CHAPTER 12

DATA AND INFORMATION MANAGEMENT

INTRODUCTION

Though often used synonymously to refer to "things that are known," the terms data and information may be variously distinguished. For example, some prefer to reserve the use of data (plural of datum) for reference to quantitative knowledge and information for qualitative knowledge. Others prefer to distinguish between them not on the basis of type of knowledge but, rather, on whether or not individual pieces of knowledge have been integrated into a larger understanding—an approach that reserves the use of data (or datum) for singular pieces of knowledge and information for data that have been connected to other knowledge bases or otherwise purposely processed for use.

By either definition, emergency response is always a data- and information-intensive effort, not only in terms of the level of detail, but also in terms of the diversity of data and information that must be collected, evaluated, and acted upon. The management of data and information is therefore absolutely critical to the success of emergency response. Moreover, because the focus of both proactive and reactive emergency response is always action—in particular, the act of making decisions, it is perhaps best to view data as either qualitative or quantitative knowledge that must be processed into precisely that information which is most useful for decision-making.

Given the widespread accessibility to global information networks and databases and the ready availability of an ever-expanding computer technology, it might appear that the management of emergency-related health and safety data and information should be a relatively simple task. However, it is well worth considering that access to global data banks and information networks enhances not only the potential for improvement in the efficiency and comprehensiveness of decision-making, but also the potential for utter confusion. Even the most sophisticated technology for retrieving and processing information is no guarantor of competence, nor can it correct the consequences of incompetence.

As happens with the application of any new technology, the application of computer technology to emergency response needs is subject to a variety of misconceptions that can actually contravene the objectives of the response service. Some of the most common misconceptions involve the following considerations:

1. Despite the continuing development of *expert programs*, computers are essentially ignorant tools. While an extremely powerful tool in terms of flexibility, efficiency, and range of applications, a computer cannot as yet even begin to substitute for human intelligence. The practical consequence of this simple fact must be the realization that any aspect of computerized response applications must be fully conceived and developed before appropriate computerization should even be attempted—and, even then, only when the specific objectives of computerization can be clearly defined in terms of the actual needs of emergency response.

2. The rapidity with which we can now access worldwide databases means that we can retrieve bad information as quickly as we can good information. In fact, one may reasonably suppose that the likelihood of retrieving bad information, pure nonsense, or at least misleading data is far greater than retrieving information that is subject to strict quality criteria and review. The practical consequence of this situation is that data and information to be used for emergency response purposes must be evaluated for its veracity and pertinence regardless of source.

3. Software marketing hoopla to the contrary, there is no single computer program that can meet all the needs of managing emergency response databases. Each program has its capacities and its limitations—and both its capacities and its limitations are inherently obstinate. The practical consequence of this must be the realization that the capacities and limitations of each program must be carefully evaluated with regard to specific objectives of the hazardous response service. There is, in short, no such thing as "an excellent program" except that it meets precisely defined needs and objectives.

Given the importance that a computer program serve specific response needs and objectives and not vice versa, emergency response planners and safety officers should seriously consider developing, where possible, custom-made computer programs rather than simply relying upon commercially available "canned" or "off-the-shelf" programs. While this alternative is too often given little serious attention, it should be noted that few companies or other organizations entrust their financial, inventory, or billing procedures to over-the-counter computer programs but, rather, utilize the consulting services of professional programmers. Moreover, the ready availability of powerful yet simple programming languages and tools (e.g., Visual Basic) makes it increasingly possible for in-house response personnel who are not professional programmers to develop highly useful programs.

4. In many companies and organizations having extensively computerized operations, and especially where such operations entail the use of mainframe computers, computer programs and procedures are typically centralized in a computer operations or data processing department. Even where PC networking (as opposed to mainframe systems) is employed, such a centralized department usually exerts full authority over all computer hardware and software. Certainly there are very good reasons for this, including the need for data and information security and the handshaking requirements of computer networks.

However, it is reasonable to suggest that there are practical levels of flexibility required in order to ensure that the needs of corporate financial management, inventory control, and office management do not unnecessarily constrain the operational needs of health and safety programs and, in particular, those health and safety programs directly relevant to emergency response. In proposing appropriate computerization of the various elements of health, safety, and emergency-response programs, particular attention must be given to defining capabilities that provide timely and practical information to emergency response personnel without conflicting the needs of other computer-assisted corporate functions and operations.

EXPERT SOFTWARE

Over the past decade there has been an explosive development of professionally designed software of particular importance to emergency planning and response. Some of this software has been designed by governmental agencies having broad jurisdictional responsibility and/or special expertise regarding certain types of emergencies; some has been designed by independent experts who, often in close coordination with emergency response services, focus on practical response needs that are particularly data-intensive.

For example, CAMEO (Computer-Aided Management of Emergency Operations) is a software suite developed by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administra-

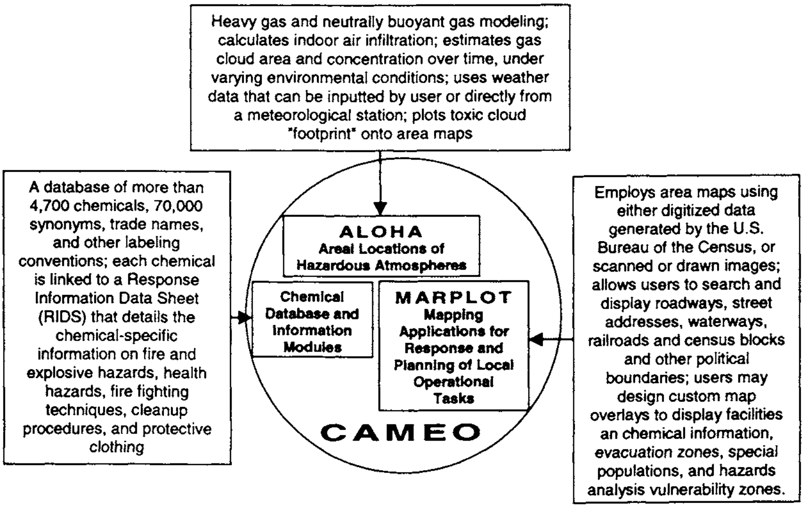

FIGURE 12.1 Basic components of the computer-aided management of emergency operations (CAMEO) interactive program.

tion (NOAA) to assist both governmental and private sector managers in (a) planning for and mitigation of chemical accidents, and (b) meeting regulatory compliance objectives of the Emergency Planning and Community Right to Now Act of 1986 (EPCRA; SARA Title III). Designed for use by EPCRA-defined entities, such as Local Emergency Planning Committees (LEPCs) and State Emergency Planning Commissions (SERCs) as well as by fire departments, emergency planners, and chemical facilities, CAMEO meets four key objectives:

- Provides instant access to safety and emergency response information on more that 4700 chemicals
- Tracks chemical inventories in the community and in transit
- Provides for the electronic submission of reports submitted by regulated facilities in compliance with EPCRA
- Performs an analysis of hazards and off-site consequences of air-dispersed chemical plumes

CAMEO is composed of three interactive programs (Fig. 12.1): ALOHA, which is a sophisticated air-dispersion model; MARPLOT, which is a mapping application for planning and managing field response operations at chemical incidents; and the CAMEO chemical database, which includes chemical-specific information on fire and explosive hazards, health hazards, fire fighting techniques, cleanup procedures, and protective clothing. The U.S. National Safety Council (NSC) provides extensive professional training on the use of CAMEO and can be directly accessed via the internet for additional information and training purposes (http://www.nsc.org/ehc/CAM/trn_main.html).

Other commercially available expert programs are also easily accessed via the internet, including programs that meet both general and highly specific emergency response operational and management needs, such as:

- 3-D modeling of groundwater flow and contaminant plumes
- hydrodynamic simulation of hydraulic flow in open channels
- simulation of contaminant flow in lakes, estuaries, and coastal waters
- modeling of soil–vapor interactions
- modeling of contaminant flow, transport, and environmental fate in saturated and unsaturated soils
- simulation of environmental transformations of hazardous chemicals

These and many other such expert programs can be accessed most easily through the use of such search-phrases as "computer models," "dispersion models," or "transport simulations," or through the home pages of individual providers (e.g., Scientific Software Group: http://www.gwsoftware.com/).

Of course, the most important sources of information regarding highly useful expert programs for emergency response are practicing emergency response professionals. For example, one of the most important software tools under current development for firefighters and other rescue personnel utilizes virtual reality technology to provide response services an operational management tool as well as a highly effective training technique by integrating site-specific structural, locational, and hazard information with simulated optical feedback. Information about this developing technology is available through Firemaster James Jameson, Strathclyde Fire Brigade (U.K.).

ELEMENTS OF IN-SERVICE DATA AND INFORMATION BASE

While the data and information base for emergency planning and response must serve the site-specific needs of an actual incident, certain types of data and information have universal relevance and can easily be implemented without the aid of expert programs and techniques derived from external sources. Examples of minimal types of data and information bases and the necessary cross-referencing among individual databases may be briefly summarized as follows:

1. Persons and Personnel at Potential Risk

• response personnel by name and operational task category, with cross-reference to potential sources of risk or hazard, pertinent regulations, training needs, required protective equipment, communication needs, decontamination and waste disposal requirements, emergency medical treatment, required medical surveillance, personal susceptibilities, or other factors of special relevance to health and safety

• other on-site persons, including facilities employees, contractors, consultants, and other support personnel, with cross-reference to specific health and safety precautions, evacuation and temporary shelter needs, task-related restrictions and constraints, and documentation requirements

• off-site persons who may be exposed to hazards associated with incident and response operations, including property abutters, downwind or downstream residents and communities, with cross-reference to environmental mechanisms of dispersal of hazardous materials and substances, automatic and manual alarm devices and systems, and evacuation procedures

2. Inventory and Assessment of Hazards

• Types of physical, chemical, and biological hazards, with cross-reference to source, modes of exposure, chronic and acute effects, signs and symptoms of exposure, rehabilitation requirements, emergency and follow-up medical treatment and surveillance

• Sources of routine and emergency hazards, with cross-reference to required engineering and managerial controls, required use of personal protective clothing and equipment, routine and emergency ambient monitoring requirements, inspection schedules, and evaluation criteria

3. Incident Response Operations

• Description of individual health and safety incidents (including routine and emergency incidents), with detailed assessment of cause and cross-reference to pertinent regulatory requirements, organizational policies, and specific requirements of the health and safety plan

• Assessment of frequency and magnitude of incidents, with cross-reference to review and modification of health and safety program, notification of regulatory authorities, and personnel training requirements

4. Support Resources

• Consultant, contractor, regulatory, and other available personnel having special knowledge and experience relevant to health and safety and response operations, with cross-reference to specific data, information, material, equipment, and other needs of support resources

- Hard copy and electronic sources of regulatory, technical, and scientific data and information, with cross-reference to routine and emergency need for importation, including up-to-date information on health and safety standards, chemical toxicity and compatibility, personal protective equipment, monitoring devices, and medical treatment and surveillance
- In-place maps, schematics, and diagrams for all facility structures and properties that locate all primary sources of hazards, routes of ingress and egress, potential pathways and receiving systems for spills or releases of hazardous materials, with cross reference to specific regulatory requirements (e.g., underground storage tanks, hazardous waste storage areas, electrical transformers)

It must be stressed that the above types of data and information should be immediately available to the incident commander or other responsible person whether or not the data and information are computerized. However, the cross-referencing required to meet the pressing needs of an actual incident, a facility inspection by regulatory or response personnel, or even routine operational decision-making clearly emphasizes the importance of well designed and highly integrated computerized files.

What is meant by "highly integrated" is that the data contained in one file allow the user to identify (i.e., through appropriate cross reference) other data that may be contained in other files. For example, a file that contains information on the general technologies available to technical rescue personnel (Fig. 12.2) can be cross-referenced to files that contain data (e.g., design specifications) on specific equipment that is available within a type of technology as well as vendors who can provide that equipment. Such cross-referencing of files (or integration) can be done, of course, without the use of computers, although computers do provide for a much more efficient management (e.g., updating, correction, correlation) of the relevant databases.

External Databases

Electronic publishing is a rapidly expanding phenomenon that commercial companies, professional organizations, and governmental agencies increasingly use to make technical and scientific information and data more easily available at little or no cost. Powerful search-and-retrieve programs, CD ROMs, and worldwide networking provide essentially instantaneous access to data and information pertinent to all aspects of emergency planning and response, including state, national, and international regulations, health and safety standards, epidemiological and laboratory studies, personal protective clothing and equipment, ambient and personal monitoring systems, and medical surveillance protocols.

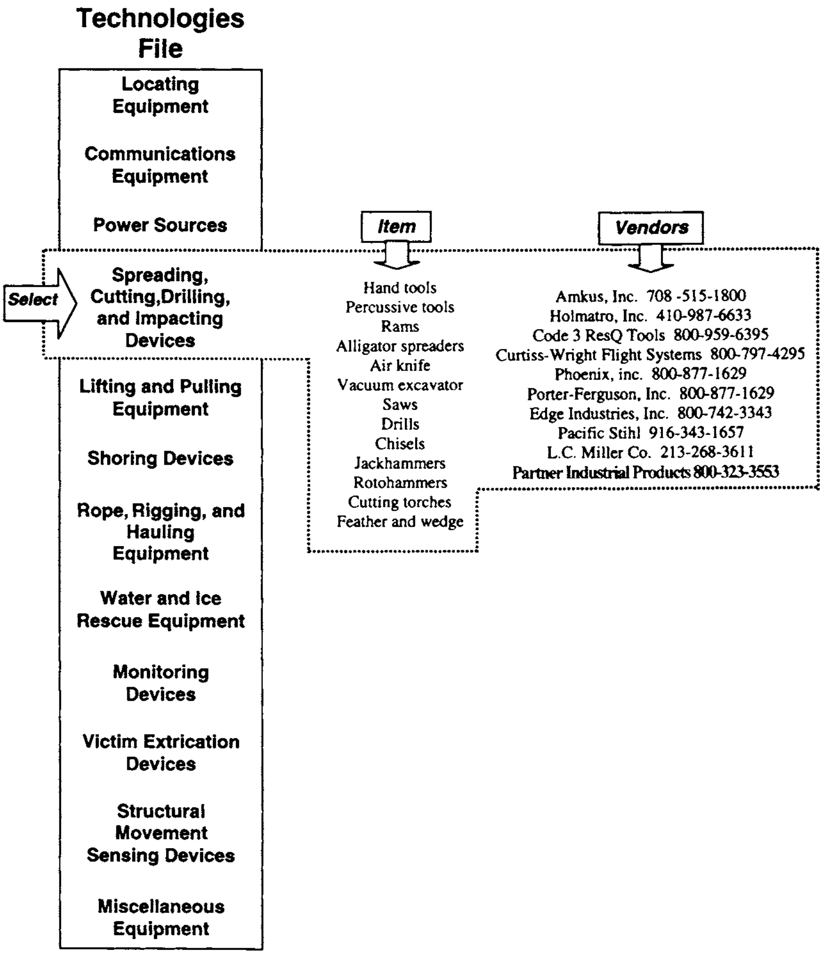

FIGURE 12.2 Example of cross-referenced fields in a database of general technologies available to technical rescue personnel.

While it is important to explore the full range of available databases, it is equally important to consider the following:

1. Even a brief perusal of health and safety standards is sufficient to determine that standards are highly variable from one legal jurisdiction to another. While it goes without saying that the safety officer must ensure compliance with the specific legal authority having jurisdictional precedence, it may very well be appropriate to adopt a more stringent standard proposed by some other authority. Such an approach is consistent with not only the

principle of minimizing health and safety risk, but also the recognition that there is often a significant lag between scientific findings and regulatory reform. Of course, there are instances in which standards become less stringent precisely because of advances in scientific understanding of hazards and risks—a consideration that should nonetheless be weighed against state-of-the-art practice.

2. There are many CD ROM databases on chemical hazards and risks, some of which are available through chemical manufacturers and some through commercial sources, including companies that specialize in the production of material safety data sheets (MSDSs). A comparison of MSDSs prepared by different companies for the same chemical substance or product will often reveal differences regarding not only specific hazards, but also routes of entry, target organs, and recommended protective clothing and equipment.

The adoption of the findings, determinations, and recommendations made by any purveyor of information does not absolve the buyer or user of such information from potential liabilities that might accrue to errors of fact or judgment on which that information is based. It is therefore necessary that comparisons of alternative databases be examined and, where differences do occur, to resolve discrepancies.

In many instances, discrepancies in hazard determinations and the toxicology of chemicals are not due to oversight or error but to differences in the interpretation of highly technical data. Where this is the case, guidance must be sought from regulatory and competent scientific authority.

3. While many commercial electronic databases are offered as part of a subscription service, which ensures periodic updating of information, updating does not ensure veracity. Confidence in a database is warranted only when efforts are made to review that database in light of recognized legal, professional, and scientific standards as promulgated through a wide range of governmental agencies and professional organizations, including the National Fire Protection Association (NFPA), Federal Emergency Management Agency (FEMA), National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), Agency for Toxic Substances and Disease Registry (ATSDR), and the U.S. Environmental Protection Agency (EPA).

Internal Databases

As important as external databases are, they cannot substitute for those databases that must be compiled on a facility- or incident-specific basis and which represent the operational details of emergency response operations. Encompassing information on all service-related health and safety policies and procedures, personal protective clothing and equipment, engineering and managerial controls, personal risk factors, ambient monitoring, medical surveillance, operations auditing and inspection, and personnel training, internal databases must not only accommodate the documentation needs of the response service but also meet the day-to-day operational and planning needs of that service, including:

- Scheduling of key activities (e.g., personnel assignments, ambient monitoring, personnel training, medical surveillance, internal audits of operations)
- Assessment of incident response
- Revisions of pertinent programs and policies in light of incidents, changes in health and safety standards, changes in operational capacity, changes in regulatory requirements, development of new materials and technologies)
- Personnel actions required to enforce health and safety policies and procedures
- Assessment of effectiveness of response strategies and tactics
- Evaluation of in-place policies, procedures, and equipment with regard to the current and developing state-of-the-art

In constructing internal databases, which include selected data and information obtained from external sources, it is vital that emphasis be given to the specific information that is most likely to be immediately needed during response operations (e.g., nature of biological hazards in facility, likelihood of release of a toxic vapor or mist into the atmosphere). Only by defining the particular informational needs engendered by actual situations can specific cross-reference and retrieval capabilities be incorporated into diverse databases—capabilities that ultimately determine the actual usefulness of those databases and which, unfortunately, are too often overlooked by personnel so mesmerized by the sheer volume of information at their command that they forget that no data or information are of any value whatsoever unless they can be readily integrated with specific planning or response objectives.

Integrating Data with Objectives

Data processing is the means by which individual pieces of information become integrated with planning and response objectives. It consists of both the analysis and presentation of data so as to facilitate purposeful decision-making. While data processing long precedes the advent of computer technology, computers not only greatly reduce the time and effort required

TABLE 12.1 Number of Fires (Boston, 1988) on Basis of Time of Day (Adapted from U.S. Fire Administration, Fire Data Analysis Handbook)

Time Period	Number	Time Period	Number
Midnight - 1 AM	478	Noon- 1 PM	307
1 AM - 2 AM	420	1 PM - 2 PM	316
2 AM - 3 AM	360	2 PM - 3 PM	363
3 AM - 4 AM	273	3 PM - 4 PM	381
4 AM - 5 AM	192	4 PM - 5 PM	417
5 AM - 6 AM	127	5 PM - 6 PM	433
6 AM - 7 AM	122	6 PM - 7 PM	492
7 AM - 8 AM	139	7 PM - 8 PM	514
8 AM - 9 AM	156	8 PM - 9 PM	540
9 AM - 10 AM	168	9 PM - 10 PM	622
10 AM - 11 AM	206	10 PM - 11 PM	510
11 AM - Noon	242	11 PM - Midnight	547

to produce a competent analysis and presentation of data, but also significantly increase the sophistication of data processing.

For example, the U.S. Fire Administration developed an comprehensive text *(Fire Data Analysis Handbook)* on statistical and graphic methods of data processing for use by fire services based on the following premise:

> Turning data into information is neither simple nor easy. It requires some knowledge of the tools and techniques used for this purpose. Historically, the fire service has had few of these tools at its disposal and none of them has been designed with the fire service in mind. (from Forward to Fire Data Analysis Handbook, U.S. Fire Administration)

Today, all of the methods and techniques discussed in this excellent text are readily available through low- to moderate-priced commercial software. In fact, a good number of these techniques are standard components of popular word processing programs that can automatically convert tabulated data (Table 12.1) typically compiled by fire service personnel into alternative graphic representations (Fig. 12.3) having direct relevance to specific operational objectives (e.g., most efficient scheduling of fire response personnel over a 24-hour period).

Essentially one step up in technical sophistication from the simple data processing afforded by word processing programs are those spreadsheet and database management programs that are typically included in home and office program suites. Yet another step up from these are simple programming languages (e.g., Visual Basic) that can nonetheless perform rigor-

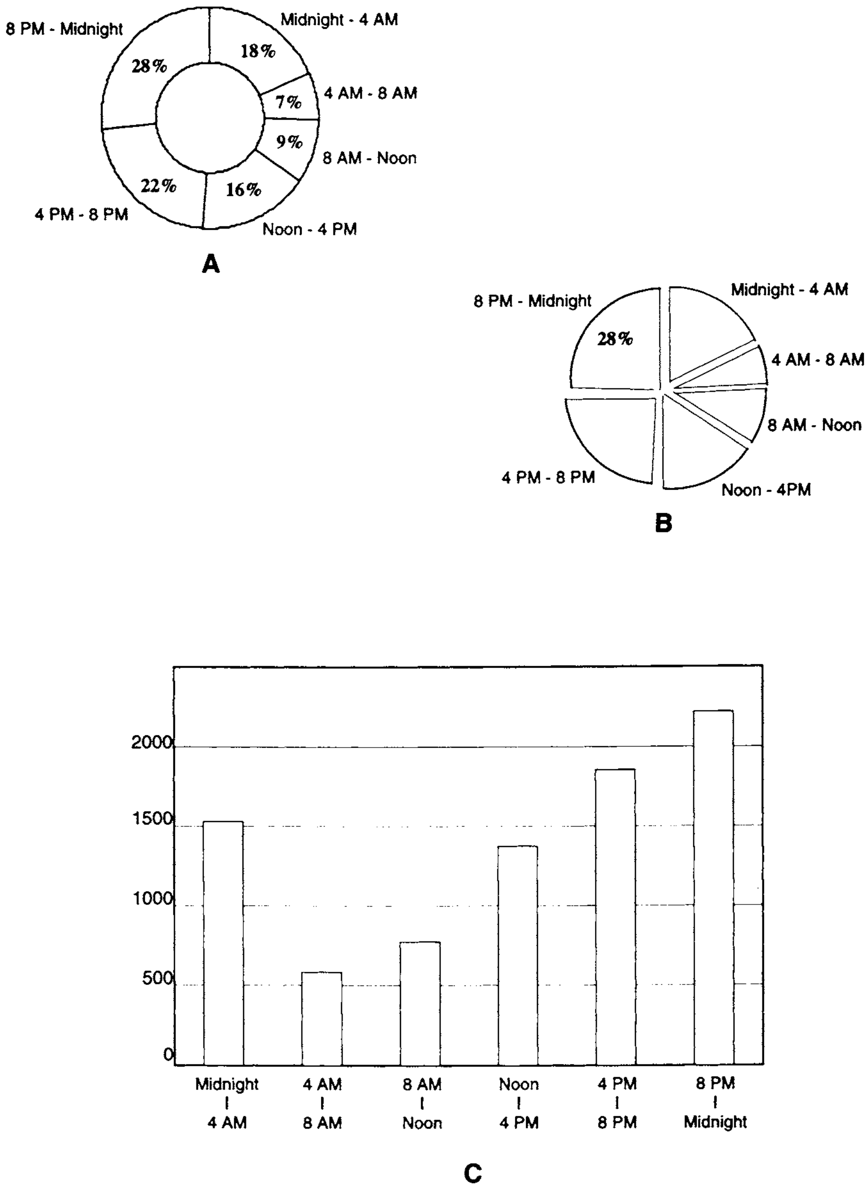

FIGURE 12.3 Example of standard graphics capabilities in contemporary word processors (data are those included in Table 12.1).

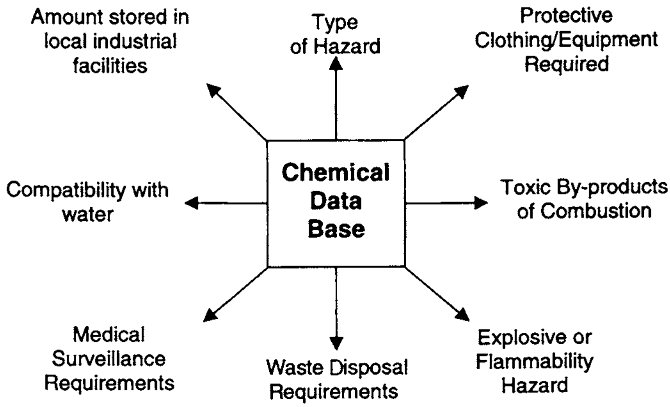

FIGURE 12.4 Some commonly cross-referenced data in a chemical database (additional types of data may also be included in the database).

ous data analysis and informational packaging with relatively little investment in time, training, or money. More complex and sophisticated programming tools are, of course, available.

Figure 12.4 is a representation of a chemical database that may be established by any readily available and simple data management program. Such a base may include from several hundred (e.g., for a small manufacturing facility) to several thousand or more individual chemicals (e.g., for a community response facility) , each being correlated with appropriate information, such as waste disposal requirements, toxic by-products, type of hazard, and other types of information important for planning or responding to a chemical incident. Thus, relevant information about a particular chemical may be retrieved on the basis of any of the types of information associated with that chemical. Of course, in an actual incident, the precise chemical involved in a spill or release may not be known, or mixtures of chemicals may be involved. Because of this, it is important to include not only the names of pure chemicals in the database, but also categorical descriptors (e.g., "flammable solvents," "toxic gases") that correspond to chemical mixtures likely to be encountered in a site-specific incident.

Whatever the tool used (i.e., whether provided by word processors, spreadsheets, database programs, or programming languages), the most important element in any data processing is the clear understanding of (a) how individual pieces of data can be linked to one another, and (b) how those linked data can be used to provide essential input into decision-making.

In short, the difficulty, today, is not the analytical techniques of data processing—these are already prepackaged for almost instantaneous use in

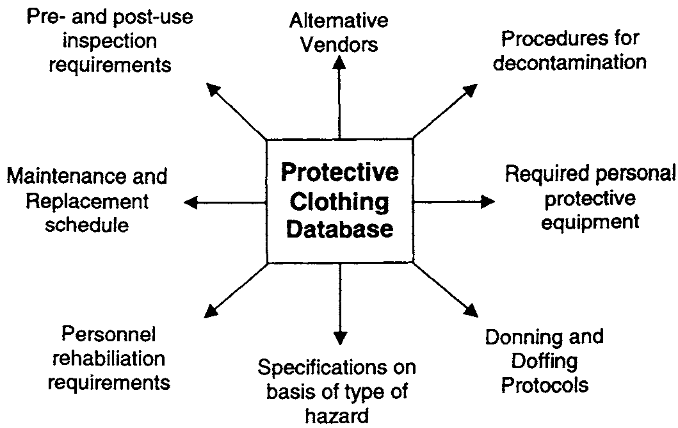

FIGURE 12.5 Some commonly cross-referenced data in a protective clothing database (additional types of data may also be included in the database).

user-friendly format; rather, the difficulty is matching informational needs with planning and response objectives. Thus, the data to be included in the database depicted in Fig. 12.4 must be selected from among voluminous available data—selected precisely because only certain types of information can be acted upon, whether for planning, operational, or training purposes.

During an actual incident, of course, informational needs will vary with a wide range of factors, including type of incident, weather conditions, and timing of the incident with respect to work schedules and community activities. Informational needs may also vary during any particular incident as additional details of the incident become evident. The substantive design of a database is therefore essentially a function of managerial strategy rather than of technical or scientific necessity.

MODULAR APPROACH TO DATABASE DESIGN

The practical approach to building databases having high relevance to the practical needs of emergency planning and response is to focus on the construction of individual modules—databases that correlate information of a particular type, such as the chemical database depicted in Fig. 12.4, or a database for protective clothing (Fig. 12.5), or for decontamination (Fig. 12.6), or for any other major category of operational concern. This compartmentalization of databases, especially if undertaken by in-service personnel, typically results in less time required for not only the design of databases, but also for upkeep due to the development of new materials,

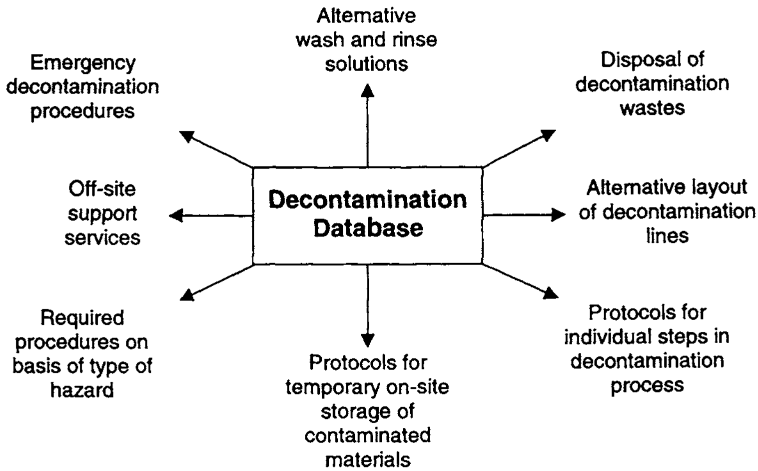

FIGURE 12.6 Some commonly cross-referenced data in a decontamination database (additional types of data may also be included in the database).

equipment, standards, and regulations. It also allows for the use of the overall format used in one module as a design template for other modules. Finally, it allows individual personnel (either singly or in small groups) to focus on topical areas in which they have particular expertise, experience, and interest.

Another key attribute of the modular approach is that it allows for more concentrated and efficiently performed debugging and testing to ensure that it contains precisely the information required and correctly performs retrieval, updating, and corrective functions. A key disadvantage of this approach is that the final product could be nothing more than a series of disconnected databases that must be individually accessed to retrieve information sets that are operationally interdependent. It is therefore vital that the design of individual modules allow for multidimensional access into related modules.

For example, in a given incident, the type of chemical may be known and can be used (either by name or category) to access response-relevant information (e.g., reactivity with water, type of health or safety hazard) from a chemical database. However, hazard type can also be used as a means of entry into the database module designed for protective clothing. If this second module (i.e., protective clothing module) contains information on procedures for decontamination, then such procedures may also serve as a means of access to a third module, which is a database for decontamination. In short, the design of individual modules can be accomplished easily so that

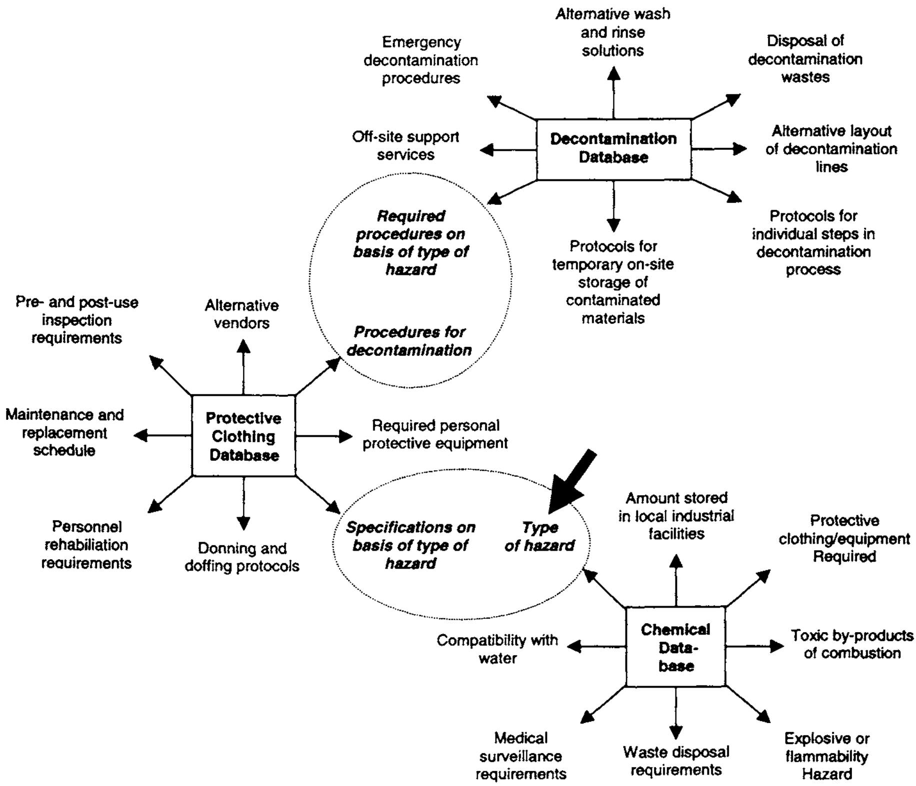

FIGURE 12.7 Example of linkage of different databases. The arrow indicates that primary linkage is through chemically specific hazard; other linkages are also possible.

one piece of information (e.g., hazard type) triggers the retrieval of relevant hazard-specific information from a range of different types of databases (Fig. 12.7)—information that singularly and collectively provides essential direction to decision-making.

Of course, in the example presented in Fig. 12.7, this approach would appear to result in an unnecessary duplication of files (e.g., decontamination procedures in both protective clothing and decontamination databases). However, this is not the case. After all, any database ultimately consists of interrelated files; the arrows in Fig. 12.7 do not point to actual duplicate files but, rather, to the same file. In this context, it is important to emphasize that the construction of interconnected modules depicted in Fig. 12.7 is not at all dependent upon computer technology—such a system can be constructed just as solidly out of traditional file folders and paper labels as out of electrons. What is depicted is simply a logic, not a technology—a way of organizing data to meet decision-making needs for information, not an exercise in arcane engineering. The computer is simply a highly efficient means for consistently exercising a defined logic on organized data to produce information in a selected format. Yes, the technology is new. But the manner of thinking is not.

Team Approach to Database Design

Ideally, the construction of any database and associated retrieval systems should be undertaken by a team composed of experienced response personnel who, because of the depth and diversity of their experience, are best able to (a) identify the types of information that are operationally critical to both emergency and normal operations, (b) identify and collect the types of data that must be organized to provide that information, and (c) define and implement design criteria for data and information management that are fully consistent with the practical constraints of time and resources imposed by emergency incidents.

The importance of using experienced response personnel to design data processing systems cannot be overstressed . Systems designed primarily by computer and other information-processing specialists are very likely to meet technical criteria of excellence and coding elegance, but they are also very likely to be impractical in terms of the actual needs and constraints of response services. In the early development of PC technology, there was an obvious need to rely upon computer specialists—after all, such specialists were the only people who had the necessary knowledge of the software and hardware intricacies of electronic data management. However, this is not longer true. Today, not only is that knowledge more widely dispersed, but it has also itself become encapsulated in user-friendly technology as readily available to grade-school students as it is to practicing professionals.

In addition to the use of an experienced and diverse response team, it is critical that the design of a data and information management system proceed in close coordination with other key members of the community partnership for emergency planning and response. Whether it is called coordination, communication, liaison, or networking, the on-going functional interaction and interdependence of all team members must be structured into the vital decision-making processes of each member—and nothing is more critical to coordinated decision-making than data and information processing, a fact that is most obvious in the midst of an actual incident where immediate, coordinated, and complementary response action must be taken by a wide range of response services and support resources. Precisely the same teamwork required to manage an actual incident should be manifest in

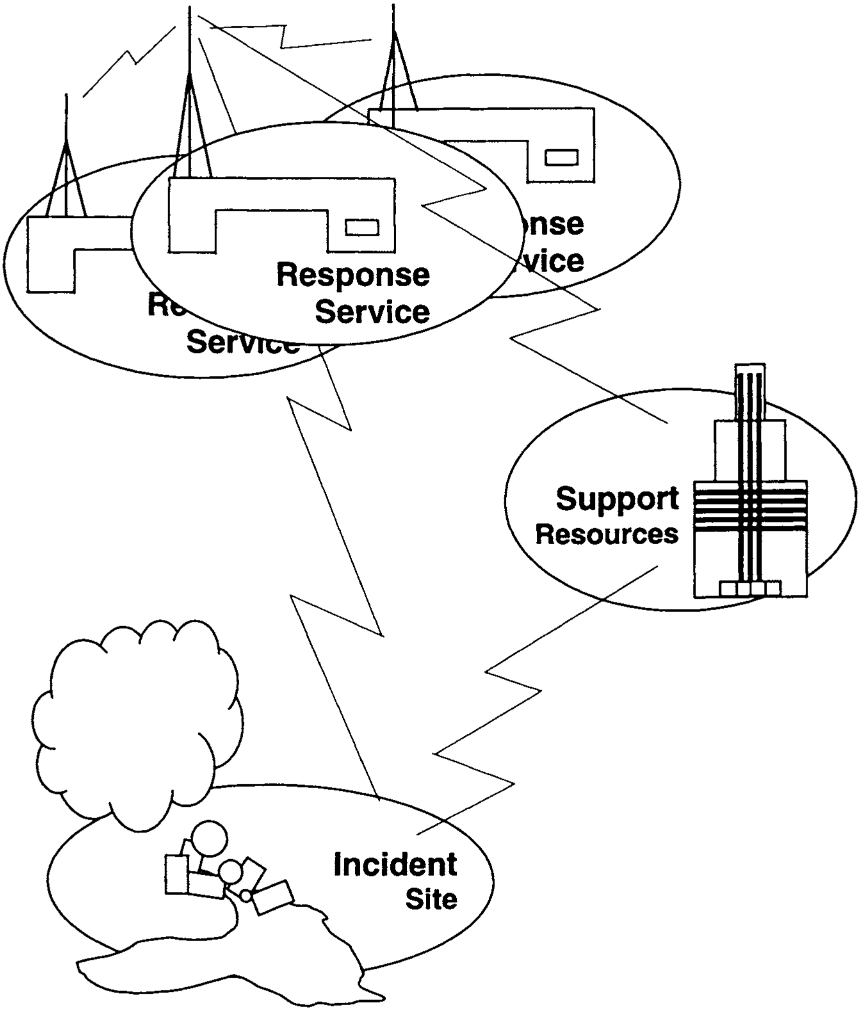

FIGURE 12.8 Data and information processing systems underlie the dynamic linkage among different response services, their support resources, and on-site incident response. Support resources include a wide range of both public and private organizations, including industrial and other community resources.

the day-to-day management of critical data and information processing systems that influence the decision-making of separate response services and support resources (Fig. 12.8). Toward the achievement of this objective, it is necessary that concerted effort be made to ensure:

1. that local industries invite community response services (e.g., fire, medical, municipal) to review, comment upon, and suggest modifications of in-house response-related data and information processing systems,

2. that community response services as well as municipal and other jurisdictional authorities similarly involve local industry as well as private support contractors and vendors in the design and implementation of relevant service and municipal databases and retrieval systems, and

3. that all members of the community response partnership actively maintain information sharing programs with their global colleagues, with particular emphasis on the sharing of ideas and approaches to the design of practical and effective data processing strategies and techniques.

Testing Database Design

Both modular and integrated databases should be tested using evaluation criteria germane to their operational uses under normal and emergency conditions. Clearly, criteria for assessing a database designed to facilitate decision-making regarding the nonemergency purchase of clothing, equipment, and supplies would not be appropriate criteria for assessing a database designed to facilitate decision-making regarding on-site deployment of PPC decontamination stations. Some criteria, however, may be consistently applied to all databases and processing software, including (but not limited to):

- Consistency of output with different users and different makes/models of auxiliary equipment (e.g., printers, monitors, fax modems, e-mail programs)
- Flexibility of output formats (e.g., monitor and printed page formats, text, graphics)
- Memory requirements
- Search time
- Ease of correcting/upgrading/deleting/archiving
- Susceptibility to crashing and user misuse
- Security
- Automatic documentation of use

Once appropriate evaluation criteria are established, serious consideration should be given to the use of table-top or other simulation exercises (Chapter 9) as means of assessing the data and information management system.

A very practical approach to such an assessment is to define a variety of scenarios (e.g., accidental spill of bulk hazardous liquid, emergency exposure of response personnel to a biological agent, on-site entrapment of technical rescue personnel, release of toxic vapor in residential area, fire in pharmaceutical R & D laboratory) that would require immediate access to particular types of information. In such an exercise, the objective is not simply to retrieve the appropriate information, but also to test the range of factors that may influence the successful retrieval and subsequent processing or use of the retrieved information. Of particular concerns should be such considerations as:

1. How does the on-site person faced with a particular problem determine which information in the database is required or, at least, most relevant?
2. Can the information be retrieved by persons most likely to be available at the time, or must it be retrieved by a limited number of personnel who may not be available in a timely fashion?
3. How can the data required for a critical situation be retrieved or processed in the case of a power failure? For example, are printed records containing the needed information readily available under any emergency condition?
4. Does the retrieved information direct the person who retrieves it how to act upon it—or is it simply assumed that available personnel will know what to do with the information?

As implied by such questions, the overriding concern that must guide the construction of any response-related database and information management system is that no single datum or bit of information can "speak for itself."

What information do I need? How do I get it? Is it good information? What do I do with it? These are the necessary questions that must be posed to any data and information management system and, as yet, they cannot be obviated by even our most sophisticated electronic tools. Unasked or unanswered, or posed imprecisely or unclearly, they transform even the most extensive database and most elegantly conceived information processing system into simply so many gigabits of pure nonsense.