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MUTUAL AID SYSTEMS IN THE UNITED STATES FOR CHEMICAL EMERGENCIES

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ABSTRACT

This paper focuses on the diverse forms of interorganizational mutual aid systems established in American localities to cope with chemical emergencies of an acute nature. Factors underlying the development of such systems and the specific forms they assume are discussed as well as the components of these networks, problems encountered and the consequences of such systems for general emergency planning and the community as a whole.

INTRODUCTION

Chemical threats vary in nature and complexity. To neutralize these threats, rather diverse resources are required. Mobilizing such resources necessitates the cooperation of corporations on the national level, between the national and local echelons of individual companies and concerns, and among the various public and private sector groups at state and community levels. Such cooperation frequently culminates in the development of some kind of mutual aid agreement. These agreements may be formal or informal in nature; they may involve disaster preparatory planning or emergent responses to sudden crises; and the resources shared may include hardware (equipment and materials), information (specialized knowledge), personnel (experts) and financial assistance.

This paper primarily focuses on the diverse forms of mutual aid arrangements which exist on the local level and deals specifically, although not necessarily exclusively, with chemical emergencies of an acute nature, the factors underlying the emergence of one form of arrangement as opposed to another, the specific characteristics of these networks and the problems encountered as well as their consequences for general emergency planning and the community at-large. Before analyzing mutual aid systems (MAS) functioning at the local level, the kinds of systems operating on a nationwide basis are briefly described since they provide a context for, or are directly interwoven with, local systems. In this paper, a mutual aid system is defined as any association among two or more organizations, with some established procedures for resource sharing directed towards preparing for and/or mitigating the effects of chemical emergencies.

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NATIONWIDE OR REGIONAL MUTUAL AID SYSTEMS

The most widely known nationwide information service is provided by the Washington-based Chemical Transportation Emergency Center (CHEMTREC). This Center, privately funded by the Chemical Manufacturers Association, serves as a source of advice to responding personnel at the scene of transportation-related emergencies. CHEMTREC maintains an around-the-clock toll-free telephone line. Through the use of a data bank which lists more than 35,000 chemical products, CHEMTREC provides information relevant to on-scene conditions.

Another form of nationwide interorganizational co-operation can be seen in networks established to facilitate emergency response to accidents involving specific chemicals. The Chlorine Institute, representing chlorine producers, has developed CHLOREP, the Chlorine Emergency Plan. The plan calls for pre-designated teams located at plants near the scene of an accident to respond, irregardless of the producer or the cargo's point of origin. Along similar lines, the National Agricultural Chemists Association operates a Pesticide Safety Team Network which includes some 40 emergency teams throughout the country. Producers of hydrogen cyanide and vinyl chloride have similar, although more loosely formulated, agreements.

On the whole, however, most of the initiative relating to the establishment of nationwide chemical emergency response programs has occurred among branches of individual corporations, rather than among different corporations. Most of the large chemical manufacturers possess regional teams ready to provide information and operational assistance in relation to accidents involving their products whether they are in unrefined, intermediary or final states. The Union Carbide Corporation, for example, operates a centralized toll-free switchboard similar to that of CHEMTREC. At the request of transporters, public officials or even individual consumers, the system, which comprises 34 plant and 31 specialty contacts (chemists, engineers, physicians, etc.) can dispatch via an elaborate nationwide communications network, a task force to any part of the country. In addition, several informal arrangements exist at the highest levels of the major corporations to provide mutual assistance when it is expeditious to do so.

In the realm of transportation, the most notable intra-organizational network is provided by the U.S. Coast Guard, which offers both information and operational assistance in the event of chemical spills on marine or inland waters. The Coast Guard has developed sophisticated mathematical models to forecast expected property damage in the event of oil or chemical releases and to indicate the area requiring clean-up crews and evacuation, if necessary. In addition, the Coast Guard has Strike Forces serving the Atlantic, Pacific and Gulf Coasts which may be mobilized in a major emergency.

With respect to accidents in the course of road or rail transportation, individual companies are currently becoming more active in developing emergency procedures to counteract accidents which may arise along routes traveled by their vehicles. Coastal

Tank Lines have, for example, developed a system whereby the truck terminal closest to an accident responds to a spill. They have also designated several personnel from corporate headquarters to respond to and oversee operations at the emergency scene. Railroad companies such as Seaboard Coastline have developed totally centralized systems, with single multidisciplinary teams responding to incidents involving the railroad, irregardless of the location. Even insurance companies have assisted client companies in emergency situations by providing personnel or consultants with expertise in the realm of hazardous materials. This concern on their part can be understood in light of the devastating economic consequences they may incur as a result of serious casualties or property damage engendered by chemical incidents. With respect to consulting firms, several companies have been formed to provide nationwide service in the neutralization of hazardous situations and the subsequent clean-up and disposal of the products involved.

LOCAL MUTUAL AID SYSTEMS

Two major types of MAS can be identified at the local level. The first one task-oriented systems, fulfills a certain set of specialized functions within the context of the multifaceted emergency situation. Frequently, fire departments share equipment and personnel during disasters as well as routine emergency situations. Similarly, medical communications systems, comprising hospitals and ambulance companies, exist in many parts of the country. Their responsibilities have included the reduction in response time of paramedical personnel to the scene of an accident, the optimal distribution of medical personnel and facilities in a community according to local needs, the logistics of placing accident victims in appropriate facilities based on the nature and volume of casualties and the expedition of resource sharing among hospitals. Thus, medical MAS also serve the community in a variety of emergency situations during routine and non-routine emergencies.

The second major kind of MAS includes those geared toward mitigating specific types of threat. These systems can be referred to as agent-oriented since they involve a network of organizations performing complementary tasks to counteract a particular disaster agent in all of its dimensions. The comprehensiveness of such systems is highly variable, and it is one objective of this paper to elaborate upon these differences. With respect to chemical agents, this type of MAS must necessarily concern itself with the performance of tasks relating to the identification, neutralization and disposal of chemical substances involved in an accident. Then, depending on its scope, such a system will be involved in conventional emergency-related tasks such as those of public notification and information regarding the emergency; the care of casualties and the deceased; the maintenance of law and order and traffic control, both vehicular and pedestrian; evacuation; the feeding, clothing and housing of victims; and so on. The aforementioned comprehensive MAS may themselves be linked by agreements with other regional systems.

Another system that has been observed contains elements of both the task and agent-oriented systems. These are assistance pacts and other arrangements among chemical companies alone which exist to fulfill only those tasks within their area of expertise and for disasters of a chemical nature.

This paper is primarily concerned with describing and analyzing comprehensive local MAS. Data for the ensuing analyis of local MAS, oriented toward the mitigation of acute chemical accidents, was taken from a 19 community survey conducted by the Disaster Research Center. The communities studied were at least moderately vulnerable to chemical incidents and were chosen in such a way as to achieve variation in community size; geographic region; the concentration of chemical companies and transportation routes; previous disaster experience; and regulations relating to hazardous material production, storage and transportation. Thus, factors which may predispose a community to prepare for emergencies in a particular manner could then be identified. In this analysis, these factors will be examined to ascertain their bearing on the form of MAS established in each community or the reason for their absence in several of the communities.

Factors Underlying the Establishment of Local Mutual Aid Systems

Clues leading to the identification of factors responsible for the emergence of MAS can be obtained by comparing relevant characteristics of communities which have MAS with those lacking such systems. Table I ranks each city in terms of relevant community characteristics.

The 19 cities have been divided into three groups according to the degree to which MAS are present in their communities. It would be inaccurate to compare communities possessing MAS with those lacking such systems since virtually all communities have some agreements, on at least an informal level, with reference to resource sharing. It is, therefore, more realistic to look at these communities in terms of the degree of their MAS development. Group A cities are those which have undertaken no initiative in the hazardous chemical sphere with respect to mutual aid or whose actions are based on legal requirements of a most rudimentary sort. Fire regulations in most communities, for example, require that fire departments periodically inspect all facilities in a community. Because this should involve chemical facilities within the community, such regulations inevitably result in some working relationship between officials from the local fire department and those of chemical companies. In the course of such contacts, it would be unusual if the two parties did not inform one another of their respective fire-fighting capabilities and did not at least informally agree to complement or supplement the resources of the other in the event of a major emergency. Such utterances, relative to the comprehensive mutual aid agreements existing in some communities, are tantamount to no agreements at all as they involve no contingency planning or commitment of resources, no hazard assessment of a technical nature nor a systematic inventorying of resources.

Group B cities are those in which community organizations have initiated planning efforts, relating to hazardous materials incidents, beyond those legally mandated. In addition to undertaking disaster planning and reaching mutual aid agreements between the industrial sector and public emergency-relevant groups such as fire departments, most of the cities in this group are characterized by mutual aid pacts among local chemical producers themselves. For most of these cities pacts are informal, although three of the nine cities in this group have formal agreements regarding the transfer of equipment in emergency situations. In addition to these links among the private sector, some of the cities have private-public sector co-operation which extends beyond the mere legally ordained contacts observed in Group A communities. Such co-operation exists in the form of chemical industry representation and input at local disaster council meetings, mutual aid agreements with public sector MAS such as those of local fire departments and mutual aid pacts with local governments.

Group C communities possess comprehensive MAS, incorporating a large segment of the local chemical industry and representation from public sector organizations most relevant to chemical incident mitigation---civil defense, fire and police departments, hospitals and ambulance companies, and the mass media. One-half of these MAS are chartered. The remaining three do not involve legally bound agreements but are virtually as organized as the former. The decision not to charter such organizations is generally based on fear of litigation for unanticipated problems, rather than for the purpose of avoiding commitment to the objectives of the MAS involved. These MAS contain numerous committees and programs and maintain separate funds and equipment not possessed by some of the individual members. The specifics of such systems will be dealt with in a subsequent section; indeed, it is the Group C cities with which most of the discussion will be concerned. In addition to these comprehensive MAS, some of the Group C communities contain separate pacts among contiguous chemical plants, as well as among these plants and local fire stations.

In Table I, "Community Population Size" has been ranked in four categories with cities under 100,000 residents constituting one category (small), those between 100,000 and 500,000 constituting a second category (medium), those between 500,000 and 1,000,000 constituting a third (large) and those over one million constituting a fourth (metropolis). This has been done for the purpose of presenting the findings of the statistical analysis undertaken. The second column in Table I, "Region", indicates the region in the United States in which a given city is located. The third column, "Prior Disaster Experience", contains the composite ratings of the cities on the basis of three indicators: the severity of previous disasters; the number of major federal disaster declarations; and the number of different disaster agents involved in federal disaster declarations. This and all subsequent variables in Table I are rated on a scale of one to three, with one representing a low rating, two a medium rating and three a high rating. Ratings for the fourth column, "Objective Chemical Vulnerability" are comprised of three equally weighted indicators:

the number of chemical plants per square mile; the number of personnel employed by the chemical industry per the total labor force in the area; and the number of accidents per square mile for 1971 through 1977 as a measure of transportation hazards by rail and truck. For the fifth column, "Perceived Chemical Vulnerability", ratings were obtained from community and company officials concerned with hazardous materials incident planning regarding their perception of the likelihood that their community would experience such an incident within a designated period of time. The sixth column, "Financial Capability", ratings were computed according to three equally weighted indicators: the per capita income for the community; the per capita property tax; and the percentage change in per capita income from 1960-1970. Ratings for the final column, "Emergency Resource Availability", were compiled on the basis of three equally weighted indicators: the number of police department personnel per 1,000 residents; the number of fire department personnel per 1,000 residents; and the number of hospital beds per 1,000 residents.

TABLE I

Community Characteristics

Group	Size	Region	Prior Disaster Experience	Objective Chemical Vulnerability	Perceived Chemical Vulnerability	Financial Capability	Emergency Resource Availability
	small	Southwest	1	1	2	2	3
	small	Southeast	3	3	no data	2	2
A	small	Southwest	1	1	1	2	2
	large	Southeast	1	2	2	3	2
	large	Midwest	3	3	1	1	1
	small	Midwest	1	1	1	3	3
	medium	Midwest	2	2	2	2	3
	metro-polis	West	3	1	1	3	2
B	medium	Southeast	2	2	1	2	2
	large	Northeast	2	2	no data	2	1
	medium	Southeast	1	2	no data	1	2
	small	Midwest	3	1	2	3	3
	medium	Southeast	2	1	1	1	1
	metro-polis	Southwest	2	2	2	3	3
	medium	Midwest	1	3	2	1	1
C	small	Northeast	3	3	1	3	1
	medium	Southeast	3	3	no data	2	2
	small	Southeast	2	3	2	1	1
	small	Southwest	2	3	2	no data	no data

Code: 1=low, 2=medium, 3=high

The data in Table I was subjected to a form of inferential statistical analysis (in this case the chi square technique was used) to determine the contribution of each of the seven variables (population, region, etc.) upon the likelihood that a MAS would be established and the form such a system would take. Chi square analysis indicates whether there is a statistically significant association between the form

of MAS existing in a community (A,B, or C type) and each of the variables posited as responsible for determining type---that is, the probability that the association is not one of chance. Table II illustrates the findings.

TABLE II

Findings Relating To Factors Underlying MAS Formation

Variable	X^2	d.f.	p.>
Community Population Size	5.20	6	.50
Region	7.92	8	.30
Prior Disaster Experience	5.26	4	.20
Objective Chemical Vulnerability	9.02	4	.05
Perceived Chemical Vulnerability	3.35	2	.10
Financial Capability	3.92	4	.30
Emergency Resource Availability	4.47	4	.30

The findings do not indicate that any of the relationships were statistically significant at the conventional .05 level. The small size of our sample makes it extremely difficult to achieve significance; however, several factors indicated strong tendencies toward statistical significance. The strongest relationships found closest to being significant were those involving community vulnerability to chemical incidents and MAS type. Both the "Objective Chemical Vulnerability" of a community and the "Perceived Chemical Vulnerability" of our respondents seem to be the most important determining factors underlying the establishment of MAS and the forms they developed. "Prior Disaster Experience" is also influential in determining the formation and function of MAS.

Factors showing a more moderate and questionable association with MAS type are "Region", "Financial Capability" and "Emergency Resource Availability." These factors may contribute somewhat to the probability of MAS establishment and the forms they assume; however, further study is required to confirm this.

Finally, our data does not reveal any association whatsoever between "Community Population" and MAS type. It appears, therefore, that the size of a community may have no bearing on the willingness of community officials and residents to develop MAS.

To sum up these findings, it seems that the decision to establish MAS and the forms they assume are based on a reasonable ordering of priorities. Community vulnerability to hazardous materials incidents is the primary consideration in the pursuit of emergency preparedness relating to MAS, with the actual capabilities of communities, i.e., financial and emergency resources, appearing to constitute only secondary considerations. "Region" may also be a secondary factor as it appears there is a tendency of Upper Midwestern and Southeastern cities to shy away from comprehensive MAS.

Virtually all of the six communities containing comprehensive MAS (Group C) have at least a moderate level of prior chemical disaster experience. All but one have

a high level of vulnerability to such incidents, and the authorities in most of Group C's cities have a moderate level of awareness of such hazards (Table I). The data indicates that for these six communities, as well as for the entire 19 in the sample, the aforementioned factors relating to vulnerability are more consistently present than are those relating to community resource availability, population or region. However, high vulnerability has not automatically translated into MAS through a systematic assessment of hazards and subsequent planning. The dynamics of this process have shown underlying similarities although some unique forces in each case have facilitated the development of the networks and shaped the course they would assume.

The first comprehensive MAS in the country was established in Baton Rouge, Louisiana in 1944. All of the six cities with such systems had developed their MAS by the following decade. In most cases, the initial impetus for MAS establishement was provided by a massive chemical disaster or near catastrophe. This frequently spurred initiative by local chemical companies and, most frequently, one active official from the private sector (a civil defense director, law enforcement or fire department official). Aside from benevolent considerations, the private sector's involvement has been stimulated by the potential cost of liability for large-scale emergencies, by the desire to minimize insurance premiums and by the notoriety such an incident may produce. Both the industrial sector and public emergency-relevant groups have been sensitive to the public outcry and extensive media coverage following major chemical incidents. Public sector participation is facilitated following such incidents due to a political climate which is more conducive to the allocation of local funds for emergency preparedness than is the case during times of quiescence. This fluctuation of public and, indeed, corporate support for MAS is exemplified by the periods of virtual latency of MAS when no major incidents have occurred in an area for several years.

CHARACTERISTICS OF MUTUAL AID SYSTEMS

The comprehensive MAS contained within the six Group C communities all, by definition, comprise extensive representation from the local chemical industry, as well as diverse elements of public sector emergency-relevant groups (civil defense, fire, police and health departments, hospitals and ambulance companies, local branches of the National Weather Service); human service organizations (Red Cross, Salvation Army, etc.); and private organizations (local radio and television stations and the press). Some of these organizations such as the National Weather Service, human service organizations and the media are represented less frequently in such systems than are the primary emergency-relevant groups such as fire and police departments and, of course, industry.

In one-half of the cases, these groups are linked together in a legally bound agreement. The decision not to charter MAS in the remaining three cities was based on two factors---liability and safety. With respect to the former, companies wish to

avoid situations whereby they are unable to discharge tasks which they have agreed to perform. Such obligations may require that they allocate additional funds to ensure that equipment and other forms of aid would be available as required. Failure to discharge agreed-upon tasks may also conceivably be due to prudence, in the event of a major emergency, in which the prospective lessor of equipment may deem it appropriate to retain such equipment as the problem may spread to its facilities. The leasing of equipment or manpower in such cases may clearly jeopardize the safety and security of the lessor.

Liability problems may also be incurred when resources are provided in ambiguous situations. In the case of the poor coordination of incoming resources at a stricken plant, the company leasing equipment and manpower may perform certain functions inappropriately, possibly producing casualties or property damage. Also, in a potentially volatile situation with chemicals of unknown properties involved, the dangers of exacerbating the existing problem or incurring casualties or property damage is increased. In such situations, when legally bound agreements do not exist, a company may elect to refrain from providing assistance altogether, or, at least, to restrict assistance in a manner consistent with its own interests.

A typical MAS charter is similar to any organizational charter, containing a preamble indicating the general objectives of the system, outlining regulations regarding the election and duties of executive members and committees and indicating the procedure to be followed during the presentation of agendas.

Planning sessions for MAS tend to take place on a monthly bases, although commitment to attendance and the extent of active participation differs dramatically in the communities studied. In most cases, the industrial sector, which has played the predominant role in the development and subsidization of the system, also dominates meetings due to its superior expertise in the technical aspects of chemical hazards and its numerical majority. Of this industrial sector, a handful of representatives of the major locally based corporations assume leadership. An exception to this can be found in one city in which public sector representatives seem to play a more dominant role in the MAS than industry does and, in fact, have spearheaded the formation of a county-wide MAS to integrate and supplement functions performed by the divergent MAS already existing in the area.

The functions undertaken by the most comprehensively prepared MAS include hazard assessment, general contingency planning (including disaster drills), actual mitigation of disaster agents (fires, explosions, etc.) and their effects (i.e., medical care), the establishment of emergency communications and public information systems, preparation for security and traffic related problems arising during emergencies and, of course, resource sharing.

The most fundamental prerequisite to emergency planning is hazard assessment, yet the most comprehensive MAS show virtually a total disregard for this area. Only one of the six systems under consideration undertakes to maintain periodic plant inspec-

tions to ascertain potential hazards; this, of course, is in addition to routine fire inspections. In another community, a committee designated to assess hazards was dissolved in 1975. It appears that the void in this area is not due to a failure to recognize the importance of hazard assessment. Rather it is the result of plant officials' resistance to intrusions upon the organizations property and their concern about the disclosure of company secrets. Furthermore, it is possible that the periodic identification of hazards in chemical facilities is incompatible with plant officials' efforts to keep a low profile in the community in terms of such dangers.

All MAS undertake contingency planning in regard to procedures involved in the activation of the system, the chain of command in an emergency involving the system, the tasks to be performed and the evaluation of plans as far as their feasibility is concerned. The extent to which these procedures are elaborated upon and tested does, however, vary considerably, depending largely upon the existence or absence of an organizational charter for the MAS. Activation of the system is invariably carried out by an impacted plant and the mode of communication used and the agency contacted depends upon the communication systems established. Loaners of equipment and manpower generally present requested resources at the front gate of the affected plant and await instructions from the officials of that plant. The executive members of the MAS, most frequently in collaboration with civil defense officials, oversee the total emergency response effort and act as liaisons between the lending organizations and the affected company.

A general requisite to membership in most MAS is the establishment of contingency plans within the individual organizations and the possession of resources which are adequate and sufficient to counteract any reasonable on-site incident. Such preparedness by each member organization precludes the necessity of activating the MAS for routine incidents. It also makes the need for detailed involvement of other MAS members in the affected plant's affairs during a major emergency unnecessary---the general emphasis is one of minimal involvement in the affairs of other members and maximum self-sufficiency. Additionally, good internal contingency planning will facilitate liaisons between the affected company and assisting groups as procedures will have been developed to request the appropriate equipment and to receive and utilize these in an appropriate manner.

Just as the extent of formal contingency planning varies substantially, so does the evaluation of these plans. For the most part, MAS undertake one large-scale disaster drill annually. These vary from paper and communication drills to simulations of projected emergencies. Subsequently, the performance of participants in these drills is evaluated.

The major tasks with which members of MAS concern themselves during an emergency are disaster agent mitigation, the delivery of medical services, communications and public information, the maintenance of security and traffic control and resource sharing. The following paragraphs elaborate upon these matters.

Although numerous forms of hazards are posed by dangerous chemicals---fires, explosions, toxicity (contamination of the soil, water, air and endangerment of living organisms), corrosion and exposure to various forms of vapors---MAS are primarily concerned with the threat of fire. Fires result in the most extensive property damage, they precipitate most explosions and frequently are the cause of accidental releases of noxious chemicals. Also, fire is the agent with which the greatest yield exists in terms of mitigation efforts. Very little can be done once a toxic plume is floating over a city other than, of course, evacuate the threatened population. Similarly, explosions initiating emergencies cannot be anticipated, only ensuing fires can be contained. On the other hand, the proper containment of fires can prevent explosions and atmospheric releases of toxic, volatile and irritating vapors. Due to the importance of the fire threat, it is not surprising that the closest liaisons of chemical companies, in the public sector, are fire departments. Various forms of fire-fighting technology are exchanged at planning sessions, and fire departments are kept abreast of details relating to fire hazards in member chemical plants. Where local fire department MAS exist, a liaison committee in the comprehansive MAS is usually formed to ensure close cooperation and coordination between the two systems during an emergency.

From the point of view of potential casualties, the medical sector (hospitals, ambulance companies, poison control centers, etc.) should be of comparable importance. However, although medical groups are involved in all of the MAS discussed herein, there is a marked difference in their role in terms of leadership, initiative and in the importance with which they are regarded by chemical company representatives. Medical committees of MAS tend to anticipate needs for personnel, equipment and facilities for emergency situations and provide coordination of medical activities during emergencies.

Another crucial set of functions considered by all MAS deals with securing the impacted site, maintaining law and order and controlling traffic. Most of these functions are performed by law enforcement agencies. The maintenance of site security and the manning of roadblocks around the emergency site are occasionally delegated to plant security personnel to free police so that they can primarily focus upon the sometimes complicated task of traffic control. Traffic control plans involving MAS range from those that are extremely specific, with contingency plans existing for incidents occurring at any point of a city, to those that provide more generalized guidelines, to those which merely identify the agencies responsible for traffic control. The establishment of roadblocks surrounding a stricken plant prevents non-essential personnel from entering the area and allows emergency-related personnel and equipment to move in and out of the area more easily. Most of the MAS have developed identification systems so that implementation can immediately follow the establishment of roadblocks. Interestingly, when considering security and traffic related functions, MAS plans put little emphasis upon evacuation procedures and the mainten-

ance of law and order in evacuated areas.

Communications and public information are stressed by MAS planners. Communications systems have been developed to activate MAS, to provide two-way communications between emergency-relevant personnel and to inform the public of the ongoing situation. Two basic procedures exist for activation. The predominant one is a centralized switchboard housed in the local fire or police station. The switchboard is notified (generally through an unlisted telephone line) of a plant's distress and thereupon dispatches emergency personnel to the scene and makes the appropriate calls for required resources. A hot-line connecting MAS members is another type of procedure used. The activation of the line by any member company immediately sounds alarms at all facilities involved in the network, as well as at local fire departments. Officials of the impacted plant can thereby communicate with any organization desired.

MAS planners are cognizant of the fact that land-based networks, such as those just mentioned, may be vulnerable to power outages during a major disaster. For such eventualities, radio communications networks of various kinds have been formed. Some MAS have received certification to operate radios on a separate frequency. Efforts have also been made to enlist the use of amateur radio networks and equipment as backups.

As far as public information is concerned, MAS often designate officers who are responsible for releasing information regarding the progress of an emergency. All persons functioning at the emergency scene are instructed to refer inquiries to that individual. These officers carefully screen all information released to the press. They do, however, provide regular updates to the public in order to avoid the potential adverse effects of disseminating rumors. One MAS maintains a communications network whereby individual plants can release information by using equipment belonging to the local office of the National Weather Service that enables them to record a statement via telephone. This recording can then be replayed on local radio in the same manner as weather reports are provided on the air. Some MAS also occasionally provide literature and lectures to the public regarding emergency procedures although these efforts are relatively low key.

Finally, an essential function of MAS is actual resource sharing. Resource inventories are made by members. Lists of resources available and from whom they can be obtained are circulated. Commitment of resources may be made by all or only several members; this latter situation only holds for non-chartered MAS. Planning sessions are frequently devoted to familiarizing members with new types of equipment, and training regarding their use.

MAS do not merely involve an amalgamation of diverse community groups, but also have links with other related systems. The fact that some systems are interconnected with specialized fire and police MAS has already been mentioned. In one city, an intersectional mutual aid agreement has been established between the city's industrial MAS, the industrial MAS of a nearby metropolis as well as an area refinery. In

another city in a different section of the country, several intercompany linkages (among contiguous facilities) have been superimposed upon the comprehensive MAS. In still another community in which three MAS exist in different sections of the city, the county government has initiated a system that would function throughout the county and draw upon the resources of existing MAS and the expertise of several persons in the public sector.

Problems Confronting Mutual Aid Systems

1. Much planning exists on paper and active participation is sporadic and stimulated only in response to crises. Meetings are generally poorly attended, with certain groups having a consistently higher rate of absenteeism than others. These most frequently are public sector or human service organization representatives who become apathetic as a result of industrial domination and are unable to develop the informal relationships established among industrial personnel.

2. Operationalization of planning through disaster drills lags in some cities. Either drills are undertaken too infrequently (less than once per year) or they do not involve simulations of incidents and are inadequately evaluated.

3. Companies that transport hazardous materials are rarely involved in MAS. When they are represented, such representation is a mere formality since these companies are not active participants in emergency planning.

4. Hazard assessment of chemical company facilities, a precondition to comprehensive planning, is virtually non-existent among MAS members. There seems to be considerable resistance to this due to fear of disclosure of industrial processes, a concern about possible prosecution for safety-related violations and the desire to keep hazards at a low level of public visibility.

5. MAS, with the numerous resources possessed by the membership, have occasionally faced the problem of convergence---that is, the delivery of resources and services to the disaster scene which greatly exceeds the demand. Such convergence contributes to serious traffic snarls. Sightseers and other extraneous persons moving toward the scene can compound the situation.

6. Plans formulated by MAS have overlooked the development of specific contingency plans for mass evacuation of impacted areas and the patrol strategies to be undertaken by law enforcement personnel once areas of a city have been evacuated. It is important to realize that mass transportation of the population must be considered in the overall traffic plan in order to avoid congestion.

Consequences of the Establishment of Mutual Aid Systems

1. The most obvious consequence of MAS is an improvement in localities' capabilities to respond to hazardous materials incidents. This is accomplished through planning and the coordination of emergency response in a climate of increased co-operation both within the industrial sector and between the industrial and public sector emer-

gency-relevant organizations. Aside from the formal aspects of emergency preparedness to which these systems have contributed, the regular contacts which members have with one another, have resulted in informal relationships that perpetuate the planning process.

2. MAS, in attempting to optimize the use of local resources in contingency planning, have been able to identify gaps in the capabilities of both private and public agencies and the duplication of services.

3. Corporate officials' participation at scenes of accidents, in which other companies are also involved, may result in greater interaction. Such contacts may lead to increased involvement in the community's problems as a whole.

4. Additionally, the cumulative efforts of MAS members have culminated in attempts to educate citizens, in general, regarding emergency procedures. This is primarily done through the dissemination of literature and public lectures.

5. As one of the preconditions of membership in most MAS is the development of emergency procedures for the individual plants and the acquisition of resources to counteract anticipated incidents therein, MAS have encouraged the pursuit of self-sufficiency of these plants in terms of hazard mitigation. The mutual education and training of members during planning sessions has furthered the attainment of this objective.

6. The existence of a comprehensive MAS to counteract chemical accidents has also enhanced emergency response to other crises arising in communities containing MAS. Many of the procedures and resources used in one kind of emergency can be transferred to mitigating the effects of other types of disastrous agents. Indeed, several of the systems studied have significantly improved responses to threats of natural origin.

The situation described is what prevails in the United States and Canada. To what extent these kinds of MAS could be used in other societies is an empirical question. However, some roughly similar types of MAS undoubtedly could be developed for chemical emergencies elsewhere.

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