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Track III, Day 1, 3:00 p.m. to 4:30 p.m.

"EXPERT SYSTEMS FOR EMERGENCY RESPONSE"

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Emergency Response and Manual Systems

Emergency response. It is a capability that most large businesses or governmental enterprises must not only posses, but own! Organizations need to "own" emergency response and crisis management for some very important reasons. Emergency management exists to prevent or minimize injury to workers and the public; protect property, plant and equipment; reduce risks; and, to provide documentation and accountability. Historically, crisis management has relied upon paper-based, manual systems. Manual approaches, although effective to a degree, are very time-consuming and labor-intensive. On a total cost basis, manual systems are quite expensive to maintain precisely because they *are* so labor-intensive. Furthermore, the quality of the data in manual systems degrades quickly. Each time a chemical process unit is modified or a pilot plant added, paper plans must be modified. Because changes occur rapidly in the manufacturing environment, however, most paper-based, emergency response plans may be out-of-date even before the 3-ring binders hit the shelves. Manual systems are simply too slow and cumbersome for effective use in actual emergencies.

Computer-Based Systems

The advent of the computer and the PC, in particular, has improved some of the deficiencies in manual systems for crisis management. Electronic databases, such as chemical property tables or material safety data sheets (MSDSs), make it easier to get critical information on chemical risks, personal protective equipment (PPE), etc. in a timely manner. But, gaps still remain. Most database management programs are not designed to be "real-time systems." Generally, they are not very user-friendly and so do not permit many among the emergency response staff to use them. This has also been a problem with some computer-based, crisis management systems in the past, which required highly trained operators or contractors to utilize them in real-time.

Other software tools have been specifically developed for or adapted to emergency response. These include: trajectory models (air dispersion or oil spills), geographic

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information systems (GIS), and automated notification equipment, such as autodialers or group pagers. Again, problems still exist. The attempted use of separate tools simultaneously or sequentially can lead to confusion and error. No software system covers *every* aspect of emergency response and crisis management. Numerous aspects of the emergency response effort may need to be covered by an electronic system.

They include:

- Crisis Plan Preparation
- Training and Simulation
- Detection and Alarm Management
- Assessment – GIS, Video, Digital Imagery
- Decision Support –
    - Trajectory Modeling
    - Database Management
    - Expert Advisory Systems
    - Forms Management/ICS
    - Automated Notification
    - Response Resource Tracking and Computer-Aided Dispatch
    - Cost Recovery
- Post-Incident Reporting and Remediation
- Web-enablement
- Mobile Systems – Remote data entry

Who Needs Computer-Based Crisis Management?

A wide variety of private and governmental entities require advanced emergency response capabilities. Organizations that can use and benefit from such technological advancements in crisis management include:

- Chemical plants
- Manufacturing facilities
- Pharmaceuticals production
- Energy generation and distribution facilities and pipelines
- Maritime Industry
- Military
- Law enforcement/Anti-Terrorism
- Emergency Management - 911
- Schools and Hospitals

Obviously, the chemical processing industry, with its necessary use of hazardous materials, often at elevated pressure and heat, has a need for computer-based crisis management. This is also true for many pharmaceutical and non-chemical manufacturing

plants. The transportation and maritime industries have similar needs, because of their storage and transshipment of hazardous materials and the potential severity of mishaps. Energy and pipeline companies can have accidents that cause serious environmental consequences, with releases on a very large scale. Recently, law enforcement on the federal, state and local level has had to deal with terrorist acts, school shootings, militia and hate group violence, bomb threats, etc. County emergency management (911 centers) and hospitals are some of the first groups involved in mass casualty situations, whether they are caused by man-made or natural disasters. The benefits to these organizations from technological solutions will differ, depending on the organization's mission, the risks posed by the operation, and the size and budget of the organization.

What is the Right System?

What is the right system or tool set for any particular organization? What is the process that an organization should go through to assess its current level of emergency preparedness and to decide what technological improvements it should it adopt?

First, an organization should look at its present state of preparedness. Are plans and procedures really up-to-date? Does out-of-date information in paper plans and procedures present a risk of harm to persons, property or the environment, if an accident occurs? The new Risk Management Plan Rule (RMP) implemented by the United States Environmental Protection Agency (EPA) in June, 1999, requires organizations that store, handle or use certain amounts of hazardous chemicals to report their five-year accident histories (among other things). This information can be illuminating on the issue of preparedness. What is the RMP's worst case scenario for a particular facility? What is the level of public trust and scrutiny? Will there come a time when a company needs more public confidence and acceptance (e.g., to obtain expansion permits, etc.)?

Secondly, an organization should assess the true cost to the organization of maintaining its paper-based systems? Those costs usually include time spent in updating plans, copying plans, distributing updated plans, etc. With the significant cutbacks in personnel in most large companies, it may no longer be secretaries or clerks who are doing this work, but safety managers or EH&S professionals, themselves. A clear advantage of computer-based, emergency management systems is that plans, procedures, checklists, and other emergency resources are updated electronically and made instantly available to appropriate personnel on the LANs, WANs, intranets or even the Internet.

Third, what is the level of training in the organization? Can an organization's personnel actually do what emergency plans and procedures require them to do in a timely and effective manner? Or will panic, general confusion and mistakes abound? What are the likely consequences of mistakes? Is the training program sufficiently site-specific or is it too vague and generic? What is the annual cost of the organization's training program? PC-based systems are now available to provide highly customized, site-specific training simulation at a reasonable cost. Such simulation technology enables the enterprise to evaluate the readiness of its emergency response staff in realistic field and desktop exercises, without requiring as much time at expensive, off-site training centers.

A fourth part of this evaluation should be an examination of whether the organization has a process to maintain and preserve corporate expertise for crisis response. This is an important and often overlooked aspect of emergency preparedness.

Expert Systems in Emergency Response

What do we mean by maintaining and preserving corporate expertise, anyway? For any organization to succeed there is a need to move forward on what we refer to as the "knowledge continuum." This continuum starts with unmanaged data. For the company that sells camels, for example, basic unmanaged data may simply mean knowing that the company stocks a product call "camels." That is helpful, but not very. Knowledge is the next higher level on the continuum. It implies a higher order of information than raw data. Using the example of a company that sells camels again, "knowledge" might tell the company sales force how many camels are in inventory on any given day ("we have 10 camels in stock, today"). The data on camels is now organized in a way that is more useful to the primary mission of the organization, i.e., selling camels. The next and highest level on the knowledge continuum is "expertise."

Expertise within an organization is usually built up over a long period of time and *may* reside with just a few "old timers." Each organization has spent a great deal of time and money training those experts. Another way of saying this is that the company has an economic stake in the expertise that resides in its employees' brains. In the example above, a company expert may let the sales force know that they should watch out for the camel named Abdul, because he is prone to bite anyone who comes too close to him. This is obviously an important piece of expert advice that should be quickly passed along within the organization, lest injury result to the unsuspecting salesman who approaches the camel, Abdul. But, if only one old-timer knows about Abdul (because he was the only existing employee around the last time Abdul was in the inventory) and, he was just let go with a severance package and is fishing in Montana, then someone is going to get bitten!

How do organizations capture and preserve not just emergency response expertise, but all sorts of business rules? Typically, this is done in an informal way, with on-the-job training. It is rare to find an organization that has implemented a regular and continuing process to convert its "lessons learned" into written policies and procedures. And, if the organization does have such a program, it is likely that expertise is being put into a manual system of 3-ring binders and not an electronic, decision-support system. "Lessons learned" is the valuable act of "downloading" corporate expertise. If the lessons learned only reside in reports or paper-based systems, it is unlikely that they will be incorporated into training or will be available in real-time emergencies. In most cases, unfortunately, expertise is not captured and preserved by these organizations. Senior staff are permitted to retire, downsizing and outsourcing take place, without much formal effort to "download" their expertise prior to leaving the company. What is the overall

cost to the organization of this "brain drain?" It is a cost that is very hard to measure, but it is probably very high.

This is where expert systems or decision-support systems can help. Expert systems are a type of artificial intelligence. The basic idea of an expert system is simple. Expertise is transferred from experts to a database, typically in the computer. The expert's knowledge and thought processes (sets of questions and guidance) are stored in the computer and multiple users can access the expertise when and as needed. Expert systems can be set up to ask the user simple, English-language questions, and provide multiple-choice paths of response. So, as the user reads the questions and selects the most appropriate answers, the expert system identifies the appropriate path in one or more electronic decision-tree matrices and posts answers to the questions, recommendations, or guidance. Expert systems are also called "rules-based" systems, because the expert has given the computer a set of rules by which to operate (called a Knowledge Base). These are often stated as IF, THEN rules. For example, the expert system is programmed to operate in the following manner, IF the user defines the situation as a CHEMICAL EMERGENCY, THEN the expert system will post the most up-to-date protocols that are appropriate for a chemical emergency.

The expert system can also be used for decision-support in many different areas. These include: hazardous chemical spills and releases, fires, explosions, emergency medical services, oil spills, natural disasters, workplace violence, anti-terrorism, and more. Decision-Support systems also have many daily uses such as site security management, hazardous work permits, and maintenance troubleshooting, etc.

Typically, an organization will consider using expert systems in the following situations:

- When the solution to the problem has a high payoff;
- When the cost of maintaining expertise within the organization is high;
- When expertise is needed in many different locations;
- When large amounts of data must be sifted through quickly in the decision-making process;
- When expertise is needed in hostile or hazardous environments;
- When an error in the decision-making process could lead to disastrous results;
- When there is a shortage of experts available to the organization;
- When the expert system is needed for training as well as decision-making; and,
- When expertise is needed to augment the knowledge of junior personnel.

A common complaint of corporate executives is: "we don't know what we know." Employees are always trying to re-invent the wheel – failing to leverage the lessons learned, best practices and expertise that exist throughout the enterprise. The expert system for crisis management can effectively collect, document, catalogue and distribute corporate knowledge and expertise in a way that makes it accessible and useful in real-time. When corporate knowledge is used in this effective manner, productivity goes way up.

The Expert System as "Mission Control"

Today's PC-based, expert systems are quite sophisticated and can also operate as an intelligent manager over many existing parts of a plant's distributed control system (DCS). For example, expert systems can act as alarm managers. They can collect and interpret detector or sensor information, monitor weather data from meteorological stations, and feed data from such systems into other software modules, such as GIS, trajectory models, or emergency notification equipment. The expert system can be programmed to automatically take certain actions, once it receives signals from DCS equipment. E.g., a gas detector, when activated, can send a signal to the expert system, which will then activate the autopage system, select an alphanumeric message to broadcast to specified response personnel. The expert system can also activate the decision-support system, which will post immediate action recommendations to the computer, and show a graphic representation of a toxic gas cloud over a GIS map or CAD drawing, all within a matter of seconds.

Knowledge Management

The expert system can also be seen as part of a broader concept called "knowledge management." Use of expert system technology has the ability to leverage information and expertise to improve safety, and foster organizational innovation, responsiveness, productivity and competency. Not only can an expert system be used to tie together the disparate software programs in crisis management described above, but also it can function as a rallying point to collect and preserve corporate expertise. The safety group or similar entity that is in charge of emergencies at a facility can, over a span of months and years, regularly use the expert system for training and real-time response. The safety manager or others can create a type of "electronic suggestion box" (e.g., a Lotus Notes database) to regularly collect the knowledge, expertise, and lessons learned from team members. Then, at regular intervals, the best of the suggestions of the team will be uploaded to the expert system's Knowledge Base for that particular area of decision support. This collaborative system will work, even if team members are distributed in geographically disparate locations. In the future, the preservation of organizational memory and expertise and the leveraging of knowledge in real-time will be critical factors to an organization's ultimate success. In today's fast-paced business environment, organizations must find new ways to utilize the knowledge that they already possess.

What to do in the face of Uncertainty?

Given the situation facing an organization, what should it do? Stay with "business as usual?" Purchase separate crisis management tools from separate vendors? Create an in-house system? Seek out and evaluate integrated crisis management systems, including expert systems? Implement one or more of the above? It is hard to know what the right path is for any particular organization. In the face of global competition, budgets are

tight. The resulting corporate consolidation and downsizing just exacerbates the problem of preserving corporate expertise.

First, an organization should consider a needs assessment. The business case for electronic crisis management systems should start with a baseline assessment of financial and non-financial factors. This may involve looking at the real costs of business as usual: the costs of manual systems, the costs of employees constantly "re-creating the wheel", and the history of past accidents and mishaps. Sometimes, vendors can provide assistance in cost-justification analysis or establishing a value proposition. This may also include an evaluation of hidden costs like lawsuits, government enforcement (fines and penalties), and workers' compensation claims. Going to conferences like this one and trade shows are important ways of finding out about new technologies and learning from colleagues what is working or not working for them. Furthermore, understanding the culture of any particular organization may play an important role in the success of implementing electronic decision support systems for crisis management. Leadership and support from senior management will play a vital role in helping new technologies and systems gain acceptance.

A Few Words about the Future

It will be here sooner than you think. Are you one of those unfortunate souls old enough to remember wondering whether you would really need a computer in your job? Well, while *we* were wondering, a revolution started and it is ongoing, today. It is the information technology revolution. It is coming at us at fiber optic speed. Web-based software systems, wireless personal digital assistants (PDAs) with internet and voice capability, virtual reality simulation for the PC, and new and more sophisticated types of artificial intelligence (e.g., data mining) are just around the corner. How many of you think that you will still be relying exclusively on paper crisis management plans two years from now? How about five years from now? Probably, just a small percentage. Now is the time to get serious about rebuilding your crisis management and emergency response systems in the age of information technology.