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Improvements in Transportation Fire Safety Data Bases

William T. Hathaway

Transportation Systems Center
Cambridge MA 02142

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. Abstract

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PREFACE

The Office of the Secretary of Transportation (OST) in its role of overviewing and coordinating transportation fire safety is developing an integrated fire safety program plan. As part of this program plan, OST initiated a study to identify the data base requirements necessary to address the issue of transportation fire safety. This report presents the results of that study.

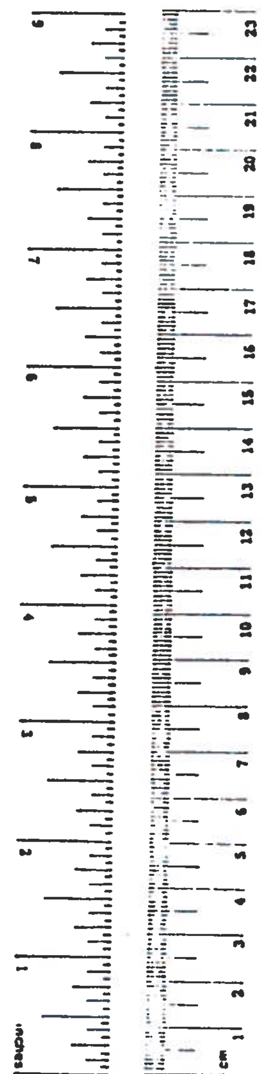
The authors, William T. Hathaway of the Transportation Systems Center (TSC) and Herbert L. Bogen, the principal author of Raytheon Service Company, wish to thank Charles W. McGuire of OST for his support and guidance in preparing this report.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

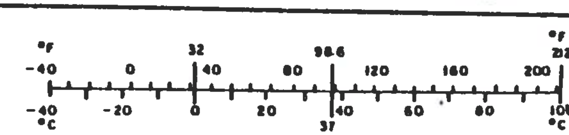
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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1. INTRODUCTION

The existing statistical data bases for transportation system accidents have been designed primarily to fulfill the modal administrative reporting functions. As such, the data collected are of a very broad nature and of limited use in the identification of areas of possible research and in the development and measurement of the effectiveness of regulatory action. This report identifies the design objectives which fire safety data bases should address, and provides recommendations for improvements in transportation fire safety data bases. A review of the available data bases containing information on transportation fires is presented in Reference 1.

From the point of view of the fire safety researcher or analyst, the existing statistical data bases containing transportation system fire incident information have several shortcomings because of their design. The data base information is directed toward accident reporting functions rather than toward investigation and analysis. The intended use of the data, the kinds of statistics to be generated, the research strategies and methodologies that would suggest certain data base requirements, and program goals and objectives must be taken into consideration.

Fire researchers and analysts need detailed information to assess transportation fire safety hazards, evaluate the effectiveness of regulations, and identify prospective fire safety research and development projects. To support this information, systematic descriptions recounting the events and conditions leading to the fire, its development, its extinguishment, and the resulting damages and casualties are needed.

Therefore, in order to address the question of improvements to transportation fire safety data bases, it is necessary to begin with a discussion of fundamental changes in data collection.

Since the needs are quite different for accident reporting and fire safety research and analysis, the two areas should be clearly separated in data base design and implementation. Such separation could result in greater effectiveness at lower costs.

A data base designed for fire accident reporting should record the basic information required by administrators and regulators. This type of file would include fire accident identifiers, information required for administrative and legal purposes, and information concerning any governmental actions taken in connection with the fire accident.

Since, for this type of report, data are supplied by local police and fire departments, transportation system operators, and others who may be untrained as fire investigators, it is not realistic to expect detailed and accurate data on the origin and development of the fire being reported.

The following sections discuss the data base design objectives and methods for attaining these objectives and recommendations.

2. DATA BASE DESIGN OBJECTIVES

Fire safety data bases should be designed with well defined objectives in mind. Data bases intended to provide data for statistical analysis of transportation fires and inputs for fire research efforts should meet the objectives in the following paragraphs.

2.1 OBJECTIVE 1 - THE ASSESSMENT OF EXISTING CONDITIONS

This objective is to provide the basis for assessing existing conditions with respect to the frequency of transportation fires and summary statistics and parameters. These data would also provide the basis for deriving probabilities of events, sequences of events, and hazardous conditions.

2.2 OBJECTIVE 2 - THE MEASUREMENT OF CHANGE

This objective is to assess the effect of various technological and operational changes on the frequency of fire accidents, types of accidents, ranking of causative factors, and the severity of fires, and to make these assessments within predetermined tolerance and confidence levels.

2.3 OBJECTIVE 3 - RISK/BENEFIT ANALYSIS APPROACH

This objective is to provide the basis for a risk/benefit analysis approach to transportation fire safety.

2.4 OBJECTIVE 4 - PROVISION OF CURRENT AND COMPLETE INFORMATION ON A RAPID RESPONSE BASIS

This objective is to ensure that the data on existing conditions and on the response to changes are current, up-to-date and complete. Also, there must be rapid response to special inquiries on transportation fires.

2.5 OBJECTIVE 5 - MEETING OBJECTIVES AT LOWEST POSSIBLE COST

Objectives 1 through 4 must be accomplished at the lowest possible cost.

2.6 OBJECTIVE 6 - MAINTENANCE OF A DATA BASE ON FIRE TESTING AND FIRE RESEARCH

This objective is to maintain fire information and data derived from fire testing and research.

2.7 OBJECTIVE 7 - REDUCTION OF THE COSTS AND DIFFICULTIES OF FIRE REPORTING SYSTEMS

This objective is to reduce the cost and difficulty of the existing fire reporting systems maintained for administrative or legislative reasons; the amount of data collected and stored in these systems must be drastically reduced; and the objective of the reporting systems must be clarified.

3. STEPS FOR ACHIEVING OBJECTIVES

The steps which are necessary to achieve each of these objectives, and the justification for these steps are presented below. Additional explanation of the objectives and approaches required for their achievement is also provided. The objectives vary in relative importance and, similarly, the requirements vary in complexity and in the level of support demanded. Objectives 1 through 3 are the most important and call for the most explanation.

3.1 OBJECTIVE 1 - THE ASSESSMENT OF EXISTING CONDITIONS

At the present time, it is extremely difficult to assess accurately the current status of transportation fire safety in the various modes. Transportation fire safety data are inconsistent and generally unrepresentative of the total population of incidents/accidents from which they are drawn.

One cause for these difficulties is the lack of a consistent conceptual approach to identifying, classifying, and describing transportation fires and their consequences. The definitions of important variables vary considerably within the field. Often, there are no generally accepted measures of severity for smoke and fire incidents/accidents. In some cases, there are threshold levels but no other indicators of severity. Reports of fires by police departments, fire departments, transportation agencies, and investigative teams tend to emphasize the severe end of the scale, particularly when casualties are involved. Data on incidents or accidents with less serious consequences are lacking, although such data are needed in order to ascertain the actual state-of-affairs concerning transportation fire safety. Owing to the lack of uniformity in reporting transportation fires and smoke incidents, the data cannot be compared or aggregated for the purpose of analysis.

All of the difficulties enumerated above have come about because none of the parties involved in the reporting of transportation smoke and fire incidents/accidents have had, as one of their objectives, the collection of data that would be the basis of assessing the existing status of transportation fire safety. Therefore, to remove these difficulties, the systems of data collection and data structures have to be redesigned with this new objective in mind. This data base redesign would include data collection by teams of trained investigators on the basis of a survey using a systematic sampling design. The sample sizes, which can be quite small, would vary for each transportation mode. In most cases, it may be desirable to use stratified random sampling, e.g., for vehicles within certain size or weight classes, or with certain technological features, or in certain age groupings. The exact sampling design will depend upon the overall research design, program objectives, and the other objectives for fire safety data bases mentioned above. However, to give a general idea of the magnitude of sample sizes and the corresponding work load for smoke and fire incidents/accidents, the following estimates for each transportation mode are provided:

Transportation Mode	Sample of Incidents
Automobiles	1000
Buses	
Transit	200
Intercity	20
Rail	
Rapid Transit	180
Railroads	120
Marine	100
Trucks	210
Air	
Carriers	
General	60

The samples would consist of both smoke and fire incidents ranging from minor incidents to extremely severe fire and smoke accidents. The proportion of fire accidents, out of the total of all smoke and fire incidents/accidents varies in each mode as well as by vehicle characteristics within each mode. Minor incidents are included in the surveys because they provide the necessary data on the entire statistical population of accidents and incidents and provide data which may be used in fire prevention. For example, studying minor incidents and comparing them with more severe accidents may provide clues as to the conditions which may determine the severity of the incidents. In addition, in the sample surveys, it may be useful to determine if serious fires or smoke accidents were preceded by minor smoke or fire episodes in the same vehicles, and whether the same components were involved.

It is recommended that the sample surveys be carried out on a continuing basis. Benchmark data obtained from the continuing surveys would help gauge the seriousness of the fire safety problem within each mode, and provide a standard against which policy changes and modifications in technology could be measured. Under present conditions, this cannot be done.

These data would provide frequency distributions for the entire range of smoke and fire incidents/accidents which may be used in developing probabilities for analytical procedures such as scenarios, fault trees, and models.

In order to serve the purposes intended, and to achieve this objective, the data should be highly detailed and disaggregated. The data content could approach the detail of Appendix A in Reference 2. The exact choice of the items included in the data base would be determined by the transportation mode under study and by the research objectives.

In order to provide the in-depth investigations that would be required to provide accurate and detailed data, investigative teams with specially trained personnel would be needed to work in all the major regions of the country.

3.2 OBJECTIVE 2 - THE MEASUREMENT OF CHANGE

An important function of statistical data bases is to provide a means of measuring change. With adequate data and appropriate data analysis, one may determine whether fires per million vehicle miles per year have changed from one year to the next, whether mean fire duration has decreased between one period of time and another, or whether the severity of transportation fires, as measured by an accepted index, has decreased within various modes. The measurement of such changes would be of value in assessing the effectiveness of various policy instruments in reducing fire accidents or decreasing their severity.

However, the measurement of change is difficult and complex. One difficulty is that actual change may be confused with equation error and measurement error. Equation error is the "disturbance" factor due to the exclusion from the analysis of many of the variables which may have various direct and indirect influences. Included here would be various unpredictable and unidentified human factors.

Measurement error, on the other hand, is observation error. Measurement error in fire safety data may occur in several ways. Variation may be introduced by the way different investigators select cases to be enumerated, there may be differences in judgment, and actual errors may be made in collecting or transcribing data.

Another major difficulty is that, even if it is determined that a change has occurred following the use of a fire safety countermeasure, one cannot necessarily assume that the change was due to the introduction of the countermeasure. Various analytical techniques must be applied to make this determination. Analytical techniques may include testing for the effect of a common causative factor not included in the original analysis, e.g., a decrease in average vehicle speed due to new regulations, may decrease vehicle collisions and fires associated with collisions. A test to determine whether a numerical difference is due to actual change or due to other factors may include using a "test variable." For example, is an increase in automobile fires accompanied by an increase in automobile insurance claims for fire? Another approach would be to compare the results of simulation modeling with the results of the data analysis. If these analytical techniques are to be employed, the statistical data base must be designed with them in mind. It must be possible to specify confidence levels. Test variables have to be included in the data collection, and the conceptual groundwork for severity indices and selection and definition of variables have to be completed beforehand.

3.3 OBJECTIVE 3 - RISK/BENEFIT ANALYSIS APPROACH

Use of the risk/benefit analysis approach and it's relationship to statistical data bases should be considered in the context of the Fire Safety Program goals of the Department of Transportation. One of these goals is an integrated program plan for "... improvement in fire accident data, regulatory coverage, and research and development coordination."

It is expected that the end result of the integrated program, comprising data analysis, regulatory action, and research and development, would be reduction of the risks of transportation fires. In order to achieve this result, risks would have been identified and evaluated, causative factors determined, countermeasures devised, benefits and costs assessed, decisions made, and planning and implementation carried out. In this process, risk analysis techniques would be an aid to decision-making, and statistical data bases would be important in support of risk analysis and other aspects of fire safety analysis.

Use of the risk/benefit analysis approach in the transportation fire safety program would be of value in the efficient and effective allocation of the resources of the government and the transportation industry. The risk/benefit analysis approach consists of the following phases:

1. Develop scenarios of fire accidents and smoke and fire incidents, using fault tree analysis or some modification of it. This stage involves data analysis, logical analysis, and, sometimes, analytical modeling.

2. Assign values to the probabilities of events and hazardous conditions presented in the scenarios and fault trees. Theses values may come from data on the frequencies of fire accidents, data on component failures and hazardous conditions, fire testing data, and results from physical and mathematical models. If no "hard" data are available, it may be necessary to depend upon expert judgment to assign these values.

3. Establish severity ratings to classify consequences of fire accidents. These consequences are various kinds of damage or loss: deaths, injuries, property loss, loss of transportation services resulting in a variety of economic and non-economic losses. For example, the severity ratings might be categorized as "minor," "moderate," "severe," "extra severe," and "extreme."

4. Assign probability values to the levels of damage severity. These values are more difficult to derive than the probabilities of occurrence. They may be based on accident data, maintenance data, records of emergency medical units, insurance records, and expert judgment. These values would be expressed as the probability of exceeding a particular severity level, given that a fire accident occurs.

5. Determine the joint probability that a fire accident will occur and that it will exceed a given level of severity. The joint probability is the product of the other two probabilities in items 2 and 4 above, and is expressed as the probability of exceeding a given severity level in a fire accident for one million vehicle miles. Joint probabilities must also be derived for the event that persons are exposed to a fire accident/incident and for the event that death or injury of persons occurs. The risk equation may be written as follows:

Risk of damage, injury, and/or death from a transportation fire accident/incident is

$$P(AFSEDI) = P(A)\cdot P(F/A)\cdot P(S/AF)\cdot P(E/AFS)\cdot P(D/AFS)\cdot P(I/AFS)$$

where:

A = event that a vehicle is in an accident/incident

F = the event that a vehicle is involved in a fire

S = the event that a fire reaches a specified level of severity

E = the event that persons are exposed to a fire accident/incident

D = the event that property damage occurs at a specified level

I = the event that death or injury of persons occurs

AF = the joint occurence of F and A

AFS = the joint occurence of F, A, and S

AFSEDI = the joint occurence of A,F,S,E,D, and I.

6. Having drawn the modified fault trees, developed the scenarios, assigned probabilities, and obtained joint probabilities, identify critical paths that result in high risk outcomes. These paths critical through the fault trees should receive the most attention.

7. Decide on the acceptable risk levels, the countermeasures necessary to change unacceptable risk levels, and the costs and benefits of various countermeasures; design policy instruments to implement the selected countermeasures.

8. Finally, after the countermeasures have been implemented, evaluate and assess the effectiveness of the countermeasures being employed and, if necessary, modify or replace them.

The decision-making process and evaluation are as complex as the risk analysis approach outlined above, but the discussion of what they entail is not included here for the sake of brevity.

A flow diagram of the phases of risk analysis, risk level decisions, and evaluation is shown in Figure 1.

In examining the phases of risk analysis, decision-making, and evaluation, it may be seen that statistical data are necessary. However, they are not sufficient to carry out certain procedures such as delineating fault-trees and scenarios, establishing severity levels, and assigning probability values. Analyses of accident reports, compilations of accident rates, accident repair records, and medical statistics are essential to this type of analysis. As has been pointed out above, there are serious deficiencies in existing data bases. But, even if the data were complete, uniform, and timely, there still would be problems in their use for risk analysis.

Paramount among these problems is the fact that certain important data are missing from accident data bases. As an illustration, consider the items in a data base regarding the causal or contributory factors in recorded accidents. Causal and contributory factors include such things as mechanical or electrical component failures, hazardous conditions, and human error. However, the frequency of occurrence of these factors cannot be determined, since, in the accident data base, they are only recorded when they are associated with an accident. For the purposes of risk analysis, an accurate estimation is required of all the occurrences and conditions whether or not they result in an accident. Since occurrences and conditions cannot be estimated from the existing data bases,this information must be obtained through some other means. It is suggested that the most likely source of such data is through sample surveys, including the population of vehicles not involved in the fire and smoke accidents/incidents that recorded. In-depth investigations of vehicles and interviews of maintenance personnel of transportation operators would also provide much useful data.

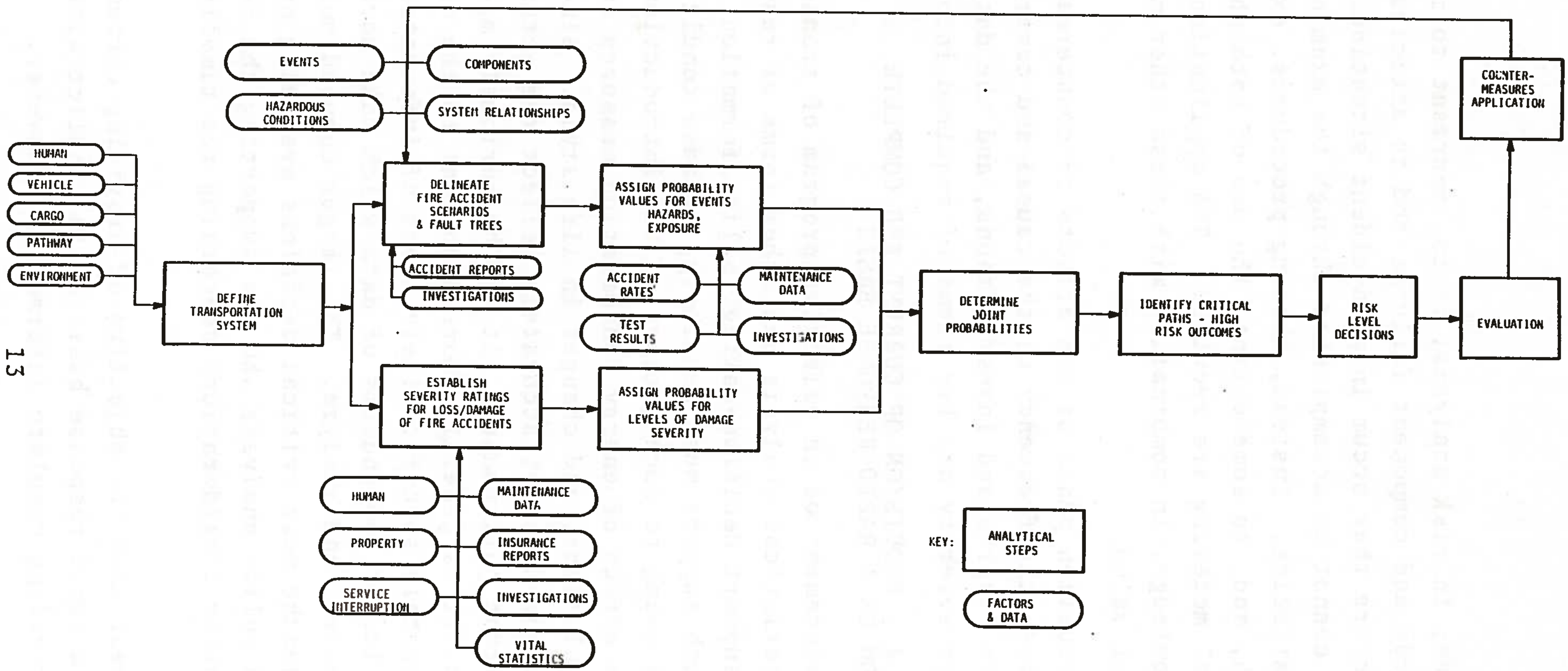

FIGURE 1. DIAGRAM OF RISK ANALYSIS APPROACH

In addition, in risk analysis, it is important to identify potential hazards and component failures and to anticipate human errors before they occur in an accident situation. Such identification cannot be accomplished through the examination of accident statistics. Instead, testing procedures, experimental research, and, to some extent, the use of both physical and mathematical modeling are required. The application of theoretical knowledge, in combination with these other methods, would also be of value.

In the evaluation phase of the effects of countermeasures, the accident rate, the frequency of the causal and contributory factors cited in reports and investigations, and the data on levels of damage severity are key items of required information.

3.4 OBJECTIVE 4 - PROVISION OF CURRENT AND COMPLETE INFORMATION ON A RAPID RESPONSE BASIS

In the advancement of an effective program of transportation fire safety, statistical analysis and other forms of research must directly support decision-making, policy formation, and evaluation. Such support must be timely, because conditions are always changing owing to such factors as the introduction of new technology, the effect of energy conservation measures and environmental regulations, and changes in life style. Since out-of-date information does not accurately reflect the actual situations that confront policymakers, it may be seriously misleading. For this reason, it is generally more important to the decision-maker to have certain specific timely items of information than to depend upon larger compendiums of data which take more time to compile, process, and analyze. The larger compendiums may not be available when the most critical decisions are being made. Researchers and policy analysts who are supporting the decision-makers have similar considerations concerning the timeliness of information.

It may appear that the objective of providing current information on a rapid response basis is in conflict with the objective of providing complete information. However, completeness implies response to the specific questions that are being addressed rather than an exhaustive study. Therefore, there is not necessarily a conflict between these two requirements.

Another aspect of the need for current and complete information for the purposes of decision-making and policy formation is that, in addition to the informational requirements of basic programs, there are also demands for special information in relation to legislation and program planning. One danger of the demand for special studies is that there may be a tendency to give more attention to these and to neglect more basic work related to countermeasures and evaluation. The solution to this would seem to be the maintenance of a constant level of effort on the basic informational support; the work on special studies would be above and beyond this.

So that a data base is capable of meeting the requirements that it be up-to-date, directed toward specific informational needs, and responsive to special demands, it is necessary that the data collection process be on a continuous or a regular, periodic basis. Furthermore, it is essential that the entire operation of data collection, data base management, and data analysis be the responsibility of a permanent team, not one assembled on an ad hoc basis for a particular project or a one-time census.

3.5 OBJECTIVE 5 - MEETING OBJECTIVES AT LOWEST POSSIBLE COST

The key to achieving the objectives which have been previously discussed at the lowest possible cost is the use of small, scientifically designed samples to obtain fire safety data rather than to follow the approach of complete compilations of detailed fire accident reports. Sampling, which can be done at reduced cost, provides greater speed in obtaining information, and provides more scope and flexibility regarding the types of information that can be obtained. Most importantly, it can provide greater accuracy, since personnel with specific skills and training can be used. In addition, more careful supervision of data collection and data processing is possible when the volume of data is reduced.

As has been pointed out, statistical analysis is feasible and useful for certain phases of the process of risk identification, risk evaluation, and risk reduction, but other methods are also required. Therefore, the areas of data collection and statistical analysis should not be extended, unless it is quite clear that data collection and statistical analysis are needed for specific applications in research and decision-making.

Additional reductions of cost in connection with the maintenance of accident report data bases are discussed in Section 3.7.

3.6 OBJECTIVE 6 - MAINTENANCE OF A DATA BASE ON FIRE TESTING AND FIRE RESEARCH

The information pertaining to fire safety is voluminous and is contained within the literature of a wide range of different fields or disciplines. In the process of practical applications of problem-solving, design, regulation formulation, standard setting, risk analysis, and policy analysis, a cross-linking and synthesis of the various areas of knowledge would be extremely valuable. A computerized scientific data base that would serve as an encyclopedia on fire science and fire safety, constantly kept up to date, would meet these needs.

3.7 OBJECTIVE 7 - REDUCTION OF THE COSTS AND DIFFICULTIES OF FIRE REPORTING SYSTEMS

Reporting of accidents, including fires associated with transportation accidents, is frequently required by legislative or administrative mandate. Data extracted from accident reports are, in many cases, maintained in automated data banks. Several agencies are in the process of having first or second-generation automated accident data banks designed. Generally, the designs of the data bases are for highly detailed, highly disaggregated information reporting requirements.

Much of the data collected in these accident data banks are not thoroughly analyzed, and most analyses consist of simple tablulations and summaries. It is not clear how useful these data bases are to administrators and legislators. Except for preliminary investigatory phases, they are almost useless for serious work in fire research.

Although the data reporting responsibility is placed most often upon units of local or state govenment or upon private firms in the transportation industry, the extraction of data from the reports, data processing, and storage is carried out by the Federal government. The costs at all levels of government, as well as in the private sector, must be substantial in the aggregate.

If, as recommended, data collection for decision-making and research were based on a sampling basis, and data bases were specifically designed and maintained for these purposes, the large accident reporting data bases could be considerably reduced in size, complexity, and cost. Accident report files would then contain only the bare essentials required to meet administrative and legislative needs not being met by the sample surveys and other procedures described above.

4. SUMMARY OF RECOMMENDATIONS

1. Accident reporting for administrative purposes and data collection for fire safety research and analysis should be clearly separated in data base design and implementation.

2. Accident reporting for administrative purposes should not include detailed information on the origin and development of fire and smoke incidents/accidents.

3. Data bases for statistical analysis by fire safety researchers should include detailed information on the origin and development of fires, extinguishment, damage, costs, and casualties. This information should be derived from in-depth investigations by trained investigators. Cases for investigation should be selected through a scientific sampling.

4. Statistical data bases should be designed to assess existing conditions, to detect change, and to provide a basis for a risk/benefit analysis approach to transportation fire safety.

5. Sample surveys should include minor incidents as well as severe fire and smoke accidents.

6. Sample surveys should be carried out on a systematic and continuing basis.

7. Statistical data bases should be geared to provide current and complete information on a rapid-response basis for both research and decision-making. Data collection, data base management, and analysis should be the responsibility of team operation on a permanent rather than an ad hoc basis.

8. Cost reductions should be achieved by reducing the size and complexity of administrative accident reporting data bases. In addition, by relying on sampling for

fire safety research and recognizing that other methods besides statistical analysis are required in fire safety research, the over-extension of data bases for statistical research may be avoided.

REFERENCES

1. Hathaway, W.T. and I. Litant, Assessment of Current DOT Fire Safety Efforts, UMTA-MA-06-0051-79-1, U.S. Department of Transportation, July 1979.

2. Hathaway, W.T., "Commonalities in Transportation Fire Safety: Regulations, Research and Development, and Data Bases," DOT-TSC-OST-80-5, U.S. Department of Transportation, November 1980.

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