MANAGEMENT OF INFORMATION FLOW IN COMPLEX SHORELINE CLEAN-UP OPERATIONS THROUGH A COMMON SYSTEM FOR SITUATION OVERVIEW AND REPORTING IN THE “M/S SERVER” INCIDENT.

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ABSTRACT
Clean-up operations following coastal oil spills may become complex with respect to handling the information necessary to keep all parts of the organisation updated on the situation and in line with recent developments. After the “M/S Server” struck aground off the island of Fedje, Norway on Friday 12th. of January 2007, and initially spilling 290 tonnes of bunker oil, the weather conditions caused the oil to break up into many small slicks and polluting a high number of shoreline segments. The weather conditions continued to prevent the safe survey of several polluted positions, further complicating the task of creating a full overview of the situation. The 201 positions of the polluted segments involved 13 municipalities, 2 counties and 3 different Regional Pollution Combat Groups as well as the overall management by the Norwegian Coastal Authorities.

Surveying of segments, prioritisation, and follow-up of progress involves both practical operational and scientific judgements, and creates paperwork. Both expert groups and on-site operative personnel will carry out surveys and report, and also need information for making decisions. Finding the right amount of data and level of detail to collect requires a common understanding of information needs, as well as the use of common forms. With the goal of reducing the overall time spent on reporting by collecting data centrally and providing a common site to stay informed, a data-based system for handling of information from shoreline clean-up operations was developed in the early days of the operation, as part of a cooperation project between The Norwegian Coastal Authority and NOFO on experience sharing and standardisation of information flow. An internet map service provided a common map of the positions and access to web-reports. Field equipment using semi-rugged PCs and mobile solutions was tried out. This paper focuses on the operational benefits and challenges of updating and coordinating information flow using a common web-based system, in an area where several different reporting procedures and forms had been previously used. Experience is shared with respect to making the system work as a useful true-time tool and not only as a hind-sight database.

INTRODUCTION
On Friday 12. January 2007, the ship M/S Server struck aground on the westernmost coast of Norway, at Fedje, near Bergen (Figure 1). 290 tonnes of bunker oil that was spilled.

The oil was spilled when the ship struck aground, but leakages also occurred when the front part was towed to Agotnes, also near Bergen. As the event developed 201 sites were registered to have been polluted along a stretch of coastline exceeding 200 km.

The overall current pattern in this area is dominated by northwards currents, overlaid by local currents in a general east-west direction driven by the 1.5 m tidal amplitude. The coastline is highly complex, with a vast array of islands, coves and bays. Rocky shores dominate the coastline, although other shoreline substrate types are also present (see Table 1). The infrastructure in the area is relatively well developed, and a number of roadfills, harbours and stone-based structures are present in the tidal zone. In relation to oil spills, these will potentially behave like rocky shores, and although not environmentally sensitive, they represent a high potential for temporarily sequestering oil that may be remobilised.
Organisation of Oil Spill Response

Response to oil spills from ships in Norwegian waters are the responsibility of the Norwegian Coastal Authority (NCA). In the response operation, NCA may draw on their own resources, located at a number of depots along the coast, on dedicated NCA vessels and Coast Guard vessels. In addition, NCA may mobilize privately owned resources, including those owned by the Norwegian Clean Seas Association for Operating Companies (NOFO).

In the subsequent cleanup operation, NCA cooperates with Regional Pollution Combat Groups (IUA). These groups organize response on a municipality level, involving harbour authorities and resources from local fire brigades. NCA has the overall responsibility for the entire operation in strategic, tactical and economic terms, and holds the position of the Operation Coordinator and the Shoreline Environmental Task Force. IUAs have the practical and technical responsibility for cleanup operations within their area, and provide On-scene Commanders, Group Leaders and the shoreline cleanup work forces.

Survey of Oiled Shoreline Sites

During the storm, the oil slicks were broken up into many small slicks that were transported a long distance from the original spill site. Many oiled sites had several kilometres of unsoiled shoreline between them. The stormy weather continued for several days and many places in the outer parts could not be surveyed immediately, for safety reasons. During the initial survey phase, the Coastal Authorities used a survey plane and helicopter to observe and register free-floating oil, and received several reports of oil polluted sites from the general public. In the early days, denoted acute phase of the operation, recovering free-floating oil was given the highest priority and getting an overview of observed slicks was very important.

Clean-up work started alongside the process of recovering free floating oil. However, in a situation such as this, getting an overview of all polluted sites as well as all the necessary factors for setting clean-up priorities according to the “book” is not always the case. Given that weather conditions permit clean-up at several locations, a priority should be given to environmentally sensitive sites and sites with a high probability of remobilisation of oil.

Ideally, when prioritising between sites for immediate or later clean-up, a standardised set of priorities shall be used. The priorities are given in a national guideline, where the following parameters are included:

- Sensitivity
- Protection value
- Natural occurrence
- Economic compensability

Highest priorities are given to sites of high sensitivity and high protection value, that are naturally occurring and if lost cannot be compensated through economic means.

In prioritising cleanup, additional elements are taken into account, including shoreline type, wave exposure, potential for accumulating and remobilising oil, and HES aspects of involved personnel.

This standardised priority-setting should ensure that environmental criteria are used and not e.g. subjective priorities. Ideally, one might argue that the operation should wait for environmental expert survey of damage and priority setting, but in the first acute phase of the operation, when surveys are going on simultaneously, waiting for full surveys of every site before starting clean-up would be deleterious to the environment. Practical and especially safety and weather conditions set other priorities: Where it was possible cleanup started with the resources and personnel available. In the “M/S Server” clean-up-operation, several of the sites farthest off shore could not even be surveyed until the weather conditions permitted several weeks later. E.g. one environmentally important site in Gulen was surveyed in mid-March. 201 polluted sites have been registered to now, the latest being in June 2007.

Information to be Registered

Within the affected area, there are 13 municipalities, 2 counties, and 3 IUAs. The complexity in organisation and dissemination of information was significant. Up to now, the forms that have been used by the NCA for registering information from surveys has contained practical information that is supplied by on-site personnel, as well as more detailed information that should be supplied by a surveying environmental expert. On-Scene Commanders and cleanup personnel are employed by the municipality, and each municipality had forms of their own, for internal reporting. The forms used were not streamlined.

Information supplied by on-site personnel was:

- Administrative/identification information regarding the group responsible for cleanup
- Location of the polluted site
- The extent of the polluted site
- An estimate of the amount of oil and polluted wreckage
- The type and length of shoreline involved
- Suggested method of clean-up
- The expected resources necessary for initial clean-up
- Information related to access from land and sea
- Safety precautions necessary at the site

A more detailed environmental survey added information such as:

- Environmental effects (e.g. bird counts)
- Evaluation of the degree of pollution
- Whether the site is a protected area or not.
• Environmental verification of method of clean-up suggested by on-site personnel

INFORMATION FLOW

This situation of simultaneous surveying and clean up leads to a situation where the registered site surveys will have a varying level of completion, and there will be a delay in information flow to the IUA from the On-Scene Commanders, and from them on to the Operation Coordinator of the NCA. Some sites were surveyed in several steps, at some sites clean-up was started before expert prioritisation was possible.

For all levels of the operation, a common understanding of the situation and timely information flow is crucial, as is the flow of necessary information for decision-making and priority setting as well as correct information to the press and public. Registration of possible and confirmed polluted sites after the M/S Server incident was time-consuming.

It is also crucial that the polluted sites are described in the same manner and with the same level of detail, since sites will be compared. Streamlining forms and training of personnel are important. When clean-up has been started a set of daily reports are written each day by the On-Scene Commanders or group leaders. These reports contain information on which sites that have been worked on that day, the resources and personnel used, waste generated and progress in the clean-up, as well as HSE issues.

Several of the same IUAs had only two years previously cleaned up after the M/S Rocknes incident, and had their own reporting systems. The result of this was that, although the on-site coordinators were experienced both with clean-up and reporting, the report formats and level of detail was highly varied.

It was therefore decided to use the M/S Server incident to develop the common database for information flow integrated with a GIS and a web-based distribution system for registered information.

USER GROUPS AND NEEDS

In the initial phase the focus was to ensure that the core oil spill response team (Operation Coordinators and Shoreline Environmental Task Force) had access to the functionality required to establish and maintain an overview of the situation. However, other user groups and needs were identified as the event unfolded, and further design and development was undertaken to cater for these. The project group identified the following user groups and needs:

Operation Coordinator and Shoreline Environmental Task Force

Need to know:
• Where oil is reported
• Whether comprehensive review has been undertaken by the task force
• As the cleanup progressed, the cleanup status of individual sites
• Daily reports on resources and costs used and needed

Need to distribute or make available:
• Where oil is reported
• Current priorities between sites
• What measures are taken
• What measures are planned
• Work orders for On-Scene Commanders

On-scene Commanders

Need to know within their area:
• Where oil is reported
• Current priorities
• Work orders
• Daily reports on resources and costs need

Need to distribute or make available:
• Work orders

Group Leaders

Need to know within their assigned sites:
• Current priorities
• Work orders

Need to distribute or make available:
• Daily reports on resources and costs need

Regulatory Authorities

Need to know:
• That priorities are made according to national guidelines
• That appropriate cleanup methods are applied
• That operations do not entail health risks

Local Communities and Stakeholders

Need to know:
• Status of cleanup operations within their jurisdiction
• That personnel involved follow working environment standards

Need to distribute:
• Information on the above topics - to the general public.
THE SYSTEM DEVELOPED

Based on needs and requirements from the user groups, the main specifications for the system could be described as follows:

- A user interface trough a digital map for entering information on contaminated shorelines, cleanup sites and progress of cleanup operations. Access to this interface should be restricted to the operations manager and the Shoreline Environmental Task Force.
- A user interface through a standardised database form for entering information on observations, priorities and work orders for cleanup sites registered through the map interface. Access to this interface should be restricted to the operations manager and the Shoreline Environmental Task Force.
- A user interface through a standardised database form and a web form for entering daily reports.
- Browse facilities giving access to all information on the cleanup sites, daily reports, as well as a number of predefined summary tables for vital statistics, including:
  - Length of contaminated shoreline of individual shoreline types
  - Degree of contamination and cleanup priority
  - Environmental damage
  - Accessibility
  - Statistics per municipality
- A dedicated password protected web site providing access to an interactive digital map, browse facilities and supplementary documentation. This site was made available to all members of the operation.

The system was developed using ArcView and ArcIMS for digital mapping and GIS, Microsoft Access for the database, and Microsoft FrontPage for the web interface.

USING THE SYSTEM

In the initial phase, the system was mainly used by the Operation Coordinator and the Shoreline Environmental Task Force, in which the development team was included. During this phase, the system was adjusted and modified according to experiences and requirements. This kind of "on-demand" reprogramming and redesign is very demanding, but the value of doing this during a real incident provided indispensable information to the system developers on needs and requirements of the system.

Information from the field was reported from the On-Scene Commanders, and Shoreline Environmental Task Force undertook several systematic field surveys to identify and prioritise sites. The progress of registration week by week is shown in figure 4.

As may be seen, the number of new sites peaked a few weeks after the incident, with a second peak some two months after the incident. This last peak coincided with a systematic Shoreline Environmental Task Force field survey and the oncoming of spring, with an increase in outdoor recreational activities and boat life, which lead to more reports of oiled beaches by the public. The total length of contaminated shoreline of individual shoreline types are given in Table 2.

TABLE 2 LENGTHS OF DIFFERENT SHORELINE TYPES WITHIN THE AFFECTED AREA FOLLOWING THE M/S SERVER OIL SPILL

<table>
<thead>
<tr>
<th>Shoreline type</th>
<th>Contaminated length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocky shore</td>
<td>17950</td>
</tr>
<tr>
<td>Cliffs</td>
<td>2370</td>
</tr>
<tr>
<td>Boulder beach</td>
<td>1906</td>
</tr>
<tr>
<td>Stony and gravel beaches</td>
<td>6133</td>
</tr>
<tr>
<td>Sandy beaches</td>
<td>4510</td>
</tr>
<tr>
<td>Mudflats and shore meadows</td>
<td>1360</td>
</tr>
<tr>
<td>Roadfills, quays etc.</td>
<td>5415</td>
</tr>
<tr>
<td>Sum</td>
<td>39644</td>
</tr>
</tbody>
</table>

After the initial phase, the number of incoming daily reports was increasing. Although a standard format was developed and distributed, a number of daily reports arrived in a paper format or as non-standardised attachments to email. To maintain an overview and ensure the archival value from the incident, NCA dedicated administrative staff to enter these in the database.

At the end of July 2007, approximately 6 months after the incident, 803 daily reports from On-Scene Commanders are stored in the database, from the 201 cleanup sites. At this time, all but a very few sites are cleaned. In total, 12,500 work days have been used.
FEEDBACK AND LESSONS LEARNED

The response to the browse facilities provided through this systematic approach was overwhelmingly positive. In particular, the authorities in the individual municipalities used the web interface to provide information on the status and progress of the cleanup operations to the local population. Their direct access to relevant information caused a massive decrease in requests for information to the Operation Coordinator and his staff, compared to previous incidents.

For the On-Scene Commanders and Group leaders, a standardized format for daily reports proved very useful. The web interface for submitting daily reports was used to a limited extent, partly due to limited web access in some areas, and partly due to “old habits”. A cost-effective solution to this was to have administrative staff at NCA entering the daily reports received in paper format and e-mail from the On-Scene Commanders.

For the Operation Coordinator and the Shoreline Environmental Task Force, the digital map interface and the systematic database approach was very useful for maintaining an overview of contamination, priorities and progress of the cleanup operation. At the same time, seeing information organised in this manner provided new insights and triggered ideas for redesigning reporting forms and revising procedures and guidelines. The learning through this work has been extensive for these user groups, as well as for the development team, which also were members of the Shoreline Environmental Task Force.

For all members of the cleanup operation, the system provided a “common overview” of the entire situation, allowing and facilitating feedback from participants in the field on status of cleanup and location of contaminated sites. The environmental benefits of timely information flow and common perception of the situation should not be underestimated.

For the overall operation, the database serves as a documentation of priorities, methods selected and resources used in the cleanup operation. For a selected number of sites, detailed information is available on resources used to recover specific amounts of oil. Analysis of this material will be used in revising estimates and approaches for oil spill contingency analysis and response planning.

CONCLUSIONS FOR THE NEXT STAGE

Current plans are to include the functionality for registration of contaminated shorelines and cleanup sites in the updated ArcGIS version of the decision support system applied by NOFO and NCA. The functionality will allow direct entering of information in an access database by clicking in the digital map.

The forms for entering information will be redesigned. Separate forms will be designed for initial registration of information by On-Scene Commanders, and for the subsequent detailed characterization, prioritisation and selection of cleanup strategy by the Shoreline Environmental Task Force, as the previous common forms were confusing.

The organisation of and information flow in these kind of operations will be slightly modified, and procedures and instructions for the positions involved will be developed.

Last but not least, the web interface will be modified according to user feedback, ensuring that all user groups are provided with relevant information in a suitable format. Other elements in the next stage also include testing of “rugged” PCs for field registration. The objective for this next stage is a joint national system for oil spill cleanup operations, with tools and forms applied by NOFO, NCA and the IUAs.

BIOGRAPHY

The presenter holds an M.Sc. in Toxicology from the University of Oslo in 1993, and has worked with various technical environmental issues relating to the oil industry. Working for an NGO, she focused on educating SMBs on practical compliance with complex environmental/sustainability issues. Having worked in DNV since 2005, she currently carries out oil spill risk assessment, contingency analysis and contingency planning for oil spills, as well as development of tools for oil spill response information-flow.