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The Role of Spatial Information Systems in Environmental Emergency Management

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The recent advances that have taken place in the development and use of spatial information systems by environmental professionals for emergency preparedness and response have made it an exciting new area for information science research. Although the Emergency Planning and Community Right-to-Know Act of 1986, and the Clean Air Act Amendments of 1990, have been widely publicized both in the United States and abroad, the unique data handling issues associated with the use of spatial information have not been satisfactorily addressed by the information management community. This article will review the use of spatial data by environmental managers and emergency responders who are charged with the responsibility to perform hazard assessments, identify the location of toxic and hazardous materials, deploy emergency resources, and review demographic data to ensure the safety of the public and the surrounding communities.

Introduction

The wealth of environmental information being generated as a result of industry's compliance with current legislation concerning the protection of employees and the surrounding communities is an area of opportunity in need of information science research. The challenge is to develop information management standards for the cataloguing of data that can be visually represented using spatial information systems. Since 1989, public awareness of the environment has been heightened due in part to the introduction of the Toxic Chemical Release Inventory (TRI) database, maintained by the National Library of Medicine. Through the use of this database, the public and the press have online access to highly technical information furnished by industry on an annual basis covering the quantity of toxic chemicals being released into the air, land, and water (U.S. Environmental Protection Agency, 1993).

This article will address how spatial information is currently being utilized by environmental emergency management personnel, as well as how information access and retrieval can be improved through the efforts of the information science community.

Environmental Legislation

In the United States, legislation has been adopted that sets specific requirements for how industry and government are to work together to prevent, as well as respond to accidental releases of hazardous and toxic chemicals in the workplace. The Superfund Amendments and Reauthorization Act—Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III), was passed by Congress in the aftermath of the December 1984 Bhopal incident in India. The first right-to-know law in the United States was passed in 1981 in Philadelphia. A number of states and localities followed the example set by Philadelphia by passing their own right-to-know laws, frequently in response to an accidental chemical release. The right-to-know legislation moved to the federal level in 1985, three months after the Bhopal incident.

With the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), also known as superfund, scheduled to expire on October 1, 1985, Congress hoped to use the reauthorization process to change the current law, by broadening the scope of the legislation covering the management of hazardous wastes. In 1985, a bill with a proposed amendment linking community right-to-know legislation with Superfund reauthorization was passed by both houses of Congress. Final agreement upon the right-to-know issues took place on July 15, 1986, and in early October 1986, the Senate and the House passed the complete report. On October 17, 1986, President Ronald Reagan signed SARA Title III into law.

Under SARA Title III, requirements were established on how federal, state, and local governments and industries were to report on the use of hazardous and toxic chemicals in the workplace (Hadden, 1989). This was accomplished by having the chemical handling facilities cooperate with local emergency management in the planning process, which was the ultimate responsibility of the local government to update on an annual basis. The provisions of the act were also written to increase public knowledge and provide citizens online access to facility information on toxic chemical releases to land, air and water that could effect the local community.

The Clean Air Act Amendments of 1990, specifically Section 112(r) of Title III of this statute—Prevention of Accidental Releases, was approved partially in response to a number of serious incidents that had taken place at industrial sites where large quantities of hazardous substances were being stored. Under the approved legislation, the specific responsibility for planning and responding to a hazardous materials emergency rests with the company, rather than with the emergency responder, which is the case under SARA Title III. Therefore, a company producing, processing, handling or storing regulated substances over the threshold planning quantity has a general duty to identify the hazards associated with the potential release of the chemical into the environment and prepare a risk management plan to minimize the potential of an off-site accidental release. The risk management plan encompasses three components: (1) hazard assessment; (2) accidental release prevention; and (3) accidental release response.

Use of Information Technology by Emergency Responders

By the end of the 1980s, emergency managers were confronted with a rich array of specialized software that provided assistance with hazardous materials identification, hazard assessment, disaster response, and recovery management. According to Drabek, many state and local government agencies actually acquired microcomputers, but the extent of use has remained unknown (Drabek, 1991).

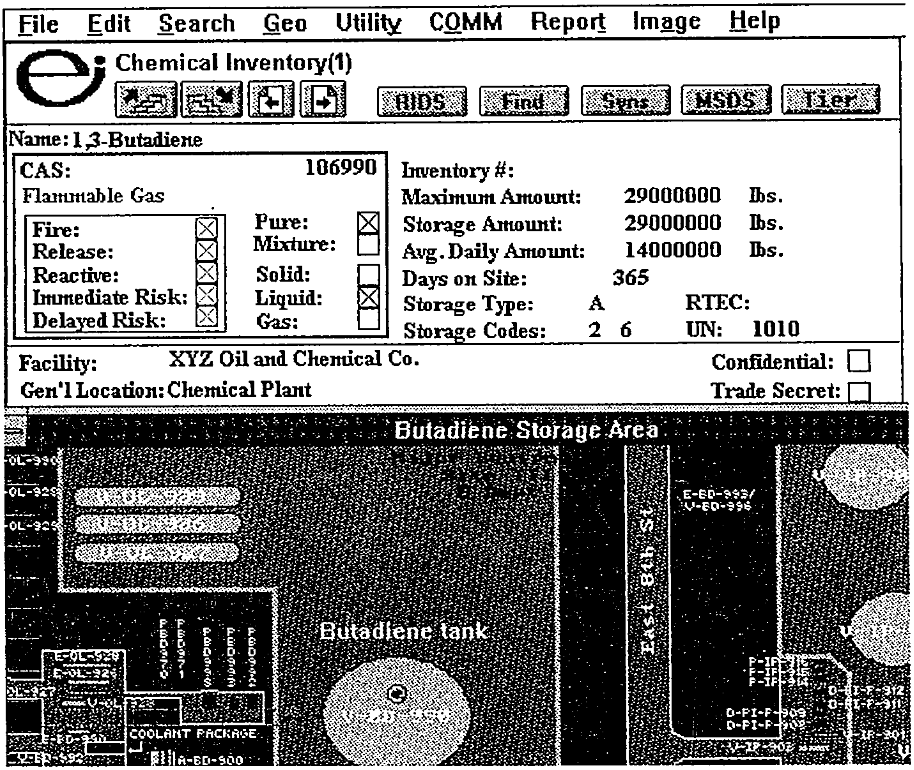
The hazard assessment requires that companies develop detailed planning documents estimating the potential quantity of chemical that could be released in the event of an incident, which includes an evaluation of the worst case scenario. Plume dispersion models, for example, ALOHA and CHARM, are used to predict the maximum downwind distance, taking into effect the release scenario, quantity of chemical being released, specified concentrations and current meteorological conditions at the release site (Technical Guidance for Hazards Analysis, 1987). The results from the models, which will project a credible worst-case scenario, as well as a more realistic vulnerability zone projection, can then be overlaid on facility and community maps, which are used to help develop emergency response plans and develop emergency drill scenarios in color Figure 1, an inventory record for the chemical 1,3-Butadiene is displayed along with the accompanying storage location for the chemical on the facility site plan. In color Figure 2, the illustration on the left, represents the results of a plume dispersion model for 1,3-Butadiene. The vulnerability zone is the area within the black circle and the isopleths depict the concentration of chemical released downwind from the source. The illustration on the right (Fig. 2) is a more in-depth view of the same chemical plume. The darker color represents the area near the source of the release where the concentration is highest, with the lighter colors depicting areas of lower concentration downwind from the chemical release.

The following is a list of data elements that can be located on community maps when developing emergency preparedness plans under current environmental regulations:

- identification of those facilities where hazardous chemicals are present;
- location of chemical storage areas;
- location of air ducts, sprinklers, and sprinkler shut-off valves;
- identification of transportation routes used when shipping hazardous materials;
- worst case scenario model displaying potential areas at risk;
- plume dispersion, which would display the location and shape of the plume and concentration isopleths based on physical properties of the chemical, amount released and current weather conditions and topography;
- population areas at possible risk;
- schools, nursing homes, and special institutions;
- location of emergency resources that would need to be deployed; and
- evacuation routes and alternates.

Surveys completed by emergency managers have provided an interesting perspective on the overall administration of computer-based emergency preparedness and response systems in state and local agencies. In a survey of local government agencies in California where 1200 questionnaires were mailed and 286 returned, 55 percent of the agencies reported that they used computers for day-to-day activities. Unfortunately, only 38% *used* them for emergencies, which is in contrast to the 91% of the survey responders who said that they were *interested* in learning how computers could be applied to emergency situations (Bradford & Brady, 1984). Applications to emergency management that were identified in this survey included community modeling or mapping, resource inventory, recovery, training, and communications. The actual experiences of local government agencies using the computer to perform these functions varied in frequency and scope with, for example, only 5% reporting some kind of hazard modeling application.

In a survey of planned microcomputer use in disaster preparedness, 16 emergency directors were interviewed about possible uses for microcomputers in disaster pre-



Chemical Inventory(1)

Name: 1,3-Butadiene

CAS: 106990

Flammable Gas

Fire: ☒
Release: ☒
Reactive: ☒
Immediate Risk: ☒
Delayed Risk: ☒

Pure: ☒
Mixture: ☐
Solid: ☐
Liquid: ☒
Gas: ☐

Inventory #:
Maximum Amount: 29000000 lbs.
Storage Amount: 29000000 lbs.
Avg. Daily Amount: 14000000 lbs.
Days on Site: 365
Storage Type: A
Storage Codes: 2 6
RTEC:
UN: 1010

Facility: XYZ Oil and Chemical Co.
Gen'l Location: Chemical Plant
Confidential: ☐
Trade Secret: ☐

FIG. 1. Chemical inventory record and accompanying storage location indicated on facility site plan for 1,3-Butadiene

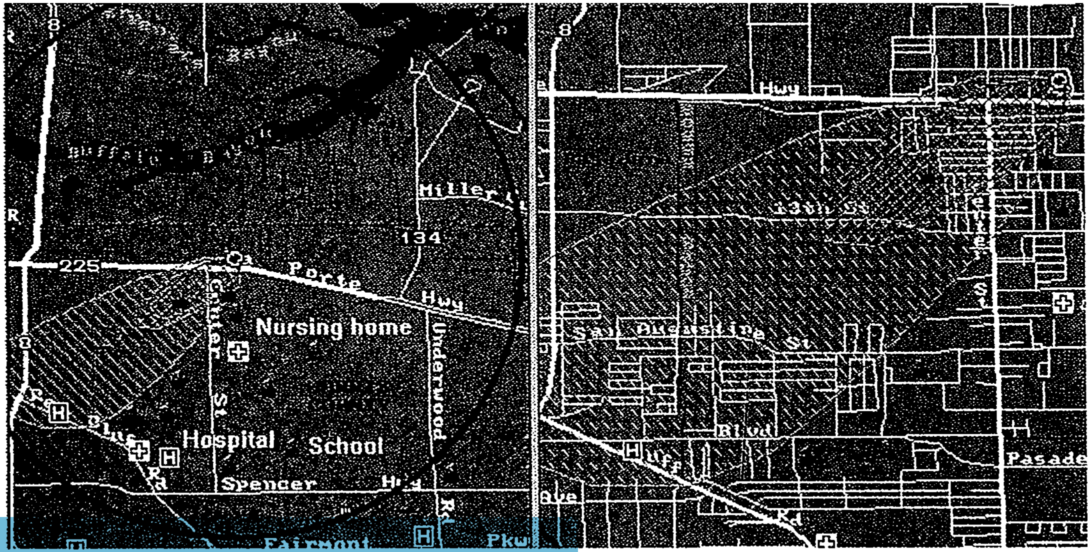


FIG. 2. Two views of a hypothetical off-site release of 1,3-Butadiene. On the left is the vulnerability zone (area within the circle), the path of the chemical plume, and the locations of schools and hospitals within the affected area. On the right is an in-depth view of the same plume showing the individual isopleths. The darkest color isopleth represents the area downwind from the release exposed to the highest chemical concentration.

paredness, for example, disaster plans and resource inventory. A total of 44% of the directors, which included one at the state level and six at the local level, reported that they used microcomputers for community mapping. Among those directors at emergency management offices who have actually used microcomputers during emergencies, Drabek found that a frequently discussed topic was the subject of acquiring expanded mapping capability.

The utility of the mapping function for emergency management is reflected in the following comments from a director who described his experiences with Hurricane Hugo (Drabek, 1991):

> The computer graphics convinced our local officials. They made a decision more rapidly because they could see it. It showed them alternatives. It answered their questions. The map we projected for them showed them how much time they had before they had to make a decision. What it really did was to confirm to the council members what I had told them previously about microcomputers and how useful they would be in a future disaster. They saw that what I had told them was the truth. (p. 148)

Based on these findings, it can be concluded that emergency responders appear to be convinced of the importance of environmental spatial information, although there is limited evidence on its actual use in emergencies. Because there is a lack of standardized terminology that would improve the information retrieval process, emergency responders will continue to consult multiple information sources, which they are most accustomed to using when time is of the essence.

TRI Database—Public Accessibility to Environmental Information

Under SARA Title III, the U.S. Environmental Protection Agency (EPA) was required to compile the Section 313 reports for toxic chemical releases into a national computerized database called *Toxic Chemical Release Inventory* (TRI). The agency made the database available in June 1989, through the Toxicology Data Network (TOXNET), operated by the National Library of Medicine (NLM).

The legislation set precedent in that this was the first time federal environmental information was required to be put on a database specifically for use by the public. The TRI database is a series of files, which contain information on annual estimated releases of toxic chemicals to the environment based on self-reported data from industrial facilities. The data includes the name and address of each facility and the amount of certain toxic chemicals being released to the air, water, or land, or transferred to waste sites. TRI data has been used by citizen groups and the media to locate individual sites that have high levels of toxic chemical emissions. In an online user evaluation of TOXNET conducted in the summer of 1991, by the National Library of Medicine, 202 responses were received indicating that the information sought was TRI/right-to-know data. This was found to be second only to toxicity/health effects, which was information sought by 412 responders to the survey (National Library of Medicine, 1991).

In a report approved by the National Library of Medicine Board of Regents, recommendations were made by a panel of experts who evaluated the goals, objectives and scope of NLM's Toxicology Information Program (National Library of Medicine, 1993). They also considered present and future requirements for information and data handling in toxicology and environmental health. One recommendation made by the panel was to work with different organizations with direct responsibility for emergency preparedness and response. NLM was encouraged to continue its research to improve access to information helpful to both the emergency management community and the health community in the event of an emergency involving hazardous materials.

Two spatial information systems, Computer-Aided Management of Emergency Operations (CAMEO) and Emergency Information System (EIS), were cited in the report as examples of information tools that contain graphic displays of facility site plans, locations of chemical storage areas, evacuation routes and special care facilities. These two emergency management systems can also display the output from plume dispersion models. The recommendation was made that information sources found to be useful in emergency situations be added to the NLM's microcomputer-based workstation ANSWER, which provides vital information to emergency response teams working on accidents involving hazardous chemicals. Although still being pilot tested, ANSWER has been shown to be fully functional in a command center environment in both crisis and noncrisis situations.

Problems in the Standardization of Environmental Information

The challenge that remains is how to standardize data from various information sources prior to being represented as a graphic image. Efforts to standardize NLM databases were a major focus of the NLM report. The recommendation was made to the NLM Board of Reagents that the information contained in NLM's toxicological and environmental health databases be integrated, whenever possible, so that they have common data elements, access methods, indexing methodologies, a common interface, and a uniform style. The objective is to select the appropriate architecture that will permit these databases to be searched as a unit and ultimately linked with all MEDLARS databases. With NLM taking the lead at striving for uniformity in naming conventions, database vendors will most likely be forced to modify their own applications to bring them in line with NLM standards.

The rationale for using spatial information systems becomes apparent when one sets out to assess the impact of an off-site chemical release. Unfortunately, a lack of standardized information compounds a difficult situation when citizens are faced with the task of reviewing information of a highly technical nature without proper guidance from someone who has received technical training in emergency management. Therefore, the risk of misinterpretation is great, considering that a graphic display of a plume covering a residential area will most likely alarm those residents living anywhere near the site of the potential accidental chemical release. The impact of this information, for instance, on property values of homes surrounding an industrial site is something that town planners could not have envisioned prior to the passage of the Emergency Planning and Community Right-to-Know Act. Because computer output is widely accepted by the public environmental management and local emergency responders must be prepared to answer inquiries from private citizens, interest groups, and neighboring local emergency planners who may request information on how certain analyses were performed. Therefore, how this information is interpreted prior to it being issued to the public is of utmost importance.

Under the Clean Air Act Amendments of 1990, a hazard assessment is to be performed on specific hazardous chemicals found in the workplace above the specific threshold planning quantity. The following three elements must be considered when performing a hazard assessment: (1) hazard identification; (2) vulnerability analysis; and (3) risk analysis. The outcome of the analysis is a display of the resulting plume, which is based on credible worst case assumptions. Using the data specified in *Technical Guidance for Hazards Analysis, Emergency Planning for Hazardous Substances*, a release scenario is projected and overlaid on facility and community maps. The worst case assumption scenario is performed first using data based on extreme conditions unlikely to ever occur (U.S. Environmental Protection Agency, 1987). Thereafter, additional analyses are executed using data that portray more realistic conditions. Not only should additional models be run to provide a more accurate picture of what could take place, but the plume dispersion models can be off by a factor of two, making estimates of population areas at risk of exposure difficult to predict with a high degree of accuracy. Therefore, emergency responders need to fully understand what the limitations are of using plume dispersion modeling prior to assessing the potential impact of an off-site chemical release.

Although the type of information required to be entered into an emergency management database is clearly stated in a variety of different publications, very little information exists regarding how it should be classified for ease of data entry and retrieval. Classifying emergency resources is one example where there appears to be a lack of uniform standards. One possible reason for this is that until recently the only individuals responsible for working with emergency resource data were emergency responders. Now that this same information is being accessed by individuals with different levels of training and experience, how the information is classified prior to data entry is of major concern.

The following example taken from a thesaurus constructed by emergency responders using the Emergency Information System Chemical (EIS/C), illustrates the problem inherent in naming emergency resources:

> The naming convention for trucks dispatched in an emergency was identified as an area where there was a lack of consistency in terminology used to identify emergency resources. If one were trying to retrieve information on all available dump trucks, how should the request be entered? The correct response is "Truck, Dump" not "Dump Truck." If one were to remember this naming convention, he or she would eventually encounter a problem thinking that all trucks, no matter what the function, were to be entered "Truck, (specific function)." Although there are a number of truck entries listed using this naming convention, e.g., flat bed, pickup, tanker and tow, to retrieve a truck that is used to fight certain types of chemical fires, i.e., foam truck, one would not retrieve the correct response following the same naming convention, i.e., "Truck, Foam." The way that this truck was classified was "Foam Truck." This inconsistency, no matter how trivial, is just one example of the problem inherent when trying to retrieve emergency resources. (p. 4)

Graphics used to identify resources and chemicals on facility and community maps also need to be standardized. In the case of chemicals, there are universal symbols that are displayed on placards, which could be used to identify storage locations for hazardous and toxic chemicals on facility maps. Although the EIS/C system has this feature, not all databases have these standard symbols in their files.

According to Drabek, when emergency managers were interviewed regarding barriers to system implementation, the data input process was mentioned first (Drabek, 1991). In addition, the attempt to standardize the format dramatically slowed down the data input process. Local directors reportedly had not realized just how much time the data entry process would require. Another barrier that was realized after the implementation process had begun dealt with the mapping capability, which many viewed as the prime reason for their first upgrade. Along with acquiring graphics was the need to obtain community-level information. Interagency alliances were thus formed with offices that conduct property appraisals. Frequently, these offices already had computerized maps that could enhance emergency management capabilities. Agreements were worked out in several instances where the emergency management agency acquired the mapping database and established provisions for periodic updates.

At a 1988 symposium on information technology and emergency management, there was much discussion regarding the lack of data standardization (Chartrand & Chartrand, 1989). This problem became acute when a request was made to share online computer databases with two or more emergency operations centers working on trying to manage an incident. The following major deficiencies in the emergency management information structure were identified: (1) no taxonomy of core emergency management terms, which classifies the information into major headings and subheadings; (2) lack of useful and accurate reference works; (3) lack of standardized data definitions and computer interfaces; (4) need for improved hardware and software compatibility; and (5) lack of written information policies, which include the involvement of information specialists to find, evaluate, and deliver information as requested by emergency managers (Craparotta & Sheldon, 1989). It can be concluded that the standardization of information will require further research and investigation in order for it to be shared with environmental and emergency management personnel and the public.

Framework for Developing Emergency Response Software

According to Morentz, the best emergency response software would include a combination of the following three types of specialty software:

- regulatory reporting used to complete the required regulatory paperwork under SARA Title III;
- hazard information, which provides textual information on the toxicological effects of specific chemicals; and
- plume dispersion modeling, which predicts the movement and concentration of airborne plumes from released chemicals.

Although the emergency response software will not be as comprehensive as any one of the three software systems looked at individually, the critical issues for success when dealing with emergency management are: (1) response time at generating, for example, a plume dispersion model; and (2) information organized in manner that can be easily accessible and understood by an emergency responder on the way to an incident. In addition, the information will be able to be shared and communicated to various levels of government and corporate decisionmakers (Morentz, 1992).

The recommended software considered to be ideal will have the following essential elements: maps to support the spatial display of data; data management systems to support regulatory reporting and hazard identification; and plume dispersion modeling and communications to permit maps, data, and models to be transferred in a matter of seconds to government and corporate departments. Therefore, to be successfully implemented, the emergency response software must be capable of managing information about the incident, the populations and communities at risk, and what resources need to be mobilized in order to handle the emergency. Being able to display the critical information related to the incident on maps in a timely fashion is therefore essential for rapid emergency response.

Case Study—Johnson & Johnson

Johnson & Johnson (J&J) selected EIS/C, a spatial information system used for emergency management and response in 1989. The system was developed by an outside company and is used in both the public and private sector. A well-designed emergency preparedness and response system was given high priority by J&J in order to accomplish the following: (1) perform hazard assessments of chemicals stored on-site; (2) cross-train facility personnel with local authorities on emergency planning and response procedures; and (3) communicate accurate chemical inventory, location, and emergency health data during an actual incident (Mondschein, 1993).

EIS/C is a PC- and LAN-based system composed of several major components. A variety of databases manage site-specific information, personnel, and emergency resources, locations of schools, hospitals, nursing homes, and environmental events or incidents. Chemical modeling is a very important component of the system. EIS/C has a database to store worst-case scenarios that can be developed using chemical plume dispersion models (Wrench, 1993). Based on the properties of the chemical and the weather conditions (a rooftop meteorological station can transmit live data to the system), a thorough hazard assessment can be made. The weather station will continuously monitor and update temperature, humidity, barometric pressure, as well as wind speed and direction. Through a data transfer program, the latest weather conditions will be automatically updated and imported into EIS/C for use in projecting the current path and direction of the plume. This can then be displayed on computer generated maps of the facility and the surrounding community. The maps are indispensible when evaluating the potential off-site impact of a chemical release. These high resolution maps, which range from 640 × 480 to 1024 × 768 pixels, depending upon the hardware, can be custom created from community and facility site maps, or imported from other programs including U.S. Census Bureau TIGER line files and GIS imported maps. The telecommunications software (ECOMM) was developed specifically for use with EIS/C. Using ECOMM, both text and graphic data can be shared and reviewed by individuals at different physical locations within a matter of seconds via asynchronous communications, which includes dial-up, packet radio, cellular, and satellite transmission. Therefore, a hazard assessment performed by one facility can be easily transmitted to another location where the results can be further analyzed.

At J&J World Headquarters, in New Brunswick, New Jersey, community and facility maps are being installed on the headquarters's local area network for all J&J affiliates with EIS/C. Over a dozen facility locations in the United States and Puerto Rico, and a few sites in Europe, now have EIS/C. Through a partnership arrangement with local emergency responders, for example, fire and police departments, J&J has purchased copies of the EIS/C software, which have been donated to these local government agencies. In addition, several principal manufacturing facilities in New Jersey have hosted three-day training sessions for company personnel and local emergency responders, who were given hands-on instruction on how to use the system. This was an excellent opportunity for facility personnel to not only learn the basics of EIS/C, but to help build stronger ties with those individuals in the community who play an important role in emergency management.

The greatest drawback to system utilization is the lack of uniform standards for entering data. In the area of emergency management, the development of naming conventions for equipment, supplies, and job titles is slowly taking place. To further complicate matters, because the system is being used internationally, there needs to be decisions made regarding the language in which the information should be entered. Initially, English was used exclusively by all EIS/C users, but many typographical and transcription errors were soon discovered. It also resulted, based on discussions with several employees, in a lack of "ownership" by some system users who were not fluent in English and thought of EIS/C as another "United States" system. The way that this issue is being handled is to have a majority of the information that concerns the community entered in the indigenous language, and have the information of a technical nature that could be shared with corporate staff, for example, details surrounding a potential chemical incident, written in English.

To test the system's communications capabilities, an emergency drill simulation took place between J&J World Headquarters and a J&J affiliate in Belgium. The simulated incident lasted over an hour. Information in the form of chemical data records and plume dispersion models were successfully transmitted between the two sites within a matter of minutes, depending upon the number and size of the individual records being sent. This provided emergency managers in Belgium, as well as environmental and corporate communications managers in the United States, with a good perspective on how an actual incident could be managed. Sharing information in English was not a problem for a majority of the employees who participated in the simulation.

The transmission of the results of the chemical plume dispersion modeling overlaid on the facility and community maps was very effective in assisting corporate managers at immediately assessing the situation. Since that time, a few domestic J&J facilities have conducted similar simulations using EIS/C where both J&J headquarters staff and the emergency responders from nearby communities were included in the drill scenario. Senior executives are also introduced to EIS/C as part of a two-day training workshop on crisis management. The system is described as one important tool that should be installed at locations that store toxic and hazardous materials in large enough quantities that require reporting to local, state, and federal government agencies.

Although it is a matter of preference whether it is easier to review lengthy chemical handling and emergency management procedures on the computer versus on paper, what the system does exceptionally well is the retrieval of data that are traditionally stored in multiple locations. This includes identifying the location of the spill, the chemicals involved, the amount stored on-site, its physical properties, and a contact list of qualified persons to handle the incident. EIS/C is put to the ultimate test on the second day of the training workshop when a desktop drill simulation is conducted for senior level managers. As part of the exercise, the executives are supplied with EIS/C-generated maps and accompanying data to assist them in decisionmaking during the course of the crisis.

Future plans include the installation of EIS/C at all J&J manufacturing locations worldwide that handle large quantities of hazardous materials, or are located in a geographic area prone to having a natural disaster, for example, hurricane or earthquake zone. The greatest challenge will be to ensure that individuals properly trained on the use of EIS/C maintain their skills, which can only be done by using the system on a regular basis. This includes the constant updating of routine chemical data and inventories and emergency contacts in preparation for conducting an annual facility drill simulation.

Future Research

Environmental legislation has for the first time provided the public with the opportunity to investigate the steps industry has taken to control the release of toxic and hazardous substances that enter the environment. The challenge for industry is to build public confidence by assuring them that the information provided is accurate, understandable, and is neither over or understated.

The introduction of spatial databases with software that contains extensive mapping capabilities has had a tremendous impact on the analysis of information that was formerly reviewed only in a text format (National Research Council, 1993). This new perspective allows emergency planners to develop contingency plans to minimize the likelihood of an event from occurring. Sharing this information with the public continues to be a challenge due to the lack of consensus among emergency management personnel on terminology that can be understood by both technical and nontechnical audiences.

One can only surmise the confusion over terminology between the facility and the local emergency management agency when the public is provided with the same data without a clear explanation. What makes this situation tenuous is that the information in the form of facility maps, data elements, and chemical models at first glance appears understandable, with little, if any, explanation required. Consequently, conclusions are drawn by the public without input from a trained professional who understands the meaning of the information.

Research should, therefore, take place to ensure that the information released to the public can be easily understood with a minimal risk of misinterpretation, that is, usability tests. Recruiting citizens to participate in focus groups where they are asked to review a graphic representation of a hazard assessment for a specific chemical may provide valuable insight into how the information is interpreted. It is envisioned that this feedback can then be used by facility personnel to help develop a standardized format whereby the data elements can be clearly represented on community and facility maps. A further recommendation would be to document the information both online and in a small, printed reference manual, which provides information to the user that is not covered in the electronic format.

Where databases are accessed by the public or through an intermediary, as is the case with the TRI database, the software must be reviewed to ensure that the database is easily accessible and the output is retrieved in an acceptable format (National Library of Medicine, 1991). Based on user feedback, the addition of a mapping capability to the database must be investigated (Hadden, 1989). Training should also be offered as an option, along with context-sensitive online help to reduce any uncertainty in using the system.

In conclusion, having environmental emergency plans that are understood by members of the community will build trust, while demonstrating responsible environmental management. Hopefully, the long-term effect of these changes will result in partnership opportunities where facility personnel, local emergency management officials, and the citizens of the community can work closely together for a safer environment. Congress has empowered the citizens of the United States with the authority to send industry a clear message to reduce the amount of toxic chemicals and hazardous substances released into the environment. This effort appears to be working, and will be a major step in helping us realize a safer and healthier environment for future generations.

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