit in the Incident Command Post (ICP) assigned to the Situation Unit Leader (SITL) was established. The GIS Unit was comprised of Technical Specialists from the California Department of Fish and Wildlife (CDFW) Office of Spill Prevention and Response (OSPR) and the Responsible Party (RP), working cooperatively as a cohesive team. Initially the GIS Unit was staffed by OSPR Technical Specialists only. The GIS Unit supported the Planning Section, Operations Section, Logistics Section, and Command Staff while the workload steadily increased. By the second week of the response, the RP brought in a GIS Technical Specialist for additional support. From the initial day of the spill, requests for map products were made directly to GIS staff from any response personnel. By day three, in order to better organize and triage the requests, they were directed to the SITL who filtered them and determined priorities. The requests were transferred to the GIS Unit Leader hand written on notebook paper. This shielded the lead GIS Technical Specialist from the onslaught of map requests and allowed the GIS Unit to focus on immediate priorities. Situational awareness was displayed by the Situation Unit in the ICP on a large (12’x6’) paper map that was updated daily. The updated map was posted late in the evening after all field teams from Planning and Operations had reported back to the ICP. PDF versions of this map were also sent out to the Unified Command Staff via email attachments.

The most vexing task for the GIS Unit was processing and collating daily Shoreline Cleanup Assessment Technique (SCAT) data. The RP hired a consultant to run SCAT operations. There were four main SCAT teams that consisted of a representative from the RP, federal government, and state government, as well as three reconnaissance SCAT teams. They all converged on the ICP in the late afternoon with a mound of field data. Initially, SCAT data were transferred to the GIS Unit via spreadsheet created by the SCAT contractor from the daily SCAT forms. This quickly became a cumbersome and sometimes daunting process as spatial coordinate information was delivered in several formats despite verbal agreements between the SCAT Coordinator and the GIS Unit Lead to have the SCAT data delivered in a consistent format. This required significant processing before the data could be entered into the GIS. After several days another consultant was hired by OSPR to pre-process the raw field data and deliver it to the GIS Unit in Environmental Systems Research Institute, Inc. (Esri®) shapefile format. This greatly aided the flow of SCAT data from the field to the situation display map. SCAT field data forms were managed and archived by the RP's consultant and delivered to the Documentation Unit. Upon demobilization of the ICP a portable hard disk drive containing all of the GIS work that was done for the response was delivered to the Documentation Unit for archiving.

Information management lessons from Cosco Busan include OSPR automating the SCAT function to a hand held computer for electronic field data collection, which provides the ability to directly download SCAT data into the GIS. Since the Cosco Busan response the OSPR GIS Unit has established a mobile GIS server. The server contains a copy of the CDFW and OSPR GIS libraries, provides networking capabilities for GIS staff plus enough disk capacity to provide a common workspace. The server is equipped with both Ethernet and Wi-Fi capabilities and provides secure, virtual private network (VPN) access to the CDFW network. The server has several security access levels preventing non-OSPR GIS Technical Specialists from accessing confidential files while working in the common workspace.

Hurricane Sandy

When Hurricane Sandy, known as Super Storm Sandy, hit land on October 29, 2012, it affected 24 states along the entire east coast from Florida to Maine and as far west as Indiana, with extensive impact in lower New York state and New Jersey (FEMA, 2013). At the pollution response ICP on Staten Island, NY, the U.S. Coast Guard (USCG) and State On Scene Coordinators (SOSC) from New York and New Jersey directed wide-area assessments by aerial observers, boat patrols, and field assessment teams to quantify the wide spread pollution threats from thousands of sources, including oil spills, abandoned vessels, and containers of hazardous material.

The effectiveness of the response was strengthened by the strong regional partnerships and state-level coastal disaster planning. In the mid-Atlantic region National Oceanic and Atmospheric Administration (NOAA), the USCG, the Environmental Protection Agency (EPA), and State agencies have worked together on environmental planning, response, and information management on multiple levels. Although there were no formal Data Sharing Agreements in place for Sandy, these existing relationships between federal and state agencies helped to facilitate seamless sharing of information as the hurricane was being tracked and in its aftermath. While on-scene, there was also cooperative, operational data sharing among industry contractors working on the Philips 66, Motiva, and Kinder Morgan sites, which supplemented the USCG's situational display and provided status to their ICP.

All the pollution response data were managed by the NOAA Scientific Support Team, a group of four GIS and COP Technical Specialists that were under the Planning Section. While they did not occupy a formal ICS Unit, they were informally called the Information Management Team. They worked extensively with the Unified Command, the Planning and Operations Sections, and the Situation, Environmental, and Documentation Units to ensure accurate and timely information for their high-level reporting needs and pollution target decision making. The leadership provided by the Unified Command enabled excellent communication across all levels.

Information management and situation display at the ICP were focused on identifying the pollution targets within USCG's jurisdiction along the coast. In the flurry of activity to get teams in the field to identify and prioritize as many targets as possible, a standardized paper or electronic form was not immediately available. As a result, there were often incorrect coordinates, unknown place names, duplicate sightings with different information, and team members who were hard to track down once they were back in the field. When the USCG field teams returned to the ICP they provided written descriptions to the Situation Unit for transcription into a spreadsheet. The Situation Unit was not able to effectively QA/QC all information retrieved by the field teams. By the end of the first week, the Operations Section provided a new field assessment form that standardized what information would be collected; however, the Situation Unit was still responsible for a high volume of field data input and QA/QC, which left many of the same issues as before.

By the second week the process began to become more formalized, with a standard field collection form and Excel spreadsheet developed in conjunction with the Operations Section, Information Management Team, Situation Unit, and the Documentation Unit. Transcription of the field data was performed in the Situation Unit by multiple persons, then provided to the Information Management Team, which performed a second round of QA/QC in GIS. By the end of the second week, ownership of the field team spreadsheets was given to the Operation Section's Branch Chiefs who knew their team's targets and had easier access to QA/QC their field work. This greatly enhanced the accuracy of data being processed in GIS and for nightly reports. Once each Branch Chief had completed their daily updates in the spreadsheet, it was given to the Information Management Team for final QA/QC in GIS, then updated in NOAA's Environmental Response Management Application (ERMA) and used for statistics in the nightly Situation Report. By the third week, the field data management and information flow was improved and streamlined.

ERMA was the designated USCG pollution response COP to provide situational awareness. It showed the day's field data that same evening so responders were able to overlay response targets with environmentally sensitive areas, other operational data, and post-hurricane satellite imagery. The resulting display allowed the Federal On Scene Coordinator (FOSC), SOSC, and industry to prioritize threats and allocate resources for pollution mitigation as appropriate. Externally, response data from ERMA were shared with Federal Emergency Management Agency's (FEMA) Joint Field Offices (JFO) in New York and New Jersey, Coast Guard Sector New York, NOAA leadership in Washington D.C. and Seattle, and higher authority and stakeholders throughout the interagency effort.

Other key technologies for post-hurricane situational awareness were the NOAA aerial and satellite images that provided overviews of the operational area. These images, obtained hours after their collection, allowed the Planning and Operations Sections to develop tactical plans based on potential high-impact areas. Photos and GPS tracks collected in the field also provided valuable ground truthing. These data were processed at the ICP and then uploaded to ERMA. Viewed on the map in ERMA in their actual location and with other operational data, they provided visuals to the Operations and Unified Command for prioritization and progress status. The result was that each operational period’s plan was developed based on near real-time field data, allowing the Operations Section to focus resources on areas of greatest need.

Throughout the response and as the ICP was demobilized, the NOAA Information Management Team worked with the Documentation Unit Leader to ensure that the electronic data collected and processed would be provided to the Documentation Unit at the end of the incident.

A major lesson from Sandy was to have a basic, standardized pollution target field assessment form used nationally to provide consistency in data collection. Forms could be customized to meet certain regional or incident needs, but the overall concept of collecting key data would be the same. Using them in workshops and drills would provide familiarization before an actual response. Also, ensuring that there is response staff on-scene during the initial field collection, whether government, industry, or contractors, who are familiar with basic information management practices is necessary. Reporting statistics to the public, the media, and agency headquarters must be done with an extremely fast turnaround, often just a few hours. Expectations are greater than ever and the data reported will be scrutinized, so the data must be accurate and the collection process must be efficient.

CANUSLANT Exercise:

The CANUSLANT exercise took place June 19-20, 2013. It was a full-scale exercise led by Shell Oil that took place along the international border between Maine and New Brunswick, Canada, in the Bay of Fundy. Agencies represented included Shell, NOAA, the USCG, Canadian Coast Guard, Environment Canada, and Maine Department of Environmental Protection (MDEP). Command posts were located in St. John, New Brunswick, and Calais, Maine (USCG, 2013). In the months leading up to the drill, there were regular planning meetings with information management and GIS players from NOAA, MDEP, Environment Canada, and Shell to discuss roles that staff would be playing, what data they’d be providing or responsible for, what format the data would be delivered in, what technology they’d be testing, and what data sharing restrictions existed in their organizations. These meetings were designed to ensure the drill ran smoothly given the very short timeline of the exercise. Goals agreed upon before the drill by the information management players were to test data interoperability between NOAA, Environment Canada, MDEP, Shell, and other parties for eventual display in both the RP and federal COPs.

Preparation for CANUSLANT was made easier by joint agency projects in New England. These include the 2007 NOAA ERMA prototype for Portsmouth Harbor, New Hampshire, developed with the assistance of GIS staff from MDEP and New Hampshire Department of Environmental Services (NHDES), and the March 2010 Spill of National Significance (SONS) exercise in Portland, Maine, which brought together NOAA, MDEP, NHDES, USCG, and industry lead organizer, Shell Oil. Additionally, NOAA has worked extensively with Environment Canada to build relationships regarding incident preparedness and data sharing along both the Atlantic and Pacific borders as well as the Arctic.

Since the CANUSLANT exercise incident initially took place in Canadian waters, Shell GIS Specialists in the St. John Situation Unit processed the bulk of the operational data, and then created Web services to display in their COP. The federal COP, ERMA, was updated after NOAA GIS Specialists were notified of these new data services. Subsequently, after accepting the new data services, all COPs were automatically synchronized with these common data layers. Shell and NOAA GIS staff communicated about data updates via phone, email, or instant messaging to their counterparts between command posts and the Shell London casualty center.

In both command posts, the GIS staff were collectively located under the Situation Unit and informally called the GIS Unit. They were managed by a GIS Lead who ensured data requests and updates were logged, assigned, and processed. This GIS Lead worked closely with the SITL so they could both ensure response data were collected and displayed consistently among the GIS maps, COP, and Situation Status Board. A designated Situation Unit person regularly checked with the Operations Section and other units for data, or GIS staff actively circulated and engaged units in data requests.

Managing requests for new data, spatial analysis, or updates can quickly exceed staff capacity in a large incident. Having an information management tasking system in place is extremely important. At previous exercises, Shell and NOAA have tracked GIS and data requests using an ICS-213 General Request form to capture the data request, point of contact name, unit, date, time, and then have it signed off by the SITL or Deputy SITL. This has proved to be an excellent method of maintaining structure and accountability. At CANUSLANT, Shell brought a Web-based tasking system to test for the first time with external partners. The GIS Lead in Calais managed requests by logging them in the system and assigning each to a GIS Specialist located in Calais, St. John, or London. The GIS Lead was able to triage priorities, verify their status, and mark them as complete. Because everyone in the GIS Unit had access to the system, they were also able to track requests and see what remained in the queue.

Both the RP and federal COPs were used for situational awareness within the command posts and in Unified Command briefings. The Shell ArcGIS Online viewer was the primary COP in both St. John and Calais, which allowed participants to view the same COP on the main screen and in briefings. ERMA was used by federal and state staff including NOAA, MDEP, and USCG leadership interaction in Calais. In Calais, the Shell COP was projected onto a large screen in the main ICP room where participants could observe the latest oil observations, GRP deployments, and wildlife observations. The COP was also used to brief the Unified Command on situation status. Paper maps were created by Shell from ArcMap for the Situation Status board.

Another exercise objective was to produce a Data Sharing Agreement that would be circulated among the agencies, RP, and Unified Command. Its language would provide a basis for future Data Sharing Agreements and used to familiarize players with its concept. A Data Sharing Agreement was produced by NOAA on the second day of the drill in St. John and was circulated among Shell leadership and the Unified Command with general agreement.

There were several key lessons from this exercise. The first was to have a Data Sharing Agreement template in place for any exercise or incident that would be a regular tool used by information managers. Having all parties who are creating, managing, and processing data involved in the Data Sharing Agreement's design and approval ensures they will follow the same guidelines to ensure success. No one entity should prevent access to any cooperatively collected response data. If any restrictions are required by an agency, they should be identified. For example, Environment Canada was limited in its ability to share original GIS data, which affected some environmental information that could be displayed for decision making by responders. Working on these issues ahead of time would be crucial in a real incident where pre-planning meetings about data, limitations, and expectations aren't already laid out.

It is vital to have a GIS Lead dedicated to ensuring that information is flowing into the GIS and Situation Units, and to manage priorities and ensure tasks are completed. The GIS Unit needs to have a system for GIS and data request tracking, whether an electronic system or informal use of ICS-213 General Request forms. If the incident is small and manageable enough, the GIS Lead role can be rolled into the SITL or Deputy SITL's responsibilities. For larger scale, multiple command post events, an electronic tracking system would be essential.

Communication and information exchange between multiple command posts can be difficult. The GIS Unit assumed the electronic tracking system would be adequate to support communication needs among its GIS Technical Specialists, but the system didn't have an option to email collaborators. There is still the need to rely on good verbal communication, either facilitated by a single point of contact like the GIS Lead or direct interaction and meetings. Frequent check-ins are necessary to know when new layers are created and updated on COPs so responders aren't caught by surprise with new information.

Lastly, GIS server feeds can't be 100% reliable, particularly in the first few days when systems are being set up and tested for interoperability and data access. There were several occurrences of the feeds going down when maps needed to be created or when participants were doing briefings. NOAA began to rely on their own shapefiles to provide necessary backup of parallel layers.

Overall the CANUSLANT exercise was an excellent opportunity for several diverse agencies to work together and learn from new challenges, and more importantly, to build relationships for the future.

DISCUSSION:

The three case studies discussed above provide substantial lessons that future responders and leaders can adopt into their information management planning, preparedness, and response routines.

Leaders Must Set the Stage for Effective Information Management

Unified Commanders must not underestimate information management system requirements, including staffing, technology, and reporting demands. At minimum, an information management system needs to provide accurate information to all its users; be adaptable to changing information needs; be fully resourced with personnel, equipment, and funding; managed by an experienced and technologically aware leader; and cooperative in nature to involve all members of the Unified Command (USCG, 2013).

Additionally, cooperation is paramount. In each of the three case studies, government and industry cooperatively responded to effectively mitigate major pollution incidents. Representatives should take the opportunity at Area Committee and Regional Response Team (RRT) meetings, or in the months before an exercise, to plan out and regularly discuss information requirements, data sharing, and situation displays. Response personnel should understand the information landscape and practice rapid implementation of both government and industry situation displays (USCG, 2011a, 2013, 2011c).

Have an Information Management Plan & Data Sharing Agreement

An active response has several ways to introduce data into situation displays and provide critical information. In order to effectively manage data pathways so they complement each other, a response-wide Information Management Plan (IMP) is required. The IMP should be developed at the beginning of any response from an existing template that is scalable to the incident, uses the existing data systems, and reflects the information requirements. It should then be refined during the course of the incident as necessary (USCG, 2011a, 2011c, 2013). The IMP lays the groundwork for agreed-upon standards such as data formats, field reporting requirements, QA/QC of raw data, monitoring social media outlets, COP and data ingest methods, situation displays and reporting requirements, as well as data archive and sharing. Proactively identifying IMP requirements by the Area Committees or RRT as part of their Area Contingency Plan (ACP) package would facilitate an effective IMP at the onset of a response with little delay.

Having this kind of plan in place also manages expectations and data continuity between COPs through a Data Sharing Agreement section. Different organizations use different GIS applications and viewers for their information requirements, so interoperability and pre-established data practices are essential (USCG, 2013, 2011c). On a cooperative response, there can be different electronic COPs managed by the RP, NOAA, EPA, and the States. Government and RP computer security requirements can limit information flow or access to different audiences, requiring more than one situation display. If an RP is involved, the public may have a trust bias against the RP situation display and desire transparency of operations. Yet another level of potential complexity is a large-scale response with an Area Command and multiple ICPs, where the continuity of information among decision makers is imperative. Therefore, implementing an agreed upon Data Sharing Agreement and promoting its guidelines among all information management players across ICS roles or geographic boundaries provides the structure for consistent information displays.

A Data Sharing Agreement in the IMP is especially important to ensure data continuity between COPs and so all parties involved will have access to the same response information during and after the incident. Ensuring that data delivered as Web services are also shared as original GIS shapefiles or geodatabases provides data managers the ability to control their own display, have a backup if the service fails, and to recreate previous days' data. Implementing a secure, mobile GIS server with various security levels or a secure FTP site is an ideal way to bridge the data gap among information management staff. Furthermore, government and RP Trustees will need the information for long-term damage assessment case work (USCG, 2011a, 2011c, 2013). No one organization should control the bulk of data collected cooperatively during the response and all should require full access.

Employ Current Technology

In addition to electronic COPs, other technology discussed in these case studies to increase processing and reporting efficiency include using electronic field data collection forms on a smartphone, tablet, or simple spreadsheet to directly download into a data management application. There should be an intermediate QA/QC process before displaying data on maps and COPs to reduce the likelihood of error. Field teams should remember that electronics can fail in the field and paper backup forms should still be used for recording data (USCG, 2011a, 2011b, 2011c).

Practice using standard field collection forms to become familiar with their use, especially electronic data collection technology. Leverage the work of your peers in other regions to promote nationally consistent data collection. If forms are not available ahead of time, work with data Technical Specialists on-scene to ensure that the correct information is being collected to meet decision making and reporting requirements (USCG, 2011a, 2011b, 2011c).

Have Clear ICS Roles for Information Managers

The use of technology is evolving rapidly, and defining leadership and Technical Specialist roles that can manage the influx of information at a response is needed. The current 2006 USCG Incident Management Handbook (IMH) does not provide adequate guidance for information management roles or expectations, so much of the direction found in the above case studies is based on field experience (USCG, 2006). To begin, leaders need to identify and exercise an information management team within the Planning Section. These roles should be staffed in the first 24-48 hours with interagency and RP personnel highly skilled as data and GIS managers with experience in ICS and response needs. Their prompt arrival will enable data protocols to become established from the beginning rather than spending additional time catching up even a few days later when the response is in full swing.

A GIS Lead will be the cornerstone of prioritizing and triaging data requests for the Technical Specialists by using a paper ICS-213 General Request form or an established electronic tasking system. They will also communicate closely with the Situation Unit Leader and Operations about information status. In larger responses the need for an electronic system would increase due to expanded tracking capability, additional status requests, the need for remote support, and communication among a larger technical staff (USCG, 2011a, 2011b, 2011c). Communication within these teams is paramount, especially in a response involving government, industry, and other partners. Regular COP "continuity of information" meetings should be established early in the response to ensure consistent data displays among different COPs.

Drills and exercises should be used as training platforms, and workshops used as learning opportunities. Designate an Information Management Coach at an exercise to put these roles into practice to ensure information is flowing through the correct channels and that responders understand how their role contributes.

Finally, the U.S. Coast Guard IMH needs to reflect the current needs of response information management within the Unified Command, General Staff, Planning Section, and Situation Unit structures. The IMH must provide responders with the tools to institutionalize a robust information management capability. This will ultimately determine the success of the Incident Management Team, Unified Command, and overall response operations (USCG, 2010, 2011a, 2011b).

CONCLUSION:

Response success is largely influenced by the ability to meet the simultaneous information needs of field responders, agency leadership, and the public. Information requirements can evolve rapidly during an incident, and responders can easily underestimate information demands because there is not a single, definitive method to deliver accurate information. Leaders responsible for managing the next major disaster will be challenged to deliver accurate and timely information to effectively prioritize environmental threats. It is our hope that for the next significant incident responders will:

1. Plan ahead to determine information requirements for successful operations;
2. Practice with the field technologies, data processing, information flow, and;
3. Work together to meet field personnel, leadership, and public information expectations

Unified Commanders must effectively embrace evolving information management and technology resources to provide critical information simultaneously to field personnel and agency leadership to mount an effective unified response on behalf of the public.

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