GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: 10/15/79

Project Title: Determinants of International Differences in Reported Fire Loss: Update

Project No: E-24-605

Project Director: Dr. R. L. Rardin

Sponsor: Federal Emergency Management Agency; U.S. Fire Administration; Washington, D.C. 20472

Agreement Period: From 8/31/79 Until 8/30/80

Type Agreement: Grant No. USFA-79065

Amount: $49,975

Reports Required: Quarterly Reports; Final Report

Sponsor Contact Person (s):

Technical Matters

Mr. Henry Tovey, Project Officer
Federal Emergency Management Agency
U.S. Fire Administration
Washington, D. C. 20472

Contractual Matters
(thru OCA)

Mr. Gordon Vickery
Grant Administrator
Federal Emergency Management Agency
U.S. Fire Administration
P.O. Box 19518
Washington, D. C. 20036

Defense Priority Rating: None

Assigned to: Industrial and Systems Engineering (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director—EES
Accounting Office
Procurement Office
Security Coordinator (OCA)
Reports Coordinator (OCA)

Library, Technical Reports Section
EES Information Office
EES Reports & Procedures
Project File (OCA)
Project Code (GTRI)
Other OCA Research Property Coordinator

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: 6/4/81

Project Title: Determinants of International Differences in Reported Fire Loss: Update

Project No: E-24-605

Project Director: Dr. R. L. Rardin

Sponsor: Federal Emergency Management Agency; U. S. Fire Administration; Washington, D. C. 20472

Effective Termination Date: 12/31/80

Clearance of Accounting Charges: 12/31/80

Grant/Contract Closeout Actions Remaining:

- _ Final Invoice and Closing Documents
- X Final Fiscal Report (SF 269)
- X Final Report of Inventions
- X Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ____________

Assigned to: Industrial & Systems Engineering (School/~~Laboratory~~)

COPIES TO:

Administrative Coordinator
Research Property Management
Accounting Office
Procurement Office
Research Security Services
~~Reports Coordinator~~ (OCA)
Legal Services (OCA)
Library, Technical Reports
EES Research Public Relations (2)
Project File (OCA)
Other: ____________

E-24-605

SCHOOL OF INDUSTRIAL AND SYSTEMS ENGINEERING

Atlanta, Georgia 30332 (404) 894-2300

February 22, 1980

Dr. Henry Tovey
U.S. Fire Administration
P.O. Box 19518
Washington, D.C. 20036

Dear Henry:

This letter transmits five copies of a draft of the first required report under our Grant USFA-79065 "Determinants of International Differences in Reported Fire Losses: Update." We trust the draft will be satisfactory for Phil's trip, and look forward to receiving detailed comments from USFA. After we have modified the draft for your comments, two hundred final copies will be printed for USFA.

Sincerely,

Ronald L. Rardin, Ph.D.
Principal Investigator

Jerry Banks, Ph.D.
Co-Investigator

RLR/JB:sb

cc: Duane Hutchison, OCA
M. E. Thomas, ISyE Director

Enclosures

RECEIVED
FEB 25 1980
OFFICE OF CONTRACT ADMINISTRATION

Report sent to alice 3-6-80 cab

SELECTED INTERNATIONAL COMPARISONS OF FIRE LOSS 1976-1978

DRAFT ONLY. DO NOT QUOTE.

BY

JERRY BANKS

RONALD L. RARDIN

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

WITH THE SUPPORT OF THE

UNITED STATES FIRE ADMINISTRATION

NATIONAL FIRE DATA CENTER

GRANT NO. USFA-79065

MARCH 1980

EXECUTIVE SUMMARY

Comparative estimates of fire loss experience in various developed nations have been published intermittently for a number of years. The consistent finding of such comparisons has been that the United States has one of the highest rates of per capita fire incidence and fire fatality among developed nations. This report presents the most up-to-date available analyses of the United States standing. Available statistics from Canada, Australia, Japan and several countries in western Europe are compared to those of the United States for the period 1976-78.

Any comparison between reported fire losses of different countries is beset by major incomparabilities in the data and the procedures by which the statistics are calculated. When, as in the case of this report, published results from individual countries are interpolated to conform to a standard format, additional opportunities for confusion are introduced. Thus, a reader should treat all conclusions from the data presented only as indications of possible phenomena. Within these limitations, however, some conclusions do seem appropriate.

- Building Fire Incidence. The incidence of building fires per 1,000 persons was estimated for ten nations including the United States. As was the case in earlier time periods [ ], the per capita rate of reported building fires in the United States was the highest of the countries reported. The United States rate is one and one half times that of our neighbor, Canada.
- Building Fire Loss. The United States compares somewhat more evenly with other developed countries for which data is available when

the rate of monetary building fire loss is computed. Either on the basis of monetary loss per capita or monetary loss as a percent of Gross National Product, the United States ranks at the middle of the countries considered in this report.

- Fatalities. Patterns of fire fatalities by age and sex are parallel among the fifteen to seventeen developed countries for which information can be obtained from the World Health Organization. Per capita death rates are greater in the very young, the very old, and in males. However, in all age and sex categories, the United States rate is greater than any other country considered except Canada and Ireland.
- Occupancy. When fire loss experience is subdivided by the occupancy of the property in which the fire occurs, some concentration of United States' relative difficulties appears in residential fires. In both fire incidence and monetary fire loss, the residential fire problem in the United States appears to be proportionately larger than that of other countries for which data is available. The great concentration of fire fatalities in residential fires (observed in all nations) together with the comparatively poor fire fatality ranking of the United States also suggest a concentration of United States' fire problems in residential occupancies.
- Cause. The United States experience with the cause of fires mirrors, in many ways, that of The Netherlands, the United Kingdom, and the New South Wales state of Australia (the jurisdictions for which comparable information is available). However, there are some exceptions. The most important appears to be a greater contribution of incendiary and suspicious fires in the United States. Smoking related fires also appear more prevalent in the United States residential fire.

- City Data. When available city fire incidence and fire fatality rates are compared for United States cities and world cities, the realtively poor standing of the United States is confirmed. Both per capita fire incidence and per capita fire fatalities in the United States cities average significantly higher than comparable foreign cities. In the largest cities (over 1,000,000) United States values are several times world cities. Relatively greater fire incidence in the United States is apparently reflected in the comparatively larger numbers of fire personnel employed by American cities.

TABLE OF CONTENTS

Executive Summary i

Table of Contents iv

List of Tables v

List of Figures vi

1. Introduction 1

1.1 Sources of Information 3

2. Comparisons of Aggregate Fire Indices 6

2.1 Economic and Technological Determinants 13

2.2 The Uniqueness of Japan 17

3. Comparisons by Occupancy and Cause 18

3.1 Comparison by Broad Occupancy Classifications 18

3.2 Residential Fires 21

3.2 Non-residential Structure Fires 24

3.4 Mobile and Outside Fires 28

4. Fatality Patterns 31

5. Comparisons of City Data 37

Appendix A 43

Appendix B 48

Appendix C 49

LIST OF TABLES

1-1 Sources of National Fire Statistics 4

2-1 Comparison of Fire Loss Indices for 1976-78 8

2-2 Indices of Economic and Technological Development 14

3-1 Fire Loss by Major Property Type 19

3-2 Residential Fires by Occupancy and Cause 22

3-3 Non-Residential Structure Fires by Occupancy and Cause . . . 25

3-4 Mobile Fires by Occupancy Class 29

3-5 Outside Fires by Occupancy Class 30

4-1 Death Rates by Age and Sex, 1976-77 32

5-1 World City Fire Losses 38

A-1 Comparison of Fire Loss Indices for 1965-67 44

A-2 Comparison of Fire Loss Indices for 1972-74 45

A-3 Death Rates by Age and Sex, 1972-74 46

A-4 U.S. Cities Fire Losses 47

LIST OF FIGURES

2-1 Comparisons of Fire Loss Indices 9

2-2 Relationship Between Monetary Building Fire Loss 15
& GNP Per Capita

2-3 Relationship Between Per Capita Fire Deaths and 16
Technological Index

4-1 Comparison of 1972-74 and 1975-77 Fire Death Rates 33
(Per Million Population) by Sex

4-2 Comparison of 1972-74 and 1975-77 Fire Death Rates 34
(Per Million Population) by Age

5-1 World Cities Fire Rate Per 10,000 Persons vs. 39
United States Cities

5-2 World Cities Fire Death Rate Per 1,000,000 Persons 39
vs. United States Cities

5-3 Population vs. Total Fire Personnel for World Cities 40

5-4 Total Fires vs. Total Fire Personnel for World Cities . . . 42

1. INTRODUCTION

National summaries of fire loss statistics are published regularly by fire service and fire insurance organizations in many developed countries. Intermittently over the past several years, international comparisons of those national statistics have been produced by the United States National Fire Protection Association [ ], the British Fire Protection Association [ ], and various individual researchers [,].

The consistent finding of all these international comparisons has been that the United States has one of the highest rates for per capita fire incidence and fire fatalities among the developed nations. As a first systematic effort to obtain some understanding of what causes such differences in reported fire loss, the National Prevention and Control Administration (now the United States Fire Administration) sponsored the Georgia Institute of Technology in a grant project entitled, Determinants of International Differences in Reported Fire Loss. The object of the project was to systematically enumerate and screen the various hypotheses and theories which have been advanced to explain fire loss differences among nations - including social, economic, cultural, technological and fire policy variations, as well as differences in statistical reporting procedures. The principal results of this Georgia Tech project are a Final Technical Report [ ] and a Final Summary Report [ ] published in 1977.

As an extension of the earlier work, the Georgia Tech research team undertook in 1978 to produce two more detailed reports. The first of these entitled Report on Fire Data Collection and Presentation [ ] more thoroughly analyzes the collection and analysis systems used to prepare fire data in different countries. The second supplemental report, Selected International Comparisons of Fire Losses [ ], provided more detailed analyses of fire loss in a more limited set of countries. Georgia Tech's earlier work was based on fire statistics for the 1973-75 era.

This report extends the earlier analyses through the 1976-78 time period. The analyses of Selected International Comparisons of Fire Losses are updated to the later time, and results for the two time periods are compared for trends or changes in the relative position of the United States.

Several specific analyses are included. In Section 2, aggregate indices of fire loss are compared for the United States, Australia, Canada, Japan and six western European nations. The incidence of building fires, losses to building fires, and rates of fire fatalities are related to national populations, economic and technical activity. Section 3 contains more detailed comparisons by the occupancy of the fire site and the cause of the fire. The United States, the United Kingdom, The Netherlands and Australia are represented. Rates of fire incidence are calculated for particular classes of residential, non-residential, mobile and outside occupancy; residential and non-residential are further subdivided by cause. Section 4 focuses on fire fatalities. Drawing on World Health Organization reports of deaths due to fire and flame accidents [ ], age and sex differences in fire fatalities are analyzed for seventeen developed nations including the United States. A final section presents fire loss data from major cities of the world. Using reports collected by the Tokyo Fire Department [ ] from 52 cities (13 within the United States), populations, numbers of fires, fire deaths, and number of fire personnel are correlated.

Any major comparison between reported fire losses of different countries is beset by major incomparabilities in the data on which statistics are based and the procedures by which the statistics are calculated. When published, results must be manipulated and interpolated to conform to a standard format, additional opportunities for confusion are introduced. Still, useful insights and directions for future research do arise from such rough, investigations. Thus, the reader should accept none of the results to follow as irrefutable, but instead, should view them as indications of underlying phenomena.

1.1 Sources of Information

As detailed in Appendix C, the Georgia Tech research team has undertaken a rather thorough effort to contact and obtain reports from agencies known to be producing fire loss statistics in various industralized nations. Although only a few sources were discovered that analyze fire loss in as much detail as USFA's national estimates, information that could be used in one or more of the tables and figures in this document was obtained for a variety of countries. Specific sources of national data are detailed in Table 1-1.

In addition to the sources listed in Table 1-1, information for individual cities was obtained for 1976-78 by the Tokyo Fire Department [ ]. This data was collected by surveys of numerous fire departments throughout the world.

In preparing the values presented in the exhibits which follow, it was often necessary to perform various calculations on the data directly available from the above sources. The purpose of such calculations was to make

TABLE 1-1

SOURCES OF NATIONAL FIRE STATISTICS

COUNTRY	SOURCE OF INFORMATION
AUSTRALIA	Fire Statistics, New South Wales, 1977 [ ], which contains statistics of service calls made by the New South Wales Fire Brigade to fires and other hazards. "As New South Wales is fairly representative of Australia generally, it is reasonable to use the population ratio as a factor to obtain a national picture." [ ]
AUSTRIA	Reports for 1977 and 1978 of The Austrian Fire Prevention Agency [ ]. The report is derived from a combination of official fire reports and insurance sources.
BELGIUM	Summary of 1978 Belgian Fire Brigade operations [ ] produced by the Belgian Ministry of the Interior.
CANADA	Report for 1977 of the Dominion Fire Commissioner [ ] which is compiled from data provided by the provincial fire marshals and fire commissioners, the fire marshals of the Territories, the Canadian Forces Fire Marshal and Statistics Canada.
DENMARK	Reports of fire losses for 1976-78 were prepared by "Danmarks Statistik" [ ], based on information from insurance companies.
JAPAN	White Book on Fire Service in Japan for 1976 and 1978 [,], by the Japanese Fire Defense Agency, which is derived from reports of responses by Japanese fire brigades.
NETHERLANDS	Reports for 1976 and 1977 of the Centraal Bureau voor de Statistek in the Dutch government [ ], which is derived primarily from reports on responses of Dutch fire brigades.
NORWAY	Publications for 1976 and 1977 [,] describing the distribution of fires by sources and causes, based on reports from all fire insurance companies underwriting in Norway.
UNITED KINGDOM	Reports of the British Home Office for 1976 and 1977 [,], the statistics presented are of fires attended by local fire brigades.
UNITED STATES	USFA's Fire in the United States for 1977 and 1978 [,], which is derived primarily from reports on fire department responses entered in the NFIRS information system.

subdivisions by cause and occupancy, to convert foreign losses to United States losses for a base year, etc. in order to have all data correspond more directly with each other and with USFA's national estimates. Although values were not presented unless a reasonable basis for such calculations could be developed, some decisions were necessarily arbitrary. Furthermore, all decisions were based on the very limited information available within reports on the definitions of categories for which national statistics were reported. Details of calculations performed are provided in Appendix B.

2. COMPARISONS OF AGGREGATE FIRE INDICES

Fire statistics published by various national agencies provide numbers of fire incidents, numbers of injuries due to fires, numbers of fire fatalities, and estimates of direct monetary loss from fires. Specific reports may contain one or more of these measures. Prior Georgia Tech analysis in the Final Technical Report [ ], showed that while the number of fatalities and the amount of monetary loss attributed to non-building fires is small, there is high variability among nations in the degree to which such mobile and outside fires are included in reports. For that reason, in preparing aggregate fire loss comparisons, only building fires are included in incidence and monetary loss analyses. Some nations do report injuries, but the definition and comparability of these reports is very doubtful. For this reason, injuries are not compared in this report.

The single incidence in which fire data is systematically collected by an international agency is the fire fatality information published by the World Health Organization (WHO). WHO statistics are derived from cause of death data on death certificates. Invariably, many deaths which should be classified as fire deaths (e.g. deaths due to fires connected with motor vehicle collisons) are omitted. Thus, WHO death rates usually underestimate those produced by fire service agencies. Still, since our interest is in relative position of the various countries, the WHO values appear to present the most consistent basis for comparison among a wide group of nations. For this reason, all national death statistics in this report are derived from the WHO values.

Like fire incidents, monetary fire loss estimates in this report are adjusted to reflect only building fires. However, additional adjustments are necessary to convert monetary values into a single currency for a single year. As detailed more completely in Appendix B, monetary loss estimates for this report were obtained by adjusting to a standard year (1977) through consumer price indices of the International Monetary Fund [ ] and the prevailing exchange rates published by the United Nations Statistical Office [ ].

By whatever method fire loss is measured, it is not possible to make meaningful comparisons among nations unless loss values are standardized into indices. The most widespread approach for producing loss indices from monetary loss estimates, fire counts, and numbers of fire deaths is the calculation of per capita rates. However, per capita rates are not the only reasonable choice. Other possibilities are comparison to the size of economies as measured by the Gross National Product and the level of technological development in the various nations and computation of losses per fire incident.

Table 2-1 presents all such indices for Australia, Canada, Japan, the United States and six western European nations. Figure 2-1 compares results in Table 2-1 to similar ones for 1965-67 and 1972-74. (See appendices Tables A-1 and A-2 for details of the earlier time periods. Major highlights of Table 2-1 and Figure 2-1 are the following:

- Building Fires Per 1,000 Persons. The United States' rate of 4.7 fires per 1,000 persons is the highest of the ten nations considered. In fact, the United States' rate in each of the three time periods is higher than all other countries except for Norway in 1972-74. The

TABLE 2-1

COMPARISON OF FIRE LOSS INDICES FOR 1976-78

COUNTRIES	BUILDING FIRES/1,000 PERSONS	$ BUILDING FIRE LOSS PER CAPITA	BUILDING FIRE LOSS U.S. % OF GNP	FIRE DEATHS/ 1,000,000 PERSONS	BUILDING FIRE LOSS/ FIRE ($1,000'S)	FIRE DEATHS/ 1,000 BUILDING FIRES
Australia	1.2 26%	-	-	11.6 40%	-	9.6 157%
Austria	2.4 51%	9.6 52%	.15 75%	9.2 32%	4.0 103%	3.9 64%
Belgium	1.2 26%	-	-	10.8 38%	-	7.9 130%
Canada	3.2 68%	23.6 129%	.27 135%	32.1 112%	7.3 187%	9.9 162%
Denmark	3.3 70%	25.6 140%	.26 130%	11.6 40%	7.6 195%	3.5 57%
Japan	0.3 6%	4.0 22%	.07 35%	14.1 49%	11.6 297%	40.6 666%
Netherlands	1.0 21%	13.3 73%	.16 80%	5.3 18%	12.9 331%	5.2 85%
Norway	3.9 83%	36.4 199%	.42 210%	14.6 51%	9.5 244%	3.8 62%
United Kingdom	1.7 36%	8.9 49%	.20 100%	15.4 54%	5.2 133%	9.0 148%
United States	4.7 100%	18.3 100%	.20 100%	28.7 100%	3.9 100%	6.1 100%

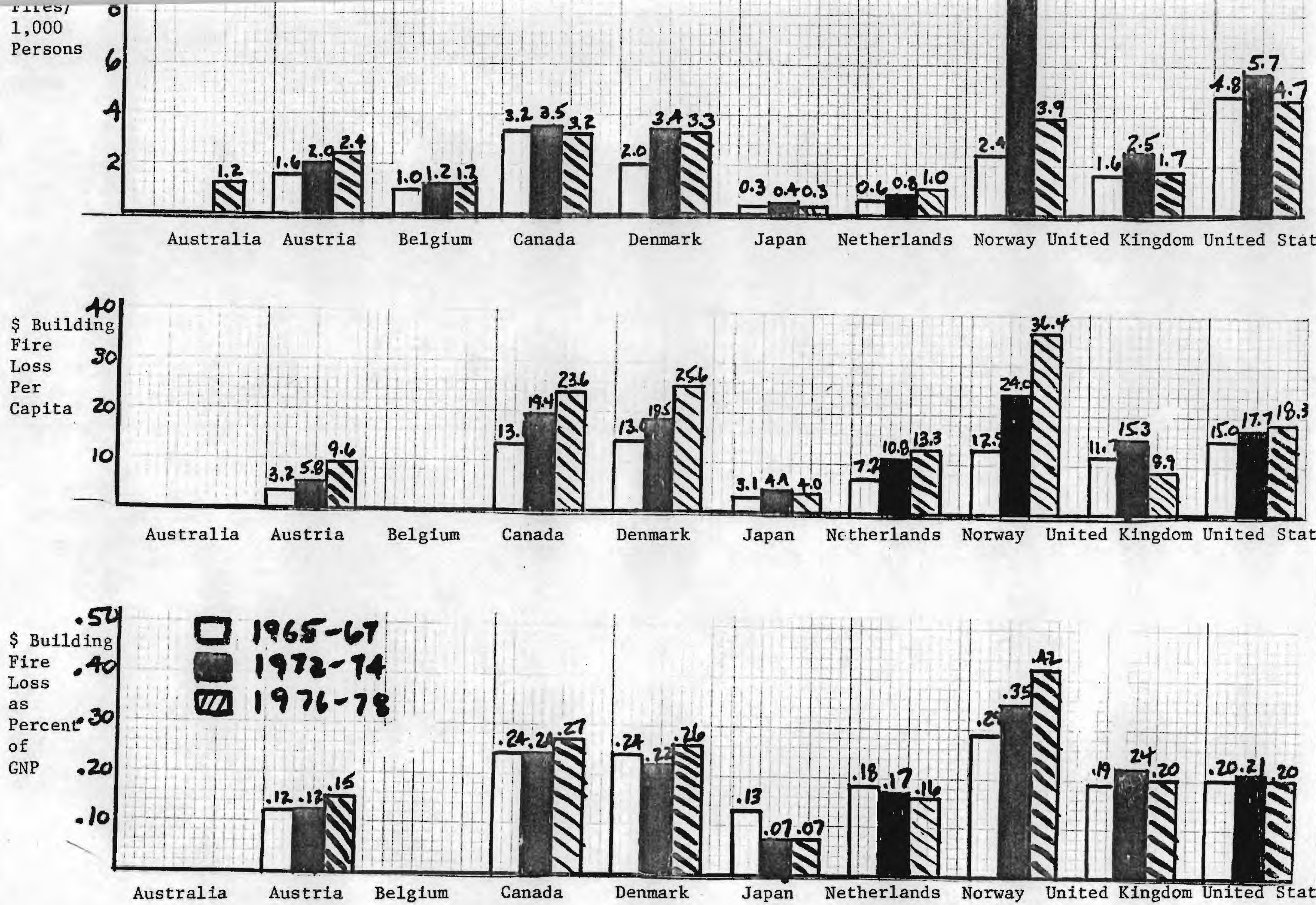


FIGURE 2-1: COMPARISONS OF FIRE LOSS INDICES

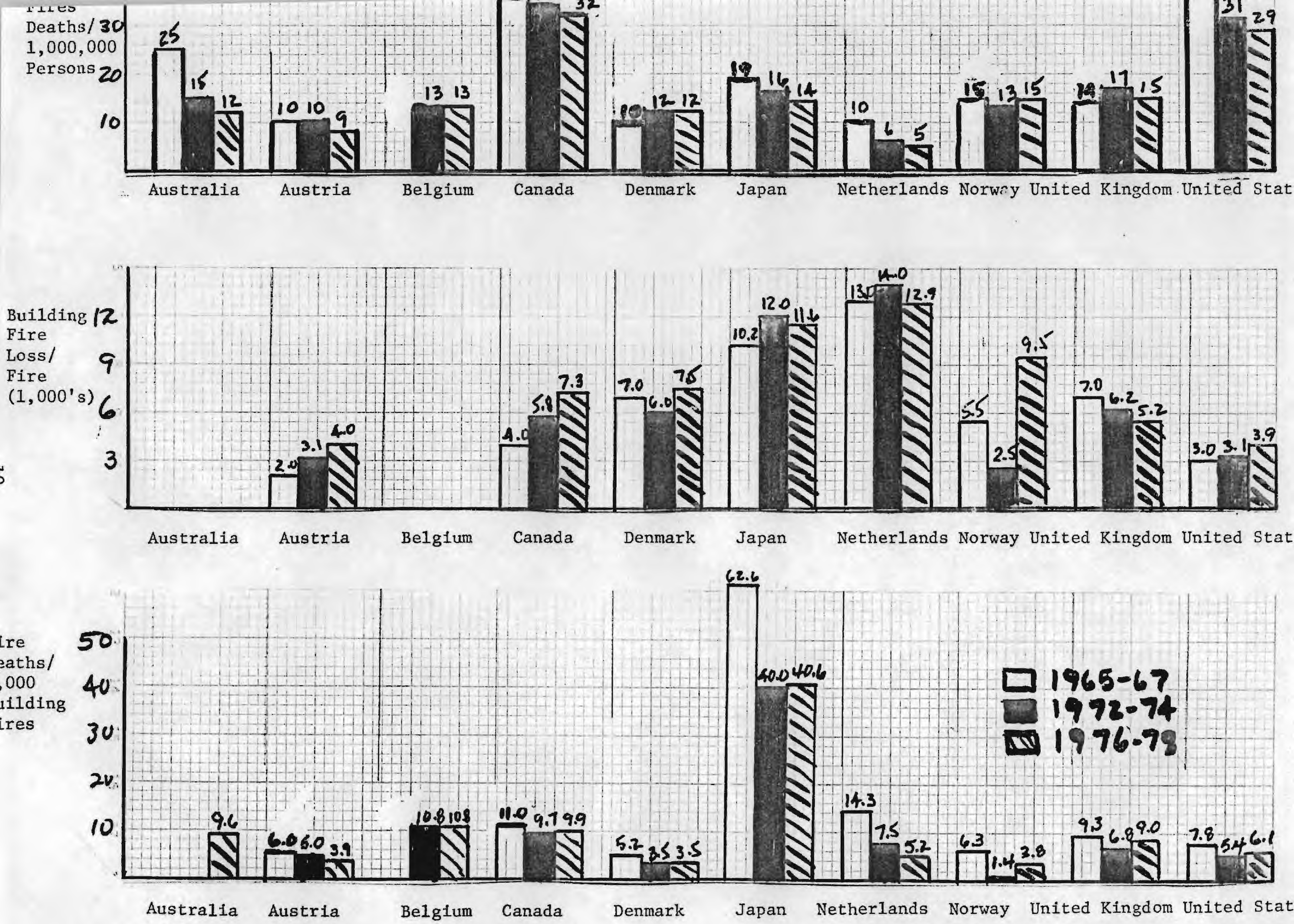


FIGURE 2.1 (CONTINUED)

lowest relative rate of building fires in all three time periods is Japan. The United States building fire incidence rate is approximately 16 times that of Japan. It is nearly one and one half times that of our neighbor, Canada.

- Building Fire Loss Per Capita. Even after adjustment to 1977 dollars, Figure 2-1 shows that building fire losses per capita are increasing in most countries for which data is available. The United States is no exception. In contrast to results for numbers of fires per capita, the United States ranks in the middle of the countries considered on monetary fire loss per capita. Table 2-1 shows Canada, Denmark and Norway with higher rates than the United States; Austria, Japan, The Netherlands and the United Kingdom have lower values. As with fire incidents, reported monetary fire loss per capita in Japan is extraordinarily low - less than one fourth of the United States' value.
- Building Fire Loss as a Percent of Gross National Product. When fire losses are measured as a fraction of Gross National Product, they reflect the economic burden of monetary fire losses on the various nations. By this standard, the burden of fire losses has remained consistent over the past several years in most of the countries reported in Figure 2-1. There are two significant exceptions. Norway's fire losses are growing dramatically as a percent of Gross National Product; Japan's have decreased by nearly 50%. The United States is one of the countries that has experienced a consistent fraction of its Gross National Product lost to fires. As with the case of building fire losses per capita however, the United States ranks in the middle of the reported countries on monetary losses per GNP.

- Fire Deaths Per 1,000,000 Persons. The WHO fire death rates reflected in Figure 2-1 show for most countries a decreasing fire fatality rate over the past decade. The United States' improvement is one of the greatest ones - a 24% decrease. Even with this improvement, however, the United States' fire death rate per million persons is second highest among the ten nations. The United States' rate is comparable only to the slightly higher one of Canada and almost twice that of all other countries reported.
- Building Fire Loss Per Fire ($1,000's). When fire losses are calculated per fire, they reflect the magnitude of the fire incidents included in published statistics. By this measure Table 2-1 shows the United States to have the least monetary fire loss per fire. The lower United States value may reflect the fact that more inconsequential fire incidents are included in the United States data, or the possibility that fires are better controlled in the United States after ignition. However, since this index is the ratio of an estimated number of fire losses to an estimated number of fire incidents, it is especially subject to errors in reporting and compiling data.
- Fire Deaths Per 1,000 Building Fires. When fire deaths are calculated per building fire, the United States stands in the middle of the countries reported. Five countries have more deaths per fire and four have fewer. The deaths per fire rate in Japan is extraordinarily higher than any of the other values, although it has improved significantly over the past decade.

2.1 Economic and Technological Determinants

In the earlier Final Technical Report [ ] and Final Summary Report [ ] Georgia Tech's analyses considered many hypotheses that might explain differences in fire losses. Among those which seemed plausibly related to fire loss were the levels of economic and technological development.

Table 2-2 shows the indicators of economic and technological development available from multinational organizations. Gross National Products per capita are obtained from estimates of the International Monetary Fund [ ] and the United Nations Statistical Office [ ]. Numbers of televisions, radios and telephones per capita are estimated by the United Nations [ ]. To obtain a single measure of technological development, the latter three were combined into a Georgia Tech technological index. The index is a weighted sum of the three component values with weights obtained as detailed in Appendix B.

Figures 2-2 and 2-3 plot relationships between the values in Table 2-2. The first of these figures demonstrates the tendency of monetary fire losses to increase with the Gross National Product of the various nations. Among the possibilities to explain this relationship are the notions that increasing GNP creates more opportunities for fires and that greater economic activity indicates greater burnable wealth.

Figure 2-3 shows the relationship between fire death rates and the technological index. Statistically, the implied relation is a relatively strong one. However, the fire death rates and technological index rates for all countries except the United States and Canada are almost indistinguishable. The substantial disparity between the United States and Canada versus the other countries suggest that the fire ignition risk presented by wider availability of technological devices may be one cause of the relatively high United States and Canadian fire death rates.

TABLE 2-2

INDICES OF ECONOMIC AND TECHNOLOGICAL DEVELOPMENT

COUNTRIES	$ BUILDING FIRE LOSS ($1,000'S)	FIRE DEATHS/ 1,000,000 PERSONS	GNP 1/ PER CAPITA ($1,000'S)	TV'S PER 1,000 POP.	TELEPHONES PER 1,000 POP.	RADIOS PER 1,000 POP.	TECHNOLOGICAL INDEX
AUSTRALIA	-	11.6	6.8	274	395	211	2.61
AUSTRIA	9.6	9.2	6.3	247	304	342	2.64
BELGIUM	-	12.6	8.2	255	300	384	2.78
CANADA	23.6	32.1	8.7	411	596	959	5.69
DENMARK	25.6	11.6	9.0	308	494	331	3.32
JAPAN	4.0	14.1	6.1	235	426	465	3.24
NETHERLANDS	13.3	5.3	7.7	259	391	284	2.74
NORWAY	36.4	14.6	8.7	255	366	319	2.77
UNITED KINGDOM	8.9	15.4	4.4	320	394	750	4.27
UNITED STATES	18.3	28.7	8.7	571	721	1,882	9.15
MEDIAN				266.5	394.5	363.0	

1/ 1977 DATA

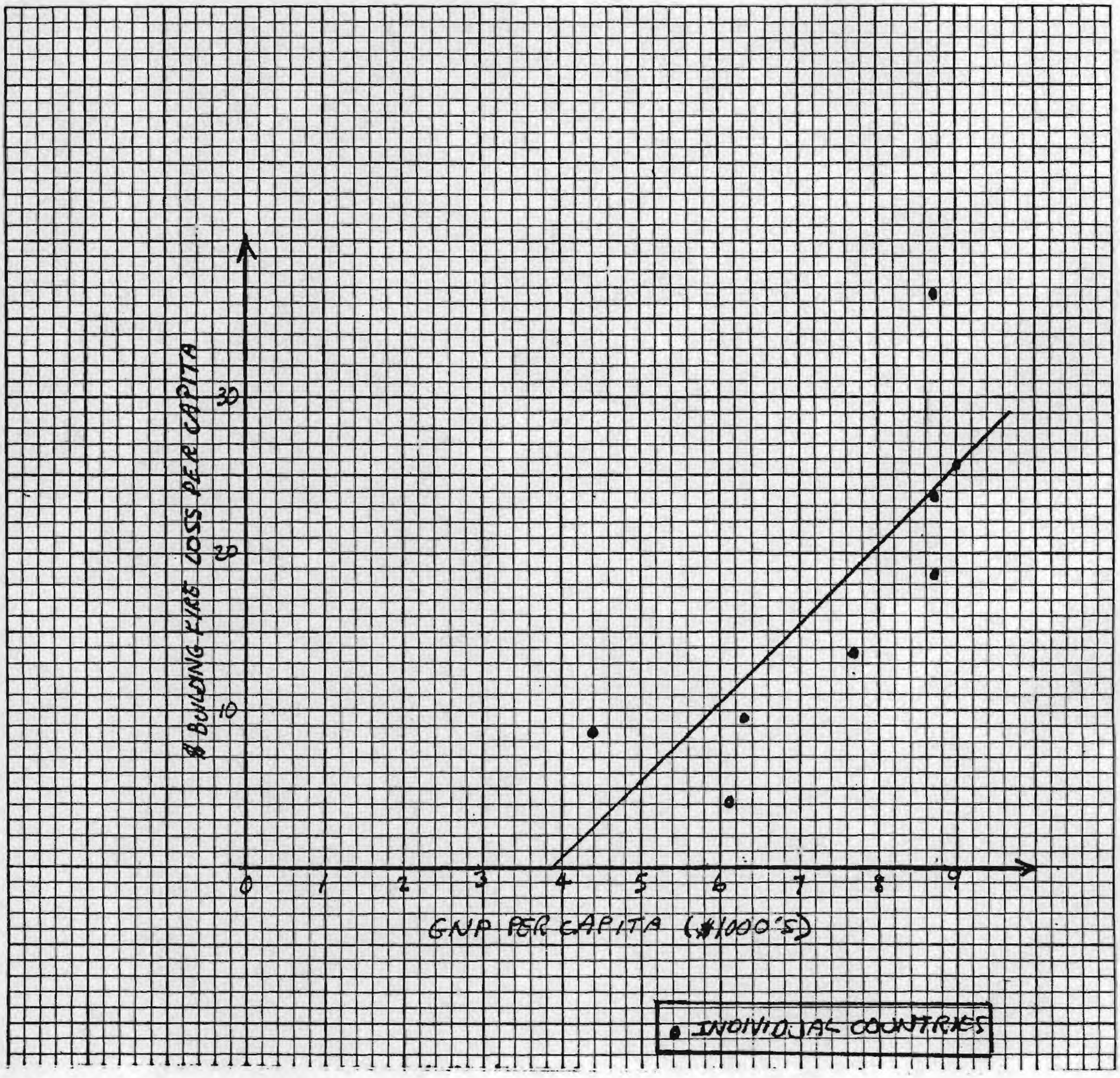


FIGURE 2-2. RELATIONSHIP BETWEEN MONETARY BUILDING FIRE LOSS AND GNP PER CAPITA

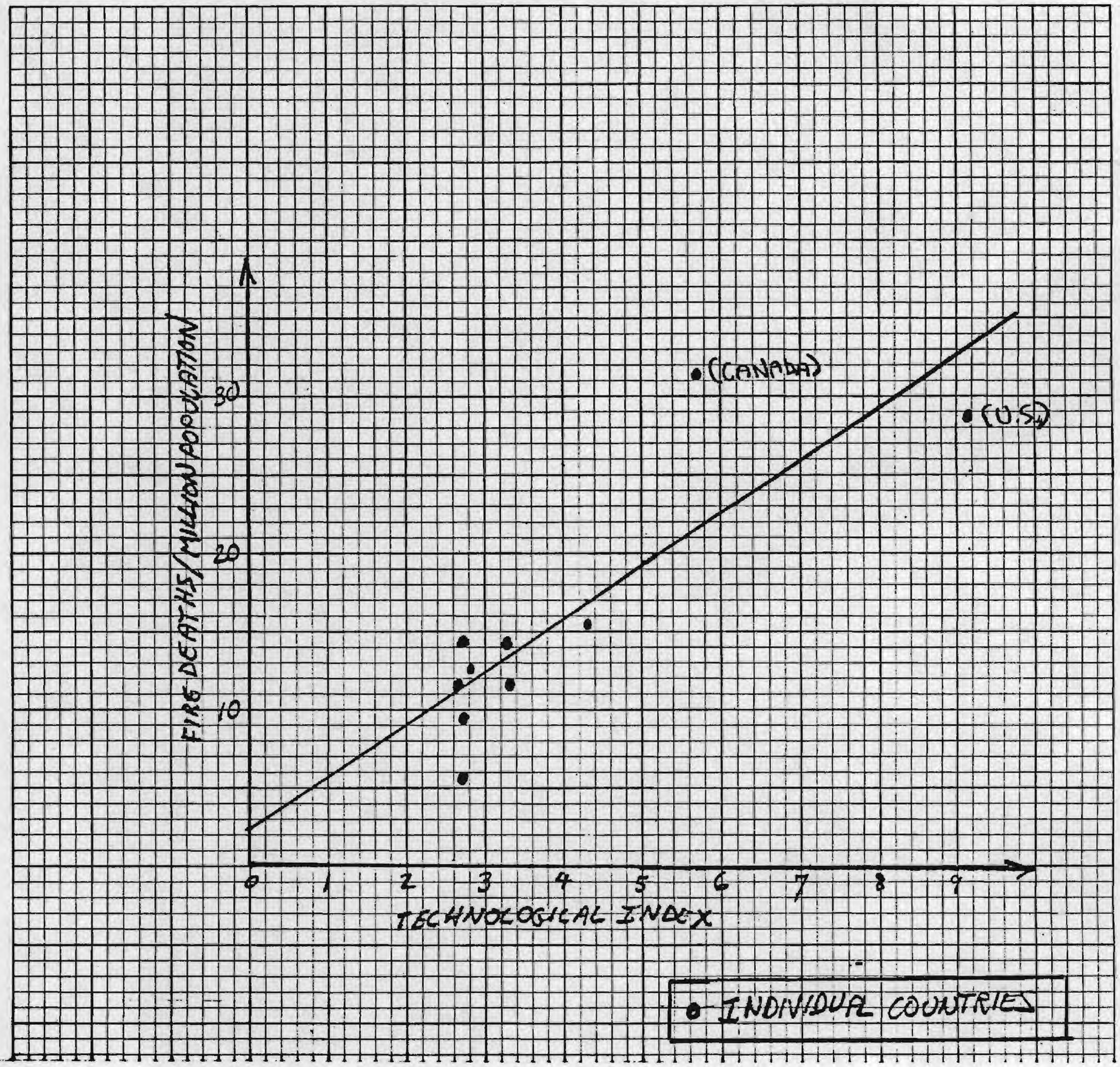


FIGURE 2-3. RELATIONSHIP BETWEEN PER CAPITA FIRE DEATHS AND TECHNOLOGICAL INDEX

2.2 The Uniqueness of Japan

Although much less quantitative information is available, some researchers have suggested that fire losses in various nations are impacted by sociological and cultural phenomena in those nations. The unique standing of Japan in the comparisons of Table 2-1 and Figure 2-1 may reflect such a cultural element. Reported values for numbers of fires and monetary loss in Japan are extraordinarily low. On the other hand, loss per fire and especially deaths per fire are exceptionally large. Japanese fire professionals [ ] suggest that the traditional burnability of the Japanese living environment is closely connected with both these unusual standings. The high risk associated with a fire is reflected in the large losses per fire. A long history of large fires--especially ones connected with earthquakes and war--has produced a strong cultural concern about fire that is expressed in low fire incidence. It is reported [ ] that great shame and embarrassment falls on any family responsible for a fire in a neighborhood.

3. COMPARISON BY OCCUPANCY AND CAUSE

Any set of fire statistics for an entire nation reflects a host of fire problems presented by different property types (or occupancies) where fires arise and by different causal factors leading to the fires. Most agencies producing fire statistics recognize this fact by subdividing statistics according to occupancy and/or cause. Unfortunately, there are no international standards for such classification of fire incidence; consequently schemes vary significantly from nation to nation. Still, insight can be gained if these classification schemes can be brought into approximate harmony. The analyses of this section are based on the recategorization and interpolation of national fire reports to achieve such harmony. Appendix B details the calculation performed.

3.1 Comparison by Broad Occupancy Classifications

The United States Fire Administration (USFA) fire experience statistics [ ] classify property type or occupancy into four broad categories: residential property, non-residential structures, mobile property (not used as a residence), and outside property. Table 3-1 shows 1976-78 breakdowns of fire losses in six nations according to this occupancy classification. Numbers of fires, numbers of fire deaths, and monetary loss due to fire are estimated for each occupancy. Per capita rates are also computed. Dashes in the table reflect values not available from the indicated country.

Results in Table 3-1 can be evaluated from two general points of view. A first question is "What is the general role of each occupancy classification in the fire problems of the nations presented?" observations about the various occupancy classes include the following:

(CANADA, JAPAN, NETHERLANDS, NEW SOUTH WALES, UNITED KINGDOM AND UNITED STATES)

	Number	Rate [3/]	Percent [1/]	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent
RESIDENTIAL																		
FIRES (1,000's)	36.5	1.6	-	20.2	.18	22%	7.1	.52	24%	3.5	.70	10%	53.9	.96	16%	706	3.3	25%
DEATHS	599	26.3	82%	993	8.8	62%	-	-	-	33	7.3	-	694	12.4	81%	4,888	22.6	79%
DOLLAR LOSS [2/] ($1,000,000'S)	206.9	9.1	-	155.2	1.4	33%	27.2	2.0	14%	-	-	-	-	-	-	2,019	9.3	45%
NON-RESIDENTIAL STRUCTURE																		
FIRES (1,000'S)	37.5	1.6	-	19.0	.17	21%	7.1	.52	24%	2.5	.50	8%	41.8	.74	12%	317	1.5	11%
DEATHS	79	3.5	11%	197	1.7	12%	-	-	-	3	0.7	-	77	1.4	9%	533	2.5	9%
DOLLAR LOSS [2/] ($1,000,000'S)	330.7	14.5	-	299.3	2.6	65%	155.5	11.3	80%	-	-	-	-	-	-	1,937	9.0	44%
MOBILE PROPERTY																		
FIRES (1,000'S)	-	-	-	36.1	.32	40%	2.8	.20	10%	3.6	-	11%	28.1	.50	8%	500	2.3	18%
DEATHS	43	1.9	6%	114	1.0	7%	-	-	-	-	-	-	72	1.3	8%	612	2.8	10%
DOLLAR LOSS ($1,000,000'S)	-	-	-	5.6	.05	1%	9.1	0.7	5%	-	-	-	-	-	-	351	1.6	8%
OUTSIDE PROPERTY																		
FIRES (1,000'S)	-	-	-	15.8	.14	17%	12.0	.87	42%	23.2	-	71%	222.4	4.0	64%	1,301	6.0	46%
DEATHS	10	0.4	1%	293	2.6	19%	-	-	-	-	-	-	19	0.3	2%	172	0.8	2%
DOLLAR LOSS ($1,000,000'S)	-	-	-	3.6	.03	1%	2.9	0.2	1%	-	-	-	-	-	-	130	.6	3%
TOTAL																		
FIRES (1,000'S)	-	-	-	9.19	.81	100%	29.0	2.11	100%	32.8	-	100%	346.2	6.2	100%	2,824	13.1	100%
DEATHS	731[4/]	32.1	100%	1,597	14.1	100%	73	5.3	100%	-	-	-	862	15.4	100%	6,205	28.7	100%
DOLLAR LOSS ($1,000,000'S)	-	-	-	463.7	4.1	100%	194.7	14.2	100%	-	-	-	-	-	-	4,437	20.5	100%

1/ Percents shown are formed from the ratio of number in property type divided by number in total, multiplied by 100.

2/ Monetary values are in terms of 1977 United States dollars.

3/ Rate shown is fires/thousand persons, deaths/millions persons, dollar loss/person.

4/ Values scaled to match averaged WHO data for years available since 1975.

5/ Years shown pertain to fires and losses only. All losses in 1977 United States dollars.

- Residential Fires. Overall, residential fires contribute only approximately 20% of the fire incidence in the countries reflected in Table 3-1. However, residential fires lead to approximately three quarters of all fire fatalities. Values in Table 3-1 vary widely in the fraction of monetary loss to residential fires.
- Non-residential Structures. The number of non-residential structure fires appears also to be a moderate 20% to 25% of all fires in most countries. However, those fires account for a large part of the monetary loss. In the United States, residential and non-residential monetary losses are approximately equal, and in Japan and The Netherlands non-residential losses are much greater. In contrast, non-residential structures account for relatively small numbers of fire fatalities--approximately 10% in the countries considered.
- Mobile and Outside Property. As already noted above, reporting of vehicle and outdoor fires varies substantially from country to country. However, results in Table 3-1 show a consistent pattern of more than half of all fire incidence taking place in vehicles or out of doors. Much smaller proportions of the numbers of fire fatalities and monetary fire loss are attributed to such fires.

A second way of analyzing the results in Table 3-1 is to ask "How does the mix of fire loss in different occupancies for the United States differ from that of other countries?" As with the earlier analyses in Selected International Comparisons of Fire Losses [ ], the most important observation of this type apparent in Table 3-1 is that residential fires seem to be a more important component of the United States' fire problem than they are for other countries. More specifically,

- Fire Incidence. The fraction of fire incidence in the United States in residential property is more than twice that in non-residential property. For Japan, The Netherlands, the United Kingdom and Australia's New South Wales, numbers of residential and non-residential fires are much more equal.
- Deaths. The ratio of residential to non-residential fire deaths varies from 5.2 up to 9.0 for the four countries reported in Table 3-1. However, fire deaths are heavily concentrated in residential fires for all countries, and (as noted in Section 2) the United States' rate of fire deaths per capita is much higher than for the other nations except Canada.
- Monetary Loss. In the United States, the fractions of monetary fire loss due to residential and non-residential fires are nearly equal. In Japan, the non-residential loss is approximately twice the residential loss, and in The Netherlands non-residential loss is almost six times residential loss.

3.2 Residential Fires

From the discussion of the previous section, it appears that residential fires are a particular interest in explaining the relationship between the United States' fire problem and that of other developed countries. Comparable detail on such fires is available for The Netherlands, the United Kingdom, the United States, and New South Wales in Australia.

Table 3-2 presents numbers of fires and per capita rates for these countries. For all countries except The Netherlands, values are subdivided by the type of residential occupancy. Except for the United Kingdom, the information is also classified by the principal cause of the fire.

TABLE 3-2

RESIDENTIAL FIRES BY OCCUPANCY AND CAUSE

			COOKING	SMOKING	HEATING	INCENDIARY/ SUSPICIOUS	ELECTRICAL DISTRIBUTION	APPLIANCES	CHILDREN PLAYING	OPEN FLAMES, SPARKS	EXPOSURE	FLAMMABLE LIQUIDS	EXPLOSIVES FIREWORKS	AIR CONDITIONING REFRIGERATION	NATURAL	GAS	OTHER	UNKNOWN CAUSE	TOTAL	PERC OF A RESIDE
E AND O MILY	UNITED STATES	-No.	91833	42389	128386	54750	49445	43556	34166	24139	15332	6473	-	-	8223	584	37667	52522	589465	
		-Rate	42.5	19.6	59.3	25.3	22.9	20.1	15.8	11.2	7.1	3.1	-	-	3.8	0.3	17.4	24.3	272.5	
	NEW SOUTH WALES	-No.	677	180	356	86	280	193	81	102	15	82	6	76	10	38	30	355	2557	
		-Rate	13.5	3.6	7.2	1.7	5.7	3.9	1.6	2.1	0.3	1.7	0.1	1.5	0.2	0.8	0.6	7.2	51.6	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35444	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63.5	
ARTMENTS, NEMENTS AND FLATS	UNITED STATES	-No.	33698	25521	8456	18998	6523	7630	7630	5125	4158	1246	-	-	699	140	8876	10554	139254	
		-Rate	15.6	11.8	3.9	8.8	3.0	3.5	3.5	2.4	1.9	0.6	-	-	0.3	0.1	4.1	4.9	64.4	
	NEW SOUTH WALES	-No.	306	129	71	22	66	50	22	5	3	6	1	16	-	3	9	59	768	
		-Rate	6.2	2.6	1.4	0.4	1.3	1.0	0.4	0.1	0.06	0.1	0.02	0.3	-	0.06	0.2	1.2	15.5	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14705	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.3	
BILE HES	UNITED STATES	-No.	3642	1848	5771	1960	4370	2046	785	951	1009	195	-	-	224	57	1206	3592	27656	
		-Rate	1.7	0.9	2.7	0.9	2.0	1.0	0.4	0.4	0.5	0.09	-	-	0.1	0.02	0.6	1.7	12.8	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	80	92	177	37	-	63	30	-	35	1	-	4	149	192	292	1148	
		-Rate	-	0.14	0.16	0.3	0.07	-	0.1	0.05	-	0.06	0.002	-	0.007	0.3	0.3	0.5	2.01	
TELS, TELS, NS	UNITED STATES	-No.	1065	5110	952	2212	909	700	140	406	154	98	-	-	98	-	854	1249	13947	
		-Rate	0.5	2.4	0.4	1.0	0.4	0.3	0.3	0.2	0.1	0.04	-	-	0.04	-	0.4	0.6	6.4	
	NEW SOUTH WALES	-No.	19	54	14	1	17	14	2	3	-	3	1	1	-	2	6	21	160	
		-Rate	0.4	1.1	0.3	.02	0.3	0.3	0.04	0.1	-	0.06	0.02	0.02	-	0.04	0.1	0.4	3.2	
	UNITED KINGDOM	-No.	369	342	186	193	166	31	34	51	-	20	1	13	7	34	88	162	1697	
		-Rate	0.7	0.6	0.3	0.3	0.3	0.06	0.06	0.09	-	0.04	0.002	0.02	0.01	0.06	0.2	0.3	3	
HER SIDENTIAL	UNITED STATES	-No.	1644	1316	2781	2182	807	732	612	763	179	90	-	-	105	15	553	2573	14352	
		-Rate	0.8	0.6	1.3	1.0	0.4	0.3	0.3	0.3	0.1	0.04	-	-	0.04	0.01	0.3	1.2	6.6	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	931	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	
TAL SIDENTIAL	UNITED STATES	-No.	131882	76184	146346	80102	62054	54664	43333	31384	20832	8102	-	-	9349	796	49156	70490	784674	1
		-Rate	61.0	35.2	67.6	37	28.7	25.3	20	14.5	9.6	3.7	-	-	4.3	0.4	22.7	32.6	362.7	
		-Percent	16.8%	9.7%	18.7%	10.2%	7.9%	7%	5.5%	4%	2.7%	1%	-	-	1.2%	0.1%	6.3%	9%	100%	
	NEW SOUTH WALES	-No.	992	363	441	109	363	257	105	112	18	91	8	93	10	43	45	435	3485	1
		-Rate	20.0	7.3	8.9	2.2	7.3	5.2	2.1	2.3	0.4	1.8	0.2	1.9	0.2	0.9	0.9	8.8	70.3	
		-Percent	28.5%	10.4%	12.7%	3.1%	10.4%	7.4%	3%	3.2%	0.5%	2.6%	0.2%	2.7%	0.3%	1.2%	1.3%	12.5%	100%	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53925	1
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96.5	
		-Percent	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100%	
	NETHERLANDS	-No.	1160	247	985	339	292	178	1320	294	6	306	78	-	28	5	302	1519	7059	1
		-Rate	8.4	1.8	7.2	2.5	2.1	1.3	9.6	2.1	0.04	2.2	0.6	-	0.2	0.04	2.2	11.0	51.2	
		-Percent	16.4%	3.5%	14.0%	4.8%	4.1%	2.5%	18.7%	4.2%	0.1%	4.3%	1.1%	-	0.4%	0.1%	4.3%	21.5%	100.0%	

Turning first to the cause classifications, the following points are indicated:

- Cooking Fires. Cooking fires are the first or second most important known cause of residential fires in the three countries for which data is available. However, the United States' per capita rate is three times that of New South Wales and seven times that of The Netherlands.
- Smoking Fires. Smoking fires cause approximately the same fraction of residential fires in the United States and New South Wales, but only one third that of The Netherlands.
- Heating Fires. Heating fires are ranked as the most important cause of residential fires in the United States, the second highest in New South Wales, and the third highest in The Netherlands.
- Incendiary/Suspicious Fires. Incendiary and suspicious fires are a significant cause of residential fires only in the United States.
- Children Playing Fires. Children playing fires form only 5.5% of the cause for the United States fires and 3% for New South Wales, but 18.7% for The Netherlands. In fact, such fires are the leading reported cause of residential fires in The Netherlands. However, it is possible that the high Dutch value merely reflects the use of the children playing category as a substitute for unknown cause. Such misclassification is known to occur in some data [ ].

Notwithstanding the differences between categories noted above, the most important observation that can be drawn from Table 3-2 is that in almost every category the per capita rate of residential fire incidence in the United States is significantly higher than the other countries reported. This disparity suggests that the difference between the United States and other developed countries in per capita fire incidence will only be reduced if the elements of residential fire can be restricted. These include more rigorous home construction codes to retard the spread of fires, and greater public awareness of the need for home fire safety.

3.3 Non-residential Structure Fires

Table 3-3 presents a detailed cause versus occupancy analysis of fires in non-residential structures in the United States, New South Wales, the United Kingdom and The Netherlands. As with Table 3-2, results in Table 3-3 should be treated with some caution because of numerous problems in defining categories. However, the results do offer some useful insights:

- Data for all four countries show that stores and offices and manufacturing properties are the sites of many non-residential fires. Stores and offices account for approximately 20% to 30% of non-residential fires in each of the four countries; manufacturing properties account for an additional 10% to 20%.
- Results for public assembly properties (theatres, restaurants, auditoriums, etc.) show some variation among the countries. Eight to nine percent of non-residential fires in the United States and the United Kingdom are classified in this category, but 15.7% of New South Wales fires and 30.2% of The Netherlands fires occur in public assembly property.
- Storage fires in the United States and vacant/construction fires in New South Wales also represent unusually high percentages of the total for non-residential fires. However, it is quite possible that these apparent disparities are a consequence of data gathering

TABLE 3-3

NON-RESIDENTIAL STRUCTURE FIRES BY OCCUPANCY AND CAUSE

			COOKING	SMOKING	HEATING	INCENDIARY SUSPICIOUS	ELECTRICAL DISTRIBUTION	APPLIANCES	CHILDREN PLAYING	OPEN FLAMES, SPARKS	EXPOSURE
PUBLIC ASSEMBLY	UNITED STATES	-No.	9138	2332	2403	6727	3508	1547	323	863	656
		-Rate	4.2	1.1	1.1	3.1	1.6	0.7	0.1	0.4	0.3
	NEW SOUTH WALES	-No.	132	28	9	33	47	6	13	4	5
		-Rate	2.7	0.6	0.2	0.7	0.9	0.1	0.3	0.08	0.1
	UNITED KINGDOM	-No.	1128	417	242	497	426	14	228	97	-
		-Rate	2	0.7	0.4	0.9	0.8	0.03	0.4	0.2	-
	NETHERLANDS	-No.	135	71	53	101	59	9	705	63	2
		-Rate	1	0.5	0.4	0.7	0.4	0.07	5.1	0.5	0.01
EDUCATION	UNITED STATES	-No.	632	914	914	11316	1328	632	740	608	239
		-Rate	0.3	0.4	0.4	5.2	0.6	0.3	0.3	0.3	0.1
	NEW SOUTH WALES	-No.	5	6	9	25	6	1	9	1	-
		-Rate	0.1	0.1	0.2	0.5	0.1	0.02	0.2	0.02	-
	UNITED KINGDOM	-No.	107	113	147	645	114	4	210	43	-
		-Rate	0.2	0.2	0.3	1.2	0.2	0.007	0.4	0.08	-
	NETHERLANDS	-No.	15	43	14	67	13	2	91	5	1
		-Rate	0.1	0.3	0.1	0.5	0.1	0.01	0.7	0.04	0.01
INSTITUTIONS	UNITED STATES	-No.	1942	7327	909	7514	2504	3476	250	2349	95
		-Rate	0.9	3.4	0.4	3.5	1.2	1.6	0.1	1.1	0.04
	NEW SOUTH WALES	-No.	17	37	7	7	17	11	4	6	-
		-Rate	0.3	0.7	0.1	0.1	0.3	0.2	0.08	0.1	-
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	19	29	14	38	15	14	28	4	-
		-Rate	0.1	0.2	0.1	0.3	0.1	0.1	0.2	0.3	-
STORES AND OFFICES	UNITED STATES	-No.	2036	5745	6031	12943	14396	7781	798	3560	3268
		-Rate	0.9	2.7	2.8	6	6.7	3.6	0.4	1.6	1.5
	NEW SOUTH WALES	-No.	23	75	19	41	106	15	9	3	5
		-Rate	0.5	1.5	0.4	0.8	0.8	0.3	0.2	0.06	0.1
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	37	39	51	78	103	16	681	128	2
		-Rate	0.3	0.3	0.4	0.6	0.7	0.1	4.9	0.9	0.04
BASIC INDUSTRY	UNITED STATES	-No.	137	229	1008	837	3104	424	149	847	332
		-Rate	0.06	0.1	0.5	0.4	1.4	0.2	0.07	0.4	0.2
	NEW SOUTH WALES	-No.	3	7	11	5	37	4	2	4	3
		-Rate	0.06	0.1	0.2	0.1	0.7	0.08	0.04	0.08	0.06
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	8	6	47	32	37	9	55	42	3
		-Rate	0.1	0.04	0.3	0.2	0.3	0.1	0.4	0.3	0.02
MANUFACTURING	UNITED STATES	-No.	1283	1873	3749	3649	4243	2711	594	4190	1480
		-Rate	0.6	0.9	1.7	1.7	2	1.3	0.3	1.9	0.7
	NEW SOUTH WALES	-No.	14	18	19	17	47	6	1	16	5
		-Rate	0.3	0.4	0.4	0.3	0.9	0.1	0.02	0.3	0.1
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	10	18	24	21	33	43	17	65	6
		-Rate	0.07	0.1	0.2	0.2	0.2	0.3	0.1	0.5	0.04
STORAGE	UNITED STATES	-No.	392	2704	3700	16870	4643	1000	6468	5404	5880
		-Rate	0.2	1.5	1.7	7.8	2.1	0.5	3	2.5	2.7
	NEW SOUTH WALES	-No.	1	17	6	11	21	2	3	2	3
		-Rate	0.02	0.3	0.1	0.2	0.4	0.04	0.06	0.04	0.06
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	1	3	3	16	4	2	42	1	-
		-Rate	0.01	0.02	0.02	0.1	0.02	0.01	0.3	0.01	-
VACANT CONSTRUCTION	UNITED STATES	-No.	51	661	458	15132	433	76	1755	1907	688
		-Rate	0.02	0.3	0.2	7	0.2	0.04	0.8	0.9	0.3
	NEW SOUTH WALES	-No.	3	66	8	30	24	8	81	1	79
		-Rate	0.06	1.3	0.2	0.6	0.5	0.2	1.6	0.02	1.6
	UNITED KINGDOM	-No.	72	113	109	269	46	2	168	70	-
		-Rate	0.13	0.2	0.2	0.5	0.08	0.004	0.3	0.12	-
	NETHERLANDS	-No.	-	4	6	3	2	2	5	4	-
		-Rate	-	0.02	0.04	0.02	0.01	0.01	0.04	0.03	-
OTHER	UNITED STATES	-No.	2549	2839	4701	9598	3035	1764	3132	3133	3329
		-Rate	1.2	1.3	2.2	4.4	1.4	0.8	1.4	1.4	1.5
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	4	52	4	73	33	3	260	3	11
		-Rate	0.02	0.4	0.02	0.5	0.2	0.02	1.9	0.02	0.08
TOTAL NONRESIDENTIAL	UNITED STATES	-No.	18160	24624	23873	84586	37194	19411	14209	22861	15967
		-Rate	8.4	11.4	11	39.1	17.2	8.8	6.6	10.6	7.4
		-Percent	4.8%	6.4%	6.3%	22.2%	9.7%	5.1%	3.7%	6%	4.2%
	NEW SOUTH WALES	-No.	198	254	88	169	305	53	122	37	100
		-Rate	4	5.1	1.8	3.4	6.2	1.1	2.5	0.7	2
		-Percent	7.9%	10.2%	3.5%	6.8%	12.2%	2.1%	4.9%	1.5%	4%
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-
		-Percent	-	-	-	-	-	-	-	-	-
	NETHERLANDS	-No.	229	265	216	429	299	100	1884	315	25
		-Rate	1.7	1.9	1.6	3.1	2.2	0.7	13.7	2.3	0.2
		-Percent	3.2%	3.7%	3.1%	6.0%	4.2%	1.4%	26.5%	4.5%	0.4%

TABLE 3-3

(CONTINUED)

			FLAMMABLE LIQUIDS	EXPLOSIVES FIREWORKS	AIR CONDITIONING REFRIGERATION	NATURAL	GAS	OTHER	UNKNOWN CAUSE	TOTAL	PERCENT OF ALL RESIDENTIAL STRUCTURES
PUBLIC ASSEMBLY	UNITED STATES	-No.	600	-	-	373	46	2307	2762	33585	8.8%
		-Rate	0.3	-	-	0.2	0.02	1.1	1.3	15.5	
	NEW SOUTH WALES	-No.	19	3	2	2	4	17	67	391	15.7%
		-Rate	0.4	0.06	0.04	0.04	0.08	0.3	1.3	7.9	
	UNITED KINGDOM	-No.	30	8	39	48	76	152	443	3845	9.2%
		-Rate	0.05	0.01	0.07	0.09	0.1	0.3	0.8	6.9	
	NETHERLANDS	-No.	65	20	-	8	2	79	771	2143	30.2%
		-Rate	0.5	0.1	-	0.06	0.01	0.6	5.6	15.6	
EDUCATION	UNITED STATES	-No.	544	-	-	284	22	1982	1976	22131	2.8%
		-Rate	0.3	-	-	0.1	0.01	0.9	0.9	10.2	
	NEW SOUTH WALES	-No.	6	2	1	1	5	5	27	109	4.4%
		-Rate	0.1	0.04	0.02	0.02	0.1	0.1	0.5	2.2	
	UNITED KINGDOM	-No.	27	5	2	21	57	70	205	1770	4.2%
		-Rate	0.04	0.009	0.004	0.04	0.1	0.1	0.4	3.2	
	NETHERLANDS	-No.	21	13	-	5	1	9	72	372	5.2%
		-Rate	0.2	0.09	-	0.04	0.01	0.07	0.5	2.7	
INSTITUTIONS	UNITED STATES	-No.	63	-	-	158	-	2128	2409	31124	8.2%
		-Rate	0.03	-	-	0.07	-	1	1.1	14.4	
	NEW SOUTH WALES	-No.	5	-	2	-	4	14	8	139	5.6%
		-Rate	0.1	-	0.04	-	0.08	0.3	0.2	2.8	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	2747	6.6%
		-Rate	-	-	-	-	-	-	-	4.9	
	NETHERLANDS	-No.	17	2	-	2	3	16	53	254	3.6%
		-Rate	0.1	0.01	-	0.01	0.02	0.1	0.4	1.8	
STORES AND OFFICES	UNITED STATES	-No.	1239	-	-	1161	71	7120	7003	73152	19.2%
		-Rate	0.6	-	-	0.5	0.03	3.3	3.2	33.8	
	NEW SOUTH WALES	-No.	36	3	9	1	43	32	84	504	20.2%
		-Rate	0.7	0.06	0.2	0.06	0.8	0.6	1.7	10.2	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	8725	20.9%
		-Rate	-	-	-	-	-	-	-	15.6	
	NETHERLANDS	-No.	84	17	-	8	3	145	655	2048	28.8%
		-Rate	0.6	0.1	-	0.06	0.02	1.1	4.8	14.9	
BASIC INDUSTRY	UNITED STATES	-No.	57	-	-	618	-	2200	1362	11304	3%
		-Rate	0.02	-	-	0.3	-	1	0.6	5.2	
	NEW SOUTH WALES	-No.	15	2	2	11	17	37	26	186	7.4%
		-Rate	0.3	0.04	0.04	0.2	0.3	0.7	0.5	3.6	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	4818	11.5%
		-Rate	-	-	-	-	-	-	-	8.6	
	NETHERLANDS	-No.	35	4	0	35	0	24	179	516	7.3%
		-Rate	0.3	0.03	0.0	0.3	0.0	0.2	1.3	3.7	
MANUFACTURING	UNITED STATES	-No.	244	-	-	2615	-	17167	5020	48818	12.8%
		-Rate	0.1	-	-	1.2	-	7.9	2.3	22.6	
	NEW SOUTH WALES	-No.	35	-	-	9	60	114	87	448	17.9%
		-Rate	0.7	-	-	0.2	1.2	2.3	1.7	9	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	7363	17.6%
		-Rate	-	-	-	-	-	-	-	13.2	
	NETHERLANDS	-No.	125	2	-	25	20	121	205	735	10.4%
		-Rate	0.9	0.01	-	0.2	0.1	0.9	1.5	5.3	
STORAGE	UNITED STATES	-No.	1203	-	-	2582	106	7387	11265	69604	18.2%
		-Rate	0.6	-	-	1.2	0.05	3.4	5.2	32.2	
	NEW SOUTH WALES	-No.	5	-	-	3	6	12	31	123	4.9%
		-Rate	0.1	-	-	0.06	0.1	0.2	0.6	2.5	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	
	NETHERLANDS	-No.	2	2	-	2	1	5	80	164	2.3%
		-Rate	0.01	0.01	-	0.01	0.01	0.03	0.6	1.2	
VACANT CONSTRUCTION	UNITED STATES	-No.	1476	-	-	127	-	1043	2724	26531	6.9%
		-Rate	0.7	-	-	0.06	-	0.5	1.3	12.3	
	NEW SOUTH WALES	-No.	5	1	2	16	15	20	239	598	23.9%
		-Rate	0.1	0.02	0.04	0.3	0.3	0.4	4.8	12.1	
	UNITED KINGDOM	-No.	12	3	1	2	136	38	406	1447	3.5%
		-Rate	0.02	0.005	0.002	0.004	0.2	0.07	0.7	2.6	
	NETHERLANDS	-No.	7	6	-	1	-	2	23	65	0.9%
		-Rate	0.1	0.04	-	0.01	-	0.01	0.2	0.5	
OTHER	UNITED STATES	-No.	588	-	-	784	98	6172	23812	65534	17.2%
		-Rate	0.3	-	-	0.4	0.05	2.6	11	30.3	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	11085	26.5%
		-Rate	-	-	-	-	-	-	-	19.8	
	NETHERLANDS	-No.	58	2	-	56	1	28	217	805	11.3%
		-Rate	0.4	0.04	-	0.4	0.01	0.2	1.6	5.8	
TOTAL NONRESIDENTIAL	UNITED STATES	-No.	6014	-	-	8702	343	47506	58333	381783	100.0%
		-Rate	2.8	-	-	4	0.2	22	27	176.5	
		-Percent	1.6%	-	-	2.3%	0.1%	12.4%	15.3%	100%	
	NEW SOUTH WALES	-No.	126	11	18	43	154	251	569	2498	100.0%
		-Rate	2.5	0.2	0.4	0.9	3.1	5.1	11.5	50.4	
		-Percent	5%	0.4%	0.7%	1.7%	6.2%	10%	22.8%	100%	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	41801	100.0%
		-Rate	-	-	-	-	-	-	-	74.8	
		-Percent	-	-	-	-	-	-	-	100%	
	NETHERLANDS	-No.	414	68	-	142	31	429	2255	7101	100.0%
		-Rate	3.0	0.5	-	1.0	0.2	3.1	16.4	51.6	
		-Percent	5.8%	1.0%	-	2.0%	0.4%	6.0%	31.8%	100.0%	

and classification procedures. Storage facility fires are sometimes classified as building fires and at other times designated as outside fires. Fires in vacant buildings and buildings under construction are often reported on short data forms [ ]. This relatively smaller paper workload on fire officials sometimes biases data toward the vacant/construction category.

Some useful insights can also be obtained by comparing the cause summary at the end of Table 3-3:

- Incendiary and suspicious fires appear to contribute a greater fraction of non-residential fires in the United States than in the other two countries for which data is available. Values in Table 3-3 show that 22.2% of United States' non-residential fires are attributed to this cause while only 6% to 7% of those in New South Wales and The Netherlands are classified incendiary and suspicious. This fact supports the theory that arson is a significant factor in the relatively greater fire incidence in the United States.
- For New South Wales, the most significant cause of non-residential fires is apparently electrical distribution systems. The fraction attributed to this cause in the United States is slightly lower, although the per capita rate of such fires in the United States is still two to three times that of New South Wales.
- A large percentage, 26.5%, of Netherlands' non-residential fires are attributed to children playing. Again, it is possible that this fact reflects variations in classification systems. Under some reporting procedures, children playing becomes a miscellaneous category when a specific cause cannot be determined.

With the exceptions of the unusual items noted above, the detailed analysis of Figure 3-3 fairly closely follows the more aggregate behavior of earlier tables. Reported fire incidence in the United States is two to three times that of the other three countries reported.

3.4 Mobile and Outside Fires

Tables 3-4 and 3-5 report the breakdowns that are available for fires in mobile property and in outside structures. The pattern presented for mobile fires parallels that of earlier tables. The per capita United States rate is one and one half to four times that of the United Kingdom and The Netherlands. However, the per capita number of vehicles is also higher in the United States. Using world vehicle registration counts available from the Motor Vehicle Manufacturers Association of the United States [ ], the mobile United States fires of Table 3-4 represent 1.28 fires per thousand registered vehicles. The comparable values for the United Kingdom and The Netherlands are 1.73 and 0.69 respectively. Thus, if the greater number of vehicles in the United States is taken into account, the number of vehicle fires in this country may be more typical than implied by per capita values.

Outside fires are unquestionably the most erratically reported of all fires accounted for in published reports. For example, United States values in Table 3-4 are known to exclude forest fires in federally owned forests. Data for the United Kingdom reflects the fact that only a brief report is collected on incident of grass or brush fires. Thus, no conclusions could appropriately be drawn from the very limited data in Table 3-4.

TABLE 3-4

MOBILE FIRES

BY OCCUPANCY CLASS [1/]

		Automobile	Other Motor Vehicles	Rail, Water, Air Trans.	Other Mobile	Total Mobile
ted States	-No.	119713	32977	5968	18689	177347
	-Rate	55.3	15.2	2.8	8.6	82
	-Percent	67.5%	18.6%	3.4%	10.5%	100%
ted Kingdom	-No.	16730	7936	917	2549	28132
	-Rate	30	14.2	1.6	4.6	50.4
	-Percent	59.5%	28.2%	3.3%	9.1%	100%
herlands	-No.	2531 [2/]	-	280	30	2841
	-Rate	18.4	-	2	0.2	20.6
	-Percent	89.1%	-	9.9%	1.1%	100%

Rates shown below numbers of fires are per 100,000 population.

All motor vehicles are grouped in Netherlands statistics.

TABLE 3-5

OUTSIDE FIRES

BY OCCUPANCY CLASS 1/

		Refuse	Trees, Grass, Brush	Forest	Crops	Other Outside	Total Outside
ted States	-No.	124737	160755	-	20078	61846	367416
	-Rate	57.7	74.3	-	9.3	28.6	169.8
	-Percent	33.9%	43.8%	-	5.5%	16.8%	100%
ted Kingdom	-No.	76299	105271	1399	1902	37536	222407
	-Rate	136.6	188.5	2.5	3.4	67.2	398.2
	-Percent	34.3%	47.3%	0.6%	0.9%	16.9%	100%
herlands	-No.	667	863	1125	81	9275	12011
	-Rate	4.8	6.3	8.2	0.6	67.4	87.2
	-Percent	5.5%	7.2%	9.4%	0.7%	77.2%	100%

Rates shown below numbers of fires are per 100,000 population

4. FATALITY PATTERNS

The statistics on deaths due to "Fire and Flames" accidents available from the World Health Organization (WHO) make it possible to compare fire fatality patterns in many developed countries. Table 4-1 shows the rates per million population of WHO fire fatalities by sex and by age grouping of the victim. Figures 4-1 and 4-2 plot the 1975-77 values of Table 4-1 versus the 1972-74 data of Appendix Table A-3.

Turning first to the sex classification of Figure 4-1, it is apparent that the rate of fire fatalities is greater for males than for females in most nations. Of the seventeen countries considered, only Ireland and the United Kingdom were exceptions in the 1975-77 time period.

Figure 4-2 confirms the widely held view that fire fatalities fall heavily on the very young and the very old. For 1975-77 the United States per million fire fatality rate for infants 0 to 4 years old was 1.6 times the overall rate, and that of persons over 65 was 2.7 times the average. Similar concentrations were observed in many other countries. However, several of the countries (Austria, Denmark, Finland, New Zealand and Switzerland) have apparently escaped extraordinary fire death rates for infants.

As with other results of this report, the clearest observation in Figures 4-1 and 4-2 is the consistently poor ranking of the United States. Per million fatality rates are often higher in Canada than in the United States, and values are also high for Ireland. However, the United States has a higher reported fire fatality rate than any of the other fourteen countries in each of the age and sex categories shown in the figures. The one exception is the over 65 age group in Japan. That concentration of

TABLE 4-1

DEATHRATES BY AGE AND SEX, 1975-77 [1/]

		0-4	5-14	15-24	25-44	45-64	65+	Total
Australia	Male	44	14	22	20	30	50	26
	Female	26	5	4	4	10	30	9
	Total	35	10	13	12	20	38	18
Austria	Male	7	1	3	6	12	37	10
	Female	6	1	1	3	5	33	8
	Total	6	1	2	4	8	36	9
Belgium	Male	53	9	12	8	11	26	15
	Female	16	3	8	6	11	24	11
	Total	35	6	10	7	11	25	13
Canada	Male	44	19	24	34	52	125	40
	Female	48	17	15	14	26	60	24
	Total	46	18	19	24	39	87	32
Denmark	Male	9	5	14	12	12	37	14
	Female	2	1	3	5	9	34	9
	Total	6	3	8	8	11	35	12
Finland	Male	6	3	10	25	59	71	28
	Female	0	3	5	2	9	32	8
	Total	3	3	7	14	32	46	17
France	Male	22	4	10	13	19	48	17
	Female	20	4	3	6	8	42	13
	Total	21	4	7	9	13	44	15
Ireland	Male	53	3	7	5	17	103	22
	Female	25	3	4	9	6	167	27
	Total	39	3	6	7	11	133	24
Japan	Male	18	6	6	8	18	115	17
	Female	14	4	4	4	6	66	11
	Total	16	5	5	5	12	87	14
Netherlands	Male	13	2	3	4	6	27	7
	Female	8	2	1	3	4	10	4
	Total	11	2	2	3	5	17	5
New Zealand	Male	10	2	5	6	26	55	13
	Female	17	11	0	6	10	38	13
	Total	13	7	3	6	18	57	13
Norway	Male	26	0	7	16	29	62	22
	Female	9	3	3	2	7	28	9
	Total	18	1	6	10	18	43	15
Sweden	Male	19	5	13	17	32	49	21
	Female	9	3	4	5	10	25	9
	Total	14	5	8	11	21	31	15
Switzerland	Male	1	5	1	4	6	25	7
	Female	3	5	3	1	6	14	5
	Total	2	5	2	3	6	19	6
United Kingdom	Male	21	6	5	7	14	55	15
	Female	23	5	5	5	11	57	16
	Total	22	6	5	6	12	56	15
United States	Male	53	18	18	26	45	104	36
	Female	42	14	9	10	23	59	22
	Total	45	16	14	17	36	78	29
West Germany	Male	16	3	6	9	12	31	12
	Female	10	2	3	3	8	18	7
	Total	13	3	4	6	10	23	9

[1/] Rates are per million population

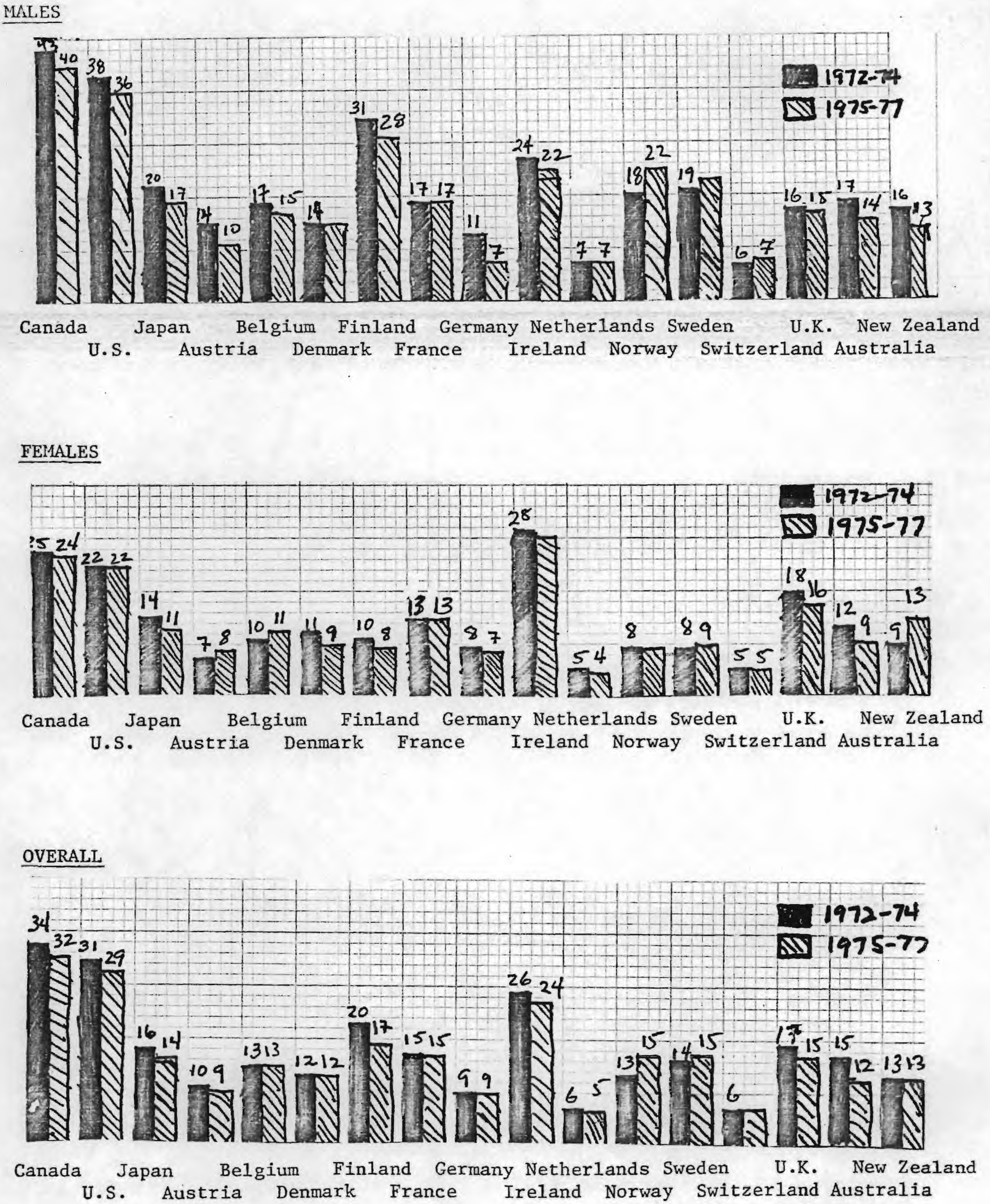
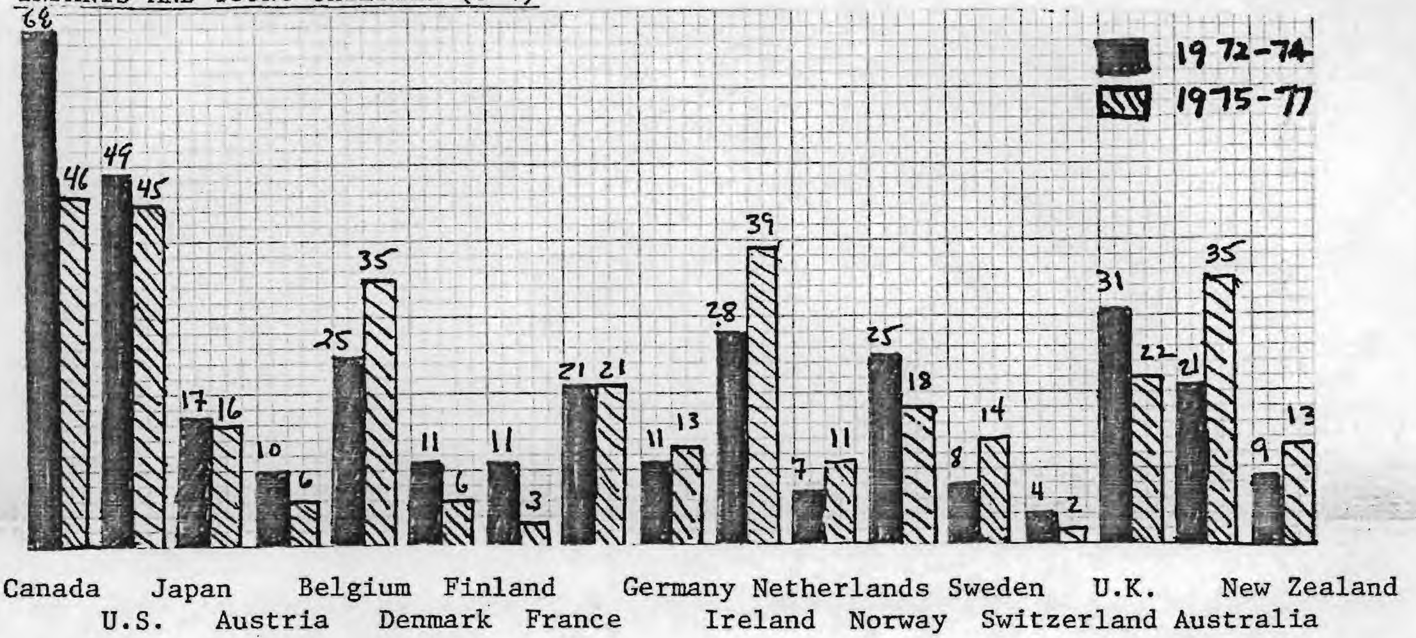
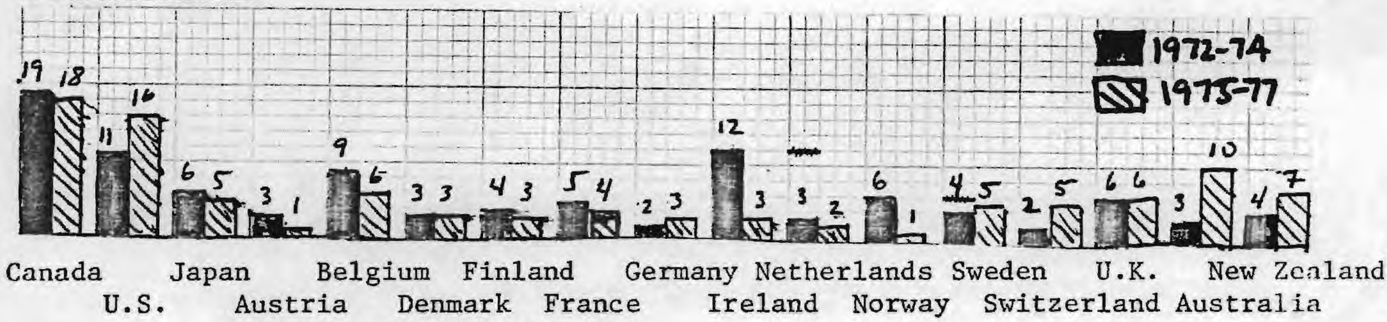


FIGURE 4-1: COMPARISON OF 1972-74 AND 1975-77 FIRE DEATH RATES (PER MILLION POPULATION) BY SEX

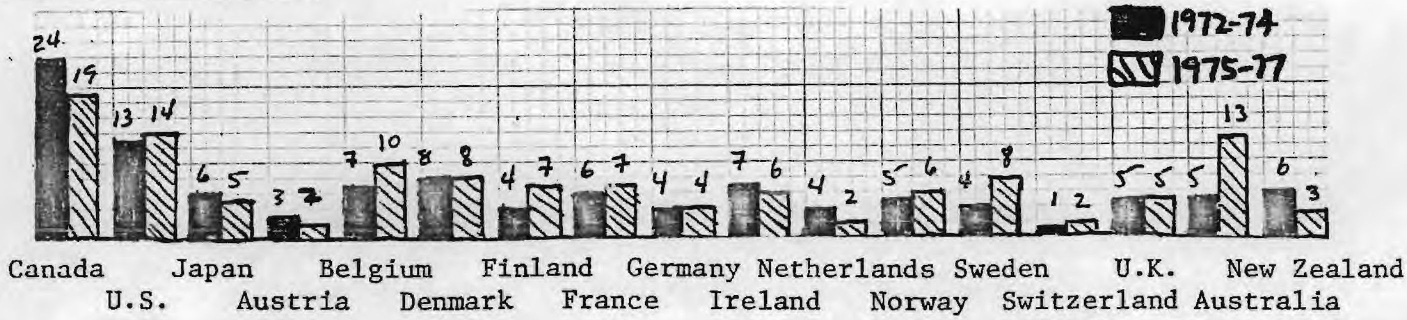
INFANTS AND YOUNG CHILDREN (0-4)



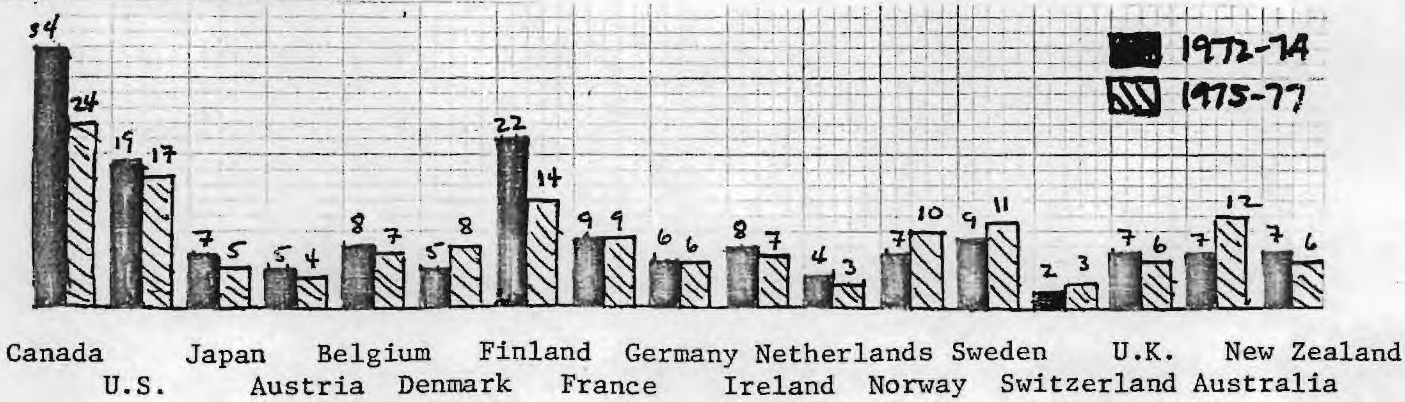
CHILDREN (5-14)



ADOLESCENTS (15-24)

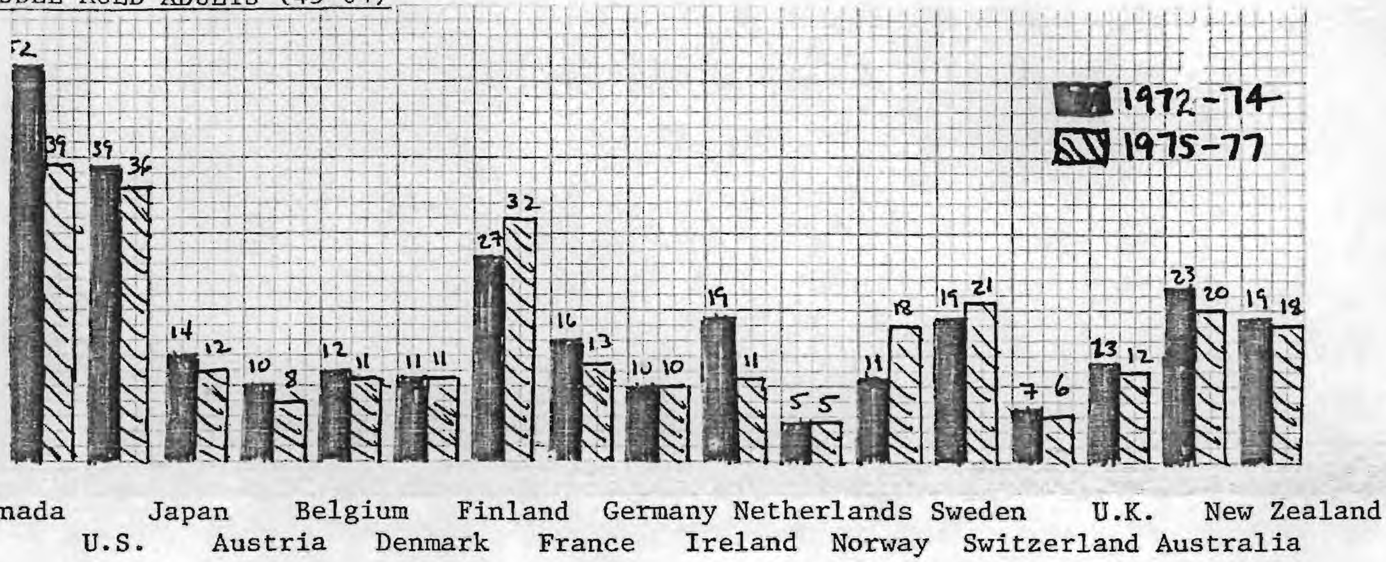


YOUNG ADULTS (25-44)



IGURE 4-2: COMPARISON OF 1972-74 AND 1975-77 FIRE DEATH RATES (PER MILLION POPULATION) BY AGE

MIDDLE AGED ADULTS (45-64)



ELDERLY (65 and over)

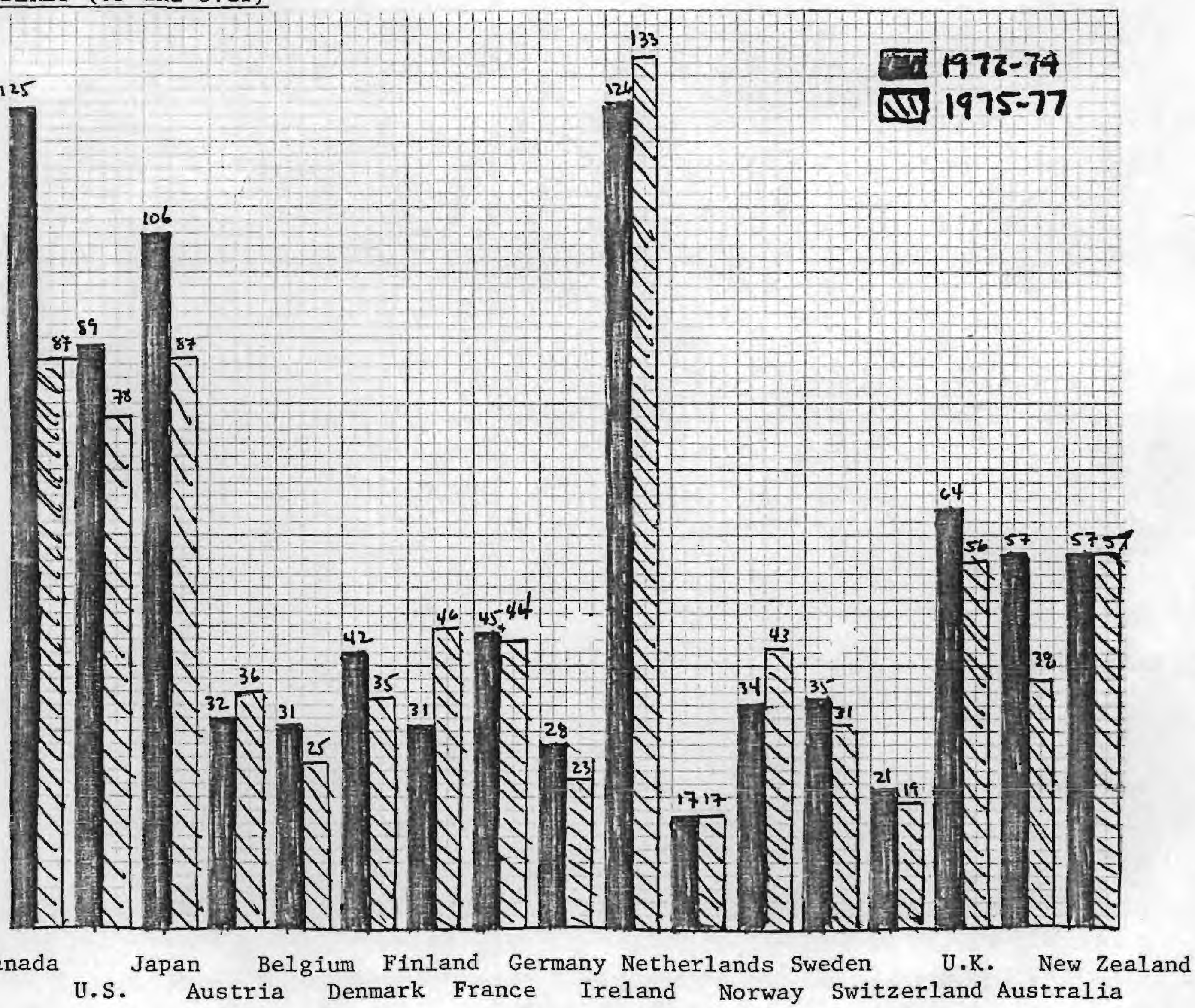


FIGURE 4-2 (CONTINUED)

fire fatalities is attributed in Japanese fire reports [ ] to suicides by fire.

5. COMPARISONS OF CITY DATA

For a number of years, the Tokyo Fire Department [ ] has collected information on the numbers of fire personnel, the number of reported fires, and the number of reported fire deaths in major cities of the world. A compilation of this world city fire loss data for 1976-78 is presented in Table 5-1. Values for United States cities are shown in Appendix Table A-4.

There is no way of knowing from the brief reports received by the Tokyo Fire Department how comparable the reported data may be. However, the average rates of fires per 10,000 population and fire deaths per million population shown in Table 5-1 mirror national experience presented in earlier sections. Figures 5-1 and 5-2 plot the average rates for non-United States cities in the survey versus those for United States cities obtained from the United States Fire Administration [ ]. Separate averages are provided for cities of over 1,000,000 persons, 500,000 to 1,000,000 persons, and 250,000 to 500,000 persons. For all three sizes of cities, and both fire incidence and fire deaths, the values in Figures 5-1 and 5-2 confirm the relatively poor standing of the United States. Particularly in the largest, Group A cities, the reported per capita fire incidence and fire fatality rate is several times that of the world cities considered.

Earlier Georgia Tech research [ ] has shown a tendency for United States cities to have larger professional fire services than world cities of comparable population. Figure 5-3 confirms this experience. That figure graphs population versus the number of fire personnel shown in Table 5-1. Separate trend lines are calculated for the United States and foreign cities. The trend line for the United States represents more than twice as many fire personnel as that for the world cities of comparable population.

TABLE 5-1

WORLD CITY FIRE LOSSES

CITY	POPULATION IN (1,000'S)	FIRE FIGHTING PERSONNEL [1/]	NUMBER OF REPORTED FIRES [1/]	NUMBER OF REPORTED FIRE DEATHS [1/]	FIRES PER 10,000 POPULATION	DEATHS PER MILLION POPULATION
Group A (over 1,000,000)						
Tokyo	11,247	16,117	7,759	146	7	13
Athens	8,769	3,618	10,976	118	13	13
London	7,083	7,310	42,077	111	59	16
New Delhi (1978)	6,500	874	3,234	63	5	10
Jakarta (1976)	5,500	2,268	522	8	1	1
Hong Kong	4,567	4,068	10,434	40	23	9
Istanbul (1976)	3,418	1,266	2,907	37	9	11
West Midlands (1977-78)	2,727	2,022	12,866	27	47	10
Greater Manchester	2,711	2,631	23,375	62	56	23
Melbourne (1976-77)	2,649	1,741	8,475	15	32	6
Manila	2,459	781	7,887	34	12	14
Singapore	2,317	821	4,048	37	17	16
Johannesburg	2,283	508	1,432	13	6	6
Berlin	2,047	3,120	6,377	29	31	14
Hamburg	1,697	2,048	4,988	10	29	6
Merseyside (1978)	1,576	176	1,887	21	12	13
Kent	1,465	1,170	5,378	22	38	15
Essex (1977-78)	1,456	1,323	6,392	17	44	12
Lancashire (1977-78)	1,348	1,689	7,819	26	58	19
Brussels (1977-78)	1,175	815	2,250	16	20	13
Montreal (1976, 1978)	1,060	2,434	6,193	43	58	39
Group A Average Rate					27.5	13.3
Comparable United States Average Rate					141.1	39.6
Group B (500,000 to 1,000,000)						
Hertfordshire (1976-77)	938	876	5,336	11	57	12
Lothian & Borders (1978)	930	1,031	6,396	26	69	28
Avon (1976, 1978)	918	836	4,678	10	51	11
Capetown	892	330	2,036	30	23	34
Amsterdam	727	784	2,637	17	36	24
Brisbane	709	724	3,488	7	50	10
Stockholm (1977-78)	656	605	5,628	29	86	44
Frankfurt (1976, 1978)	635	1,892	2,632	7	41	11
Rotterdam	600	651	2,867	7	48	12
Group B Average Rate					51.2	20.7
Comparable United States Average Rate					130.7	37.5
Group C (250,000 to 500,000)						
Helsinki (1977-78)	490	446	1,570	9	32	18
Edmonton	474	816	2,586	12	5	25
Oslo	460	473	1,366	7	30	15
Vancouver (1977-78)	410	815	2,866	13	70	32
Hamilton	312	435	2,363	14	76	45
Ottowa	306	517	3,793	8	124	26
Bonn (1976, 1978)	284	303	681	4	24	18
Group C Average Rate					51.6	25.6
Comparable United States Average Rate					136.3	35.7

1/ Average for 1976-78 unless otherwise indicated.

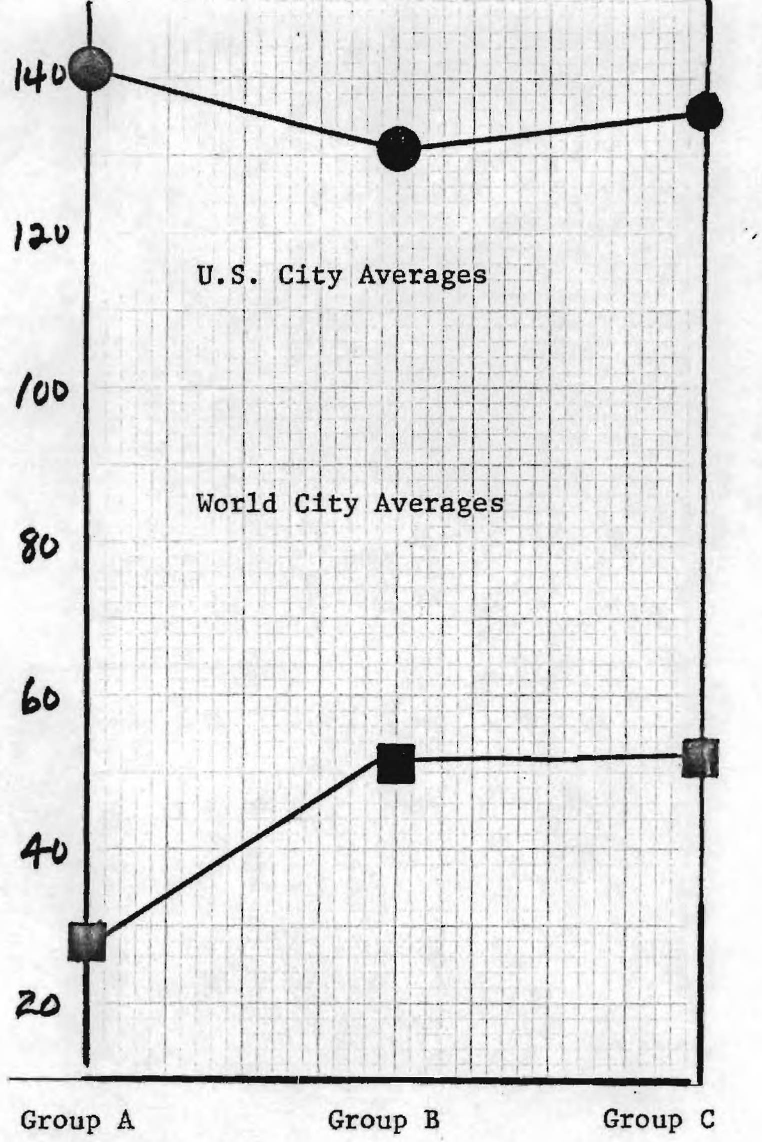


FIGURE 5-1: WORLD CITIES FIRE RATE PER 10,000 PERSONS VS. UNITED STATES CITIES

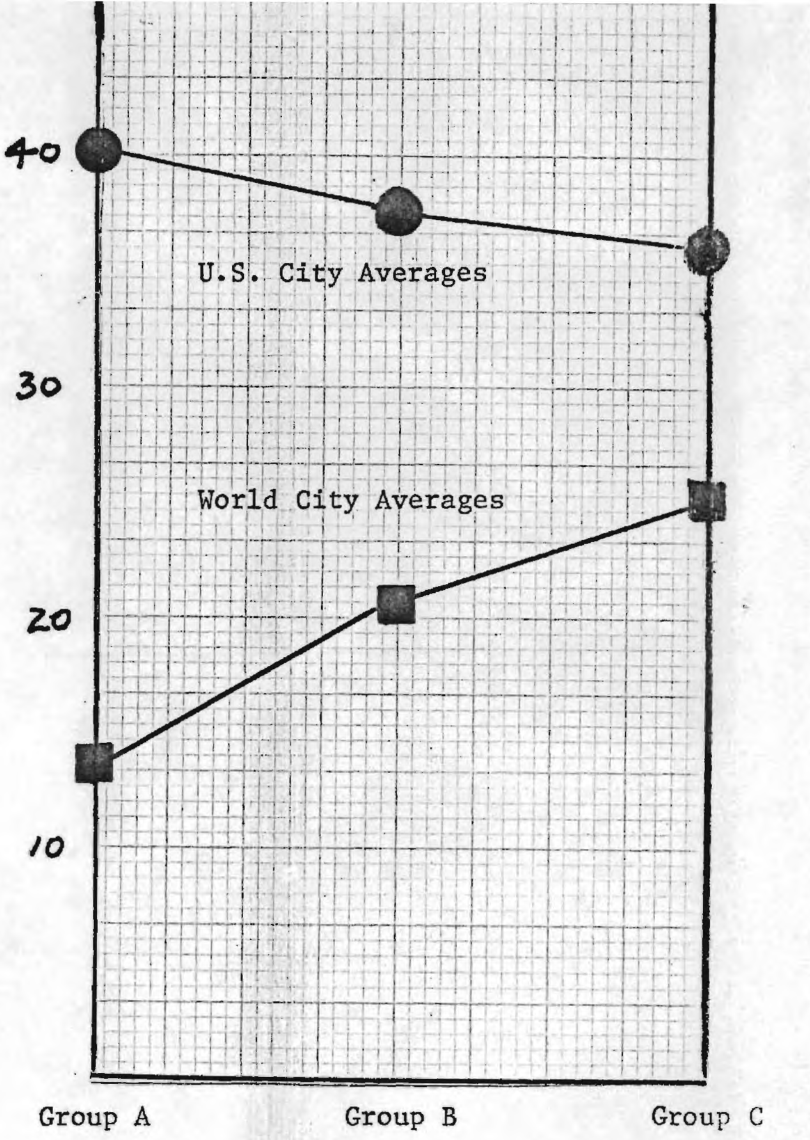
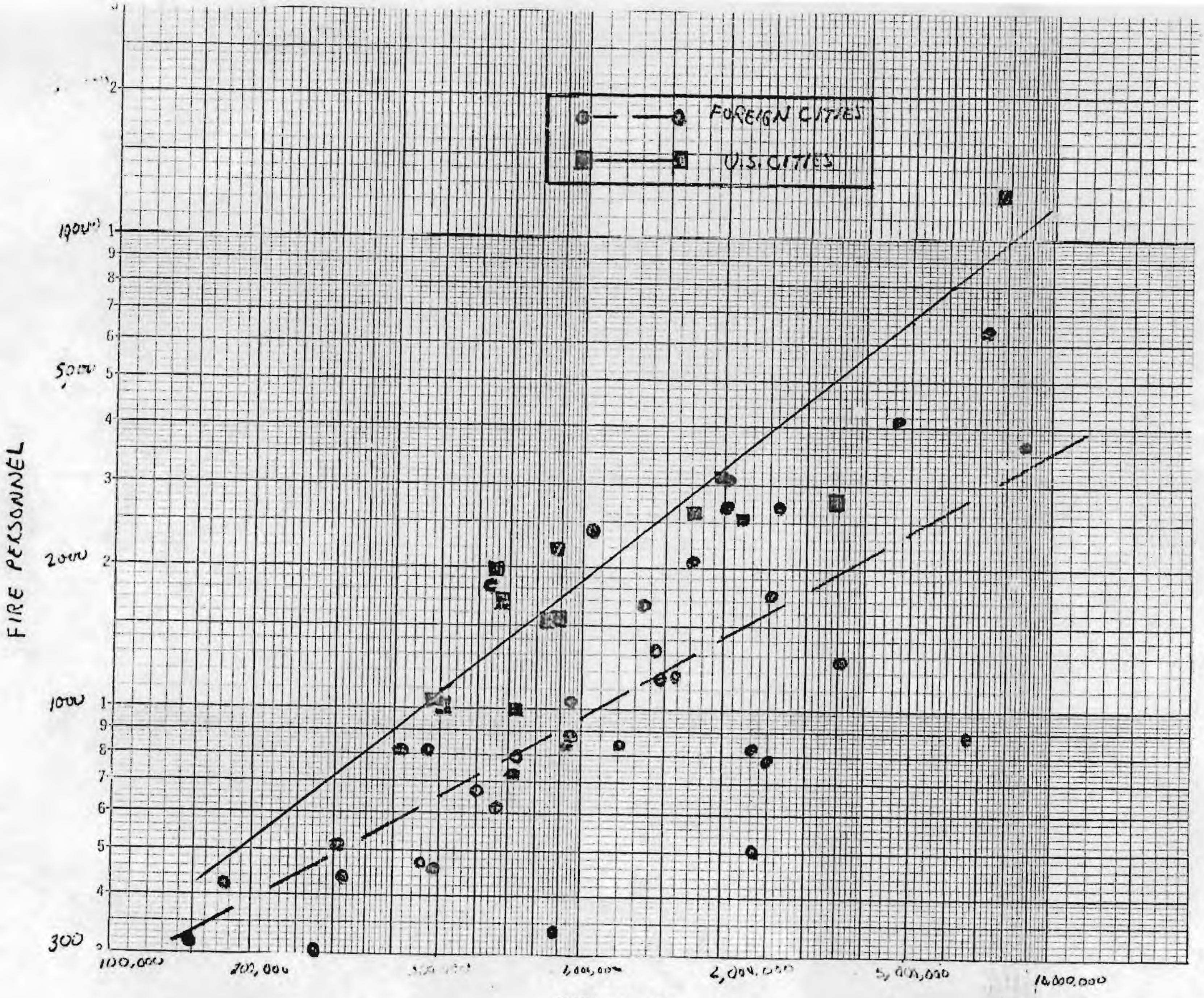


FIGURE 5-2: WORLD CITIES FIRE DEATH RATE PER 1,000,000 PERSONS VS. UNITED STATES CITIES



POPULATION

FIGURE 5-3: POPULATION VS. TOTAL FIRE PERSONNEL FOR WORLD CITIES

Figure 5-4 presents a similar analysis. Numbers of fire personnel in Table 5-1 are plotted versus the total numbers of reported fires. As with the earlier figure, separate trend lines are computed for the United States cities and foreign cities.

The latter trend lines show that fire personnel per fire in foreign cities is approximately 10% higher than the comparable value for the United States. Thus, much of the variation in per capita fire personnel shown in Figure 5-3 is apparently connected with variations in fire incidence. In the light of general findings throughout this report of relatively high fire incidence in the United States, these results suggest that the greater number of fire personnel in the United States is primarily a reflection of the greater fire problem. However, it is possible to argue for a reverse association. Greater availability of fire service in the United States cities may lead to more frequent calling of the fire service for small fire incidence and thus greater reporting of such minor incidents.

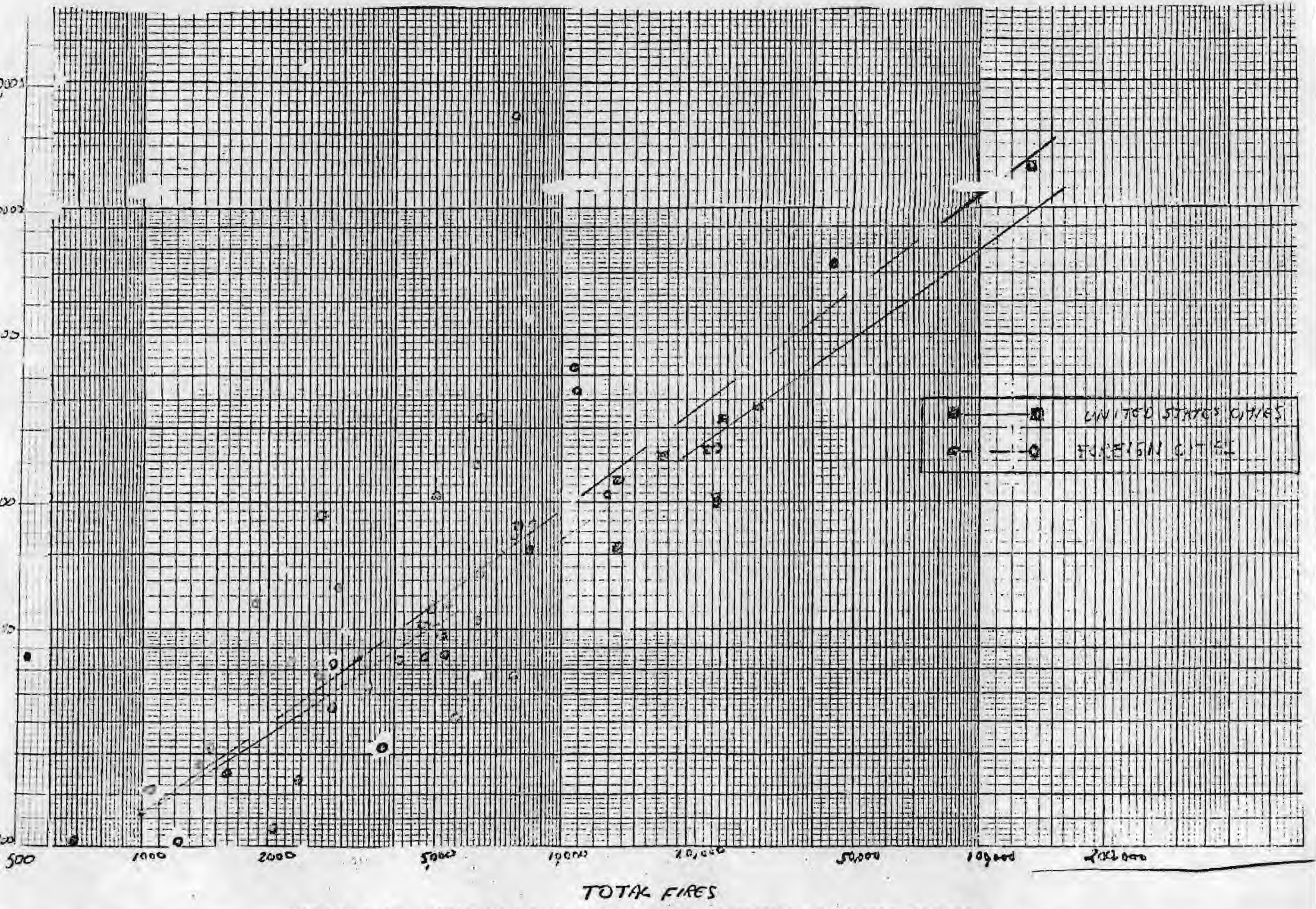


FIGURE 5-4: TOTAL FIRES VS. TOTAL FIRE PERSONNEL FOR WORLD CITIES

APPENDIX A

SUPPORTING TABLES

TABLE A-1

COMPARISON OF FIRE LOSS INDICES FOR 1965-67

COUNTRIES	BUILDING FIRES/1,000 PERSONS	$ BUILDING FIRE LOSS PER CAPITA	BUILDING FIRE LOSS AS % OF GNP	FIRE DEATHS/ 1,000,000 PERSONS	$ BUILDING FIRE LOSS/ FIRE (1,000'S)	FIRE DEATHS/ 1,000 BUILDING FIRE
AUSTRALIA	-	-	-	25 66%	-	-
AUSTRIA	1.6 33%	3.2 21%	.12 60%	10 26%	2.0 67%	6.0 77%
BELGIUM	1.0 21%	-	-	-	-	-
CANADA	3.2 67%	13.1 87%	.24 120%	36 95%	4.0 133%	11.0 141%
DENMARK	2.0 42%	13.6 91%	.24 120%	10 26%	7.0 233%	5.2 67%
JAPAN	0.3 6%	3.1 21%	.13 65%	19 50%	10.2 340%	62.6 803%
NETHERLANDS	0.6 12%	7.2 48%	.18 90%	8 21%	13.0 433%	14.3 183%
NORWAY	2.4 50%	12.9 86%	.29 145%	15 39%	5.5 183%	6.3 81%
UNITED KINGDOM	1.6 33%	11.7 78%	.19 95%	14 37%	7.0 233%	9.3 119%
UNITED STATES	4.8 100%	15.0 100%	.20 100%	38 100%	3.0 100%	7.8 100%

TABLE A-2

COMPARISON OF FIRE LOSS INDICES FOR 1972-74

COUNTRIES	BUILDING FIRES/1,000 PERSONS	$ BUILDING FIRE LOSS PER CAPITA	BUILDING FIRE LOSS AS % OF GNP	FIRE DEATHS/ 1,000,000 PERSONS	$ BUILDING FIRE LOSS/ FIRE (1,000'S)	FIRE DEATHS/ 1,000 BUILDING FIRE
AUSTRALIA	-	-	-	15 48%	-	-
AUSTRIA	2.0 35%	5.8 33%	.12 57%	10 32%	3.1 100%	5.0 93%
BELGIUM	1.2 21%	-	-	13 42%	-	10.8 200%
CANADA	3.5 61%	19.4 110%	.24 114%	34 110%	5.8 187%	9.7 180%
DENMARK	3.4 60%	18.5 105%	.22 105%	12 39%	6.0 194%	3.5 65%
JAPAN	0.4 7%	4.4 25%	.07 33%	16 52%	12.0 387%	40.0 741%
NETHERLANDS	0.8 14%	10.8 61%	.17 81%	6 19%	14.0 452%	7.5 139%
NORWAY	9.3 163%	24.0 136%	.35 167%	13 42%	2.5 81%	1.4 26%
UNITED KINGDOM	2.5 43%	15.3 86%	.24 114%	17 55%	6.2 200%	6.8 126%
UNITED STATES	5.7 100%	17.7 100%	.21 100%	31 100%	3.1 100%	5.4 100%

TABLE A-3

DEATH RATES BY AGE AND SEX, 1972-74 1/

		0-4	5-14	15-24	25-44	45-64	65+	Total
Australia	Male	22	5	7	9	29	74	18
	Female	19	2	3	5	17	44	12
	Total	21	3	5	7	23	57	15
Austria	Male	13	1	6	10	14	52	14
	Female	9	5	1	1	7	26	7
	Total	10	3	3	5	10	32	10
Belgium	Male	33	14	10	13	11	36	16
	Female	17	4	4	4	12	28	13
	Total	25	9	7	8	12	31	13
Canada	Male	78	21	23	27	58	131	43
	Female	58	17	12	13	33	60	26
	Total	68	19	24	34	52	125	34
Denmark	Male	13	0	12	6	13	52	14
	Female	8	6	4	4	9	41	11
	Total	11	3	8	5	11	42	12
Finland	Male	6	6	25	36	34	67	31
	Female	16	2	1	9	12	20	10
	Total	11	4	4	22	27	31	20
France	Male	15	6	9	14	20	51	17
	Female	21	4	3	5	8	42	13
	Total	21	5	6	9	16	45	15
Ireland	Male	24	10	5	9	17	131	24
	Female	31	13	10	8	22	122	28
	Total	28	12	7	8	19	126	26
Japan	Male	18	6	7	9	20	136	20
	Female	16	5	5	6	8	84	14
	Total	17	6	6	7	14	106	16
Netherlands	Male	9	4	6	5	5	26	7
	Female	5	2	3	2	4	10	5
	Total	7	3	4	4	5	17	6
New Zealand	Male	6	4	10	12	27	67	16
	Female	11	3	3	2	11	51	9
	Total	9	4	6	7	19	57	13
Norway	Male	37	3	8	11	17	44	18
	Female	13	9	2	2	4	26	8
	Total	25	6	5	7	11	34	13
Sweden	Male	12	4	6	13	30	50	19
	Female	4	4	2	4	9	23	8
	Total	8	4	4	9	19	35	14
Switzerland	Male	6	3	3	4	8	28	6
	Female	3	1	0	1	7	16	5
	Total	4	2	1	2	7	21	6
United Kingdom	Male	31	6	6	9	13	59	17
	Female	30	5	4	5	9	67	18
	Total	31	6	5	7	13	64	17
United States	Male	55	15	18	27	42	117	38
	Female	44	15	8	11	27	69	22
	Total	49	11	13	19	39	89	31
West Germany	Male	12	3	8	8	12	35	11
	Female	10	2	2	3	8	24	8
	Total	11	2	4	6	10	28	9

1/ Rates are per million population

TABLE A-4

U.S. CITIES FIRE LOSSES

CITY	POPULATION IN 000'S	FIRE FIGHTING PERSONNEL 1/	NUMBER OF REPORTED FIRES 1/	NUMBER OF REPORTED FIRE DEATHS 1/	FIRES PER 10,000 POPULATION	DEATHS PER MILLION POPULATION
Group A (over 1,000,000)						
New York City	7,569	12,390	131,570	159	174	21
Los Angeles City	2,827	3,474	29,962	45	28	10
Los Angeles County	2,158	2,575	17,316	40	80	19
Philadelphia	1,950	3,195	24,653	110	126	57
Houston	1,700	2,681	22,760	65	134	38
Group B (500,000 to 1,000,000)						
Dallas	881	1,561	13,376	40	152	45
Baltimore	858	2,238	13,445	41	157	48
Washington, D.C.	835	1,508	8,521	40	103	48
Honolulu	716	980	5,095	4	71	6
San Francisco	673	1,711	7,968	27	118	40
Boston	641	1,988	23,433	28	366	44
Seattle	502	1,005	4,630	13	9	26
Group C (250,000 to 500,000)						
Pittsburgh	479	1,095	4,942	12	103	24

1/ Average for 1976-78 unless otherwise indicated.

APPENDIX B

DETAILS OF CALCULATIONS

APPENDIX C

SOURCES OF INTERNATIONAL FIRE STATISTICAL INFORMATION

E-24-605

605

SCHOOL OF INDUSTRIAL AND SYSTEMS ENGINEERING

Atlanta, Georgia 30332 (404) 894-2300

Dec-Feb Prog Rept
Mar-May Prog Rept

May 14, 1980

Dr. Henry Tovey
U.S. Fire Administration
P.O. Box 19518
Washington, D.C. 20036

Dear Henry:

Jerry and I enjoyed the opportunity to review the status of our project with you on May 6. This letter is a follow-up to a series of questions raised at that meeting.

One item was a review of USFA comments on our draft of the report, Selected International Comparisons of Fire Losses. A number of relatively minor editorial matters were raised which will be corrected in the final draft. Phil was also concerned about the absence of France and West Germany in some of our tables. New data received since the original draft was submitted should permit including those two in the final draft. The major unresolved question concerns the detail breakdown of U.S. statistics by cause. As we agreed, I am enclosing a xerox copy of the U.S. data transmitted to us by Paul Gunther. I am sure you recall that John Hall has some disagreement with the tables we derived from that information. As soon as possible we would like you to arrange for John, Paul and yourself to call us and resolve any conflict. Assuming that the U.S. data issue is settled quickly, we believe we can have a corrected draft of the report back to USFA by early June. We would then expect to receive USFA final comments by early July.

A related matter concerns a "stand-alone" executive summary of the Selected International Comparisons of Fire Losses report. In our meeting, we agreed that such a report would be prepared by Georgia Tech. The report would consist of approximately four pages. It would contain a free standing executive summary of information in the Selected International Comparisons of Fire Losses report, including color graphics. Since this product was not anticipated in our proposal, Georgia Tech will not print copies of this report. Instead, we will prepare camera ready copy for USFA use. Naturally, work on this executive summary cannot advance very far until the subject report is completed. Thus, we expect to make it our last submitted product. It should be available for review by mid-August. If USFA can complete its review in one week, it will still be possible to finalize the camera ready copy by the August 31 termination date of our project.

The second main report from our effort is to deal with international reporting of fire losses. As we agreed in our meeting, the orientation will be revised somewhat from our proposal. The report should now include a design for a multinational comparative report that is achievable with existing fire data collection systems of at least a significant number of countries. Our report will propose an organization and format for such a comparative report. We will also design a survey instrument to collect the necessary data for our report. This instrument will be structured so that cooperating countries can reformat and reorganize their data as required to conform to the needs of the comparative report. We anticipate delivering a draft of this report at the end of July. If USFA comments can be received within two weeks, we should be able to finalize the draft for printing before the August 31 termination date. Per our proposal 100 copies of the printed version will be delivered to USFA.

Sincerely,

Ronald L. Rardin, Ph.D.
Principal Investigator
USFA Project

RLR:sb

cc: Jerry Banks

E-24-605

E-24-605

Jun-Aug Prog Rept's
Sept-Nov Prog Rep

UNITED STATES FIRE ADMINISTRATION
FEDERAL EMERGENCY MANAGEMENT AGENCY
Washington D.C. 20472
December 1, 1980

Dr. Ronald L. Rardin
Assistant Professor
School of Industrial & Systems Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Dear Ron:

This letter will summarize what we agreed to during the November meeting. I am sending a copy to all participants, and if anyone's recollection or understanding of what transpired differs from mine, I hope he will let me know.

1. Selected International Comparisons. This report is ready for printing after the changes we have agreed to are made. These changes are all minor, but they are numerous, and since we both have them marked in our copies of the draft report, there is no need to enumerate them here.

2. The "stand-alone," non-technical summary of the report is also ready for the final stage after the changes we agreed to are made. The final stage in this case is a "camera-ready" copy, prepared as per your discussions with Carolyn Perroni, the Chief of our Publication Office.

3. The report on outputs for the international system. We have agreed that GIT will revise the draft report and submit a second draft within a few weeks. I undertook to review and comment on the second draft within a few days from receipt. To facilitate this, by the way, please send an extra copy of the report to my home address, 1004 South Belgrade Road, Silver Spring, Maryland 20902. I get mail there on Saturdays, and it generally gets into my hands sooner than mail addressed the the office.

It was a useful session.

With best personal regards.

Sincerely,

Henry Tovey
Director, Federal & Industrial Applications Division
National Fire Data Center

cc: Banks
Hall
Perroni
Schaenman

L-24-605

HIGHLIGHTS FROM

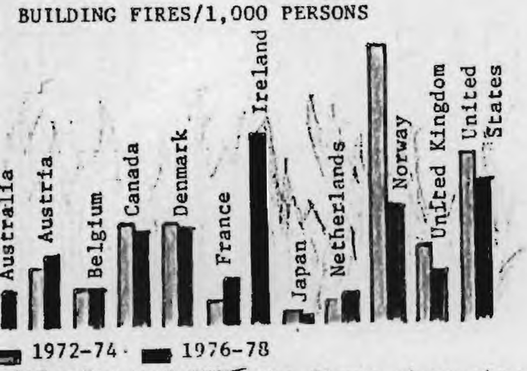
LECTED INTERNATIONAL COMPARISONS OF FIRE LOSSES FOR 1975-1978

BY

JERRY BANKS AND DONALD L. PARDIN OF THE GEORGIA INSTITUTE OF TECHNOLOGY

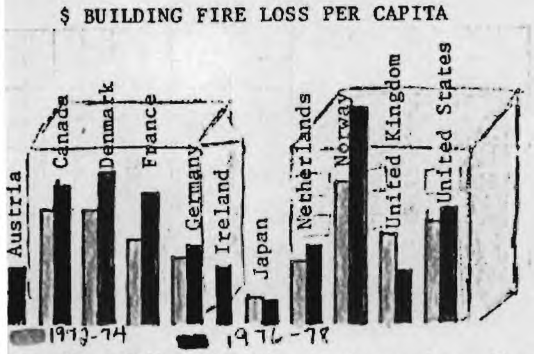
Comparative estimates of fire loss experience in various developed nations have been published intermittently for nber of years. The United States has consistently had one of the highest rates per capita of fire incidence and fire lity. This brochure highlights Georgia Tech's report, Selected International Comparisons of Fire Loss for 1975-78, most up-to-date comparison available of the United States, Canada, Australia, Japan and thirteen West European nations.

BUILDING FIRES/1,000 PERSONS



ING FIRE INCIDENCE- The figure above shows com- rates of building fires per one thousand per- for thirteen nations in two time periods. ugh slightly down in 1976-78, the U.S. rate e second highest of the countries reported h time periods. Only Ireland is higher in '8. The 1976-78 United States value is one ne half times that of our neighbor, Canada.

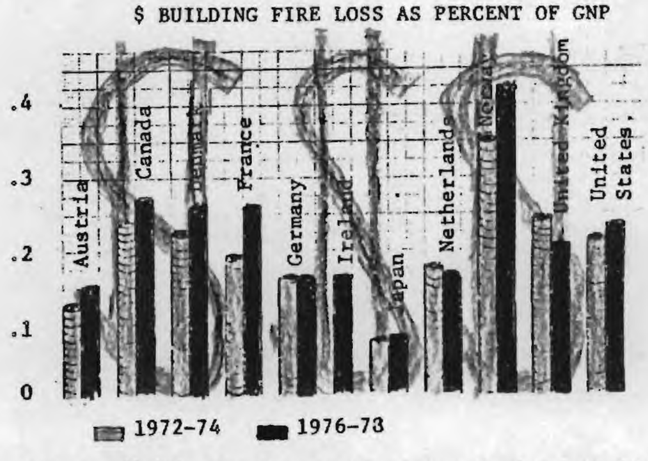
$ BUILDING FIRE LOSS PER CAPITA



NG FIRE LOSS - The figure above shows that the States compares somewhat more evenly with other ped countries when the rate of monetary building oss is computed. In both time periods the U.S. in the middle of the countries considered.

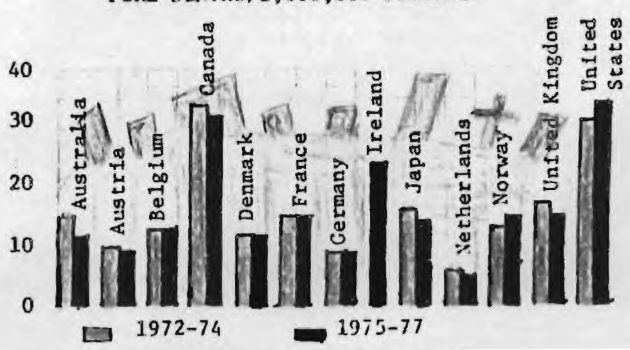
The figure below shows monetary fire loss computed as a percent of Gross National Product. Agair the United States ranks in the middle of the eleven countries reported.

$ BUILDING FIRE LOSS AS PERCENT OF GNP



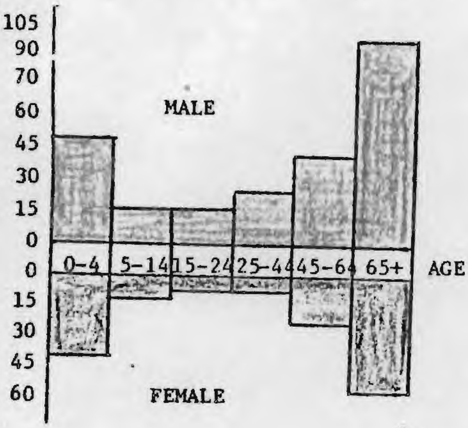
FIRE DEATHS- The United States' relative standing on fire deaths is poor as shown in the figure below. Most countries have shown some reduction in fire deaths per million population between the two time periods under study. Still, only Canada and Ireland approach the U.S. rate in either period.

FIRE DEATHS/1,000,000 PERSONS



As illustrated below, per capita death rates e United States are greater in the very young, ery old and in males. Patterns of fire fatalities the seventeen developed countries reporting e World Health Organization parallel experience e United States.

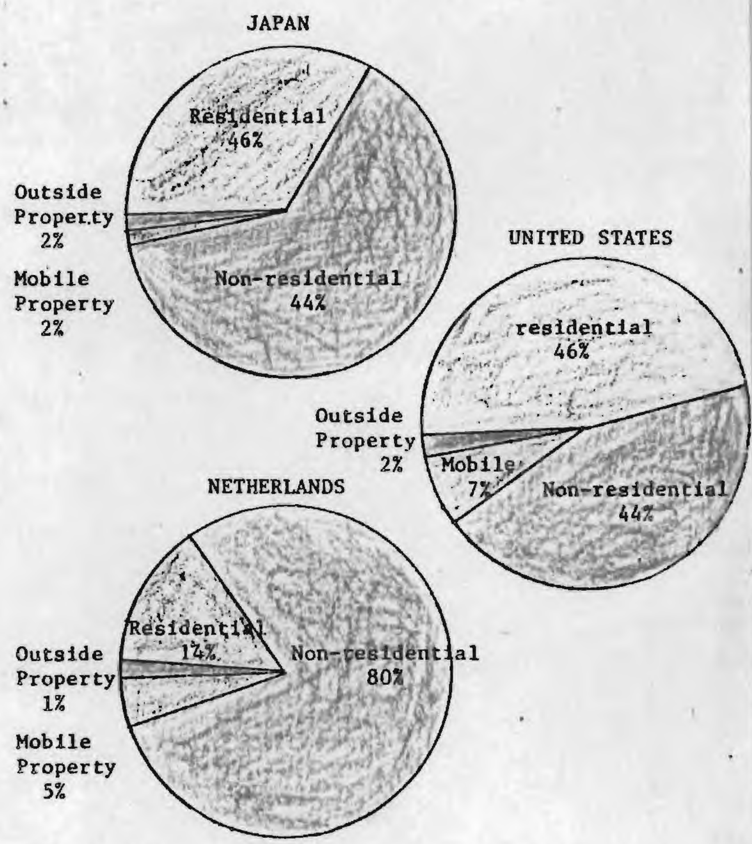
J.S. DEATH RATES BY AGE AND SEX FOR 1975-77



RTY TYPE OR OCCUPANCY As seen below, when the r of fires is subdivided by the use or occupancy e property in which the fire occurs, the United s percentages due to residential, nonresidential utside property rank in the middle of the other countries for which data are available. The perge due to mobile (vehicle) property, however, is ighest of all the countries considered.

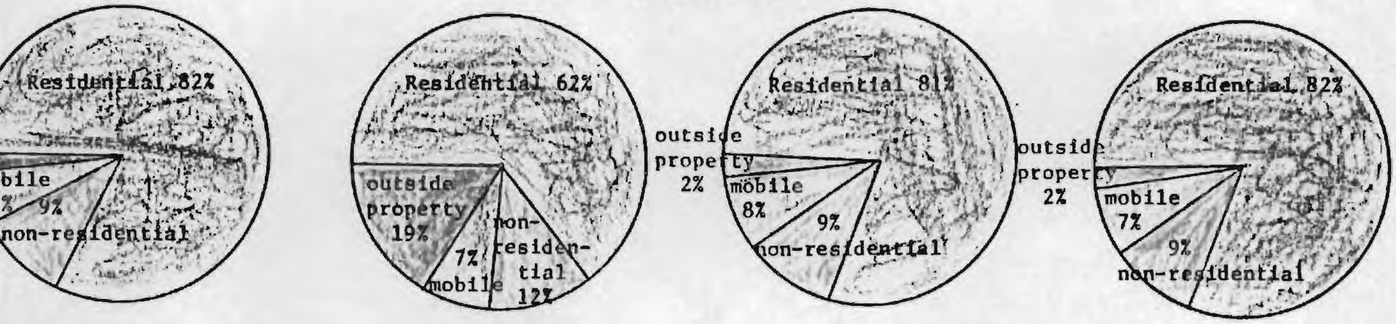
As shown below, a similar analysis of monetary loss indicates some concentration of the United Stat relative difficulties in residential fires. Monetar loss due to residential fire is proportionately larg than that of other countries for which data is available.

MONETARY FIRE LOSS BY OCCUPANCY FOR 1975-77



FIRES BY OCCUPANCY FOR 1975-77

FIRE DEATHS BY OCCUPANCY FOR 1975-77

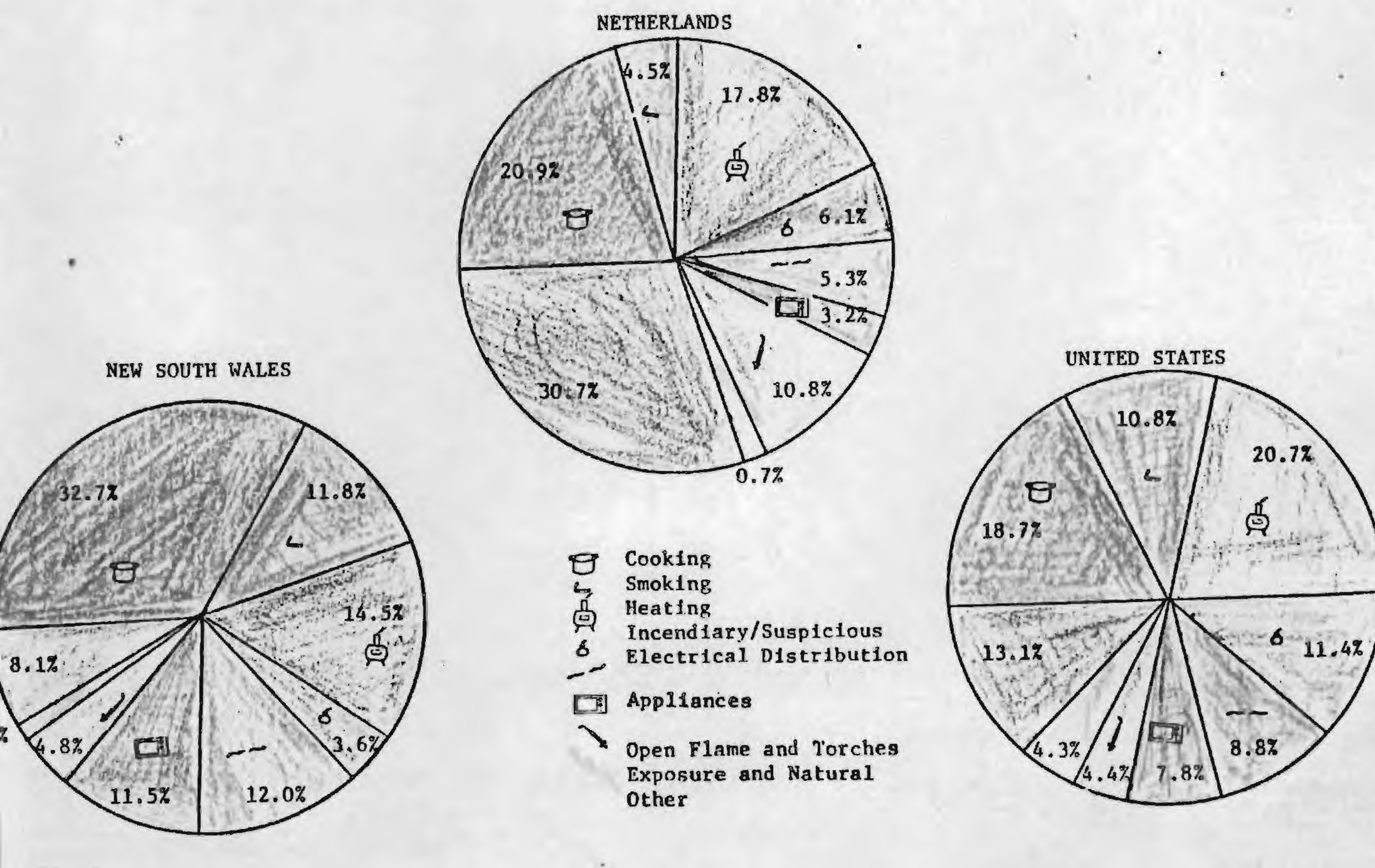


CANADA JAPAN UNITED KINGDOM UNITED STATES

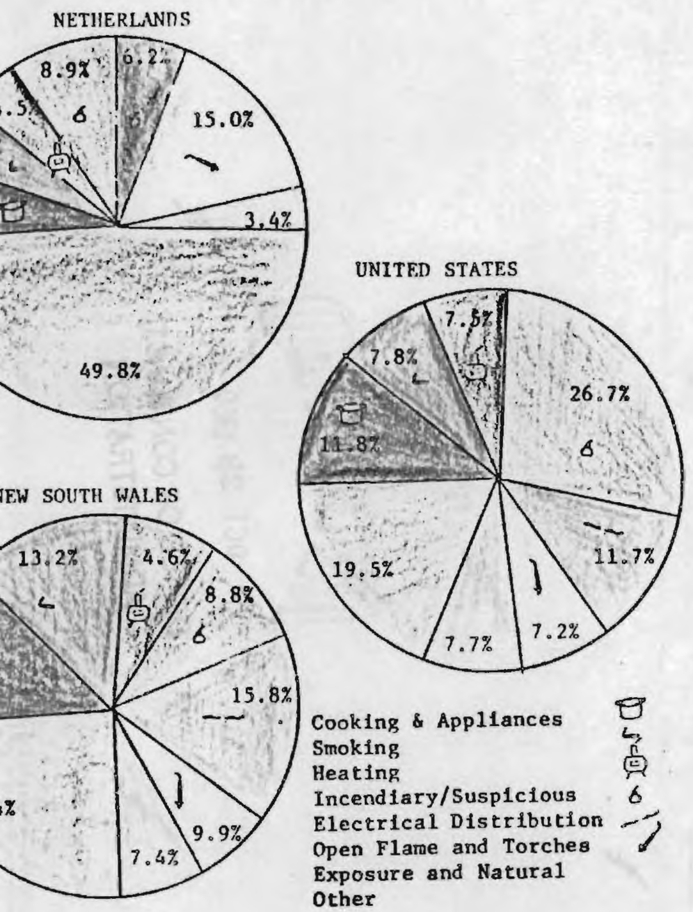
When fire deaths are subdivided by occupancy groups nown above, the United States experience is similar to our neighbor, Canada, and the United dom. However, Japan seems to have a much larger ortion of fire deaths occurring in outside proper- than the other three countries.

CAUSE - The United States experience with the reported cause of fires, as shown below and on the next page, mirrors, in many ways, that of the Netherlands, the United Kingdom and New South Wales in Australia. However, there are some exceptions. Smoking causes twice the fraction of residential fires in the United States and New South Wales than it does in the Netherlands. The United States also has a much greater percentage of incendiary and suspicious fires than the other two countries.

RESIDENTIAL FIRES BY CAUSE FOR 1975-77

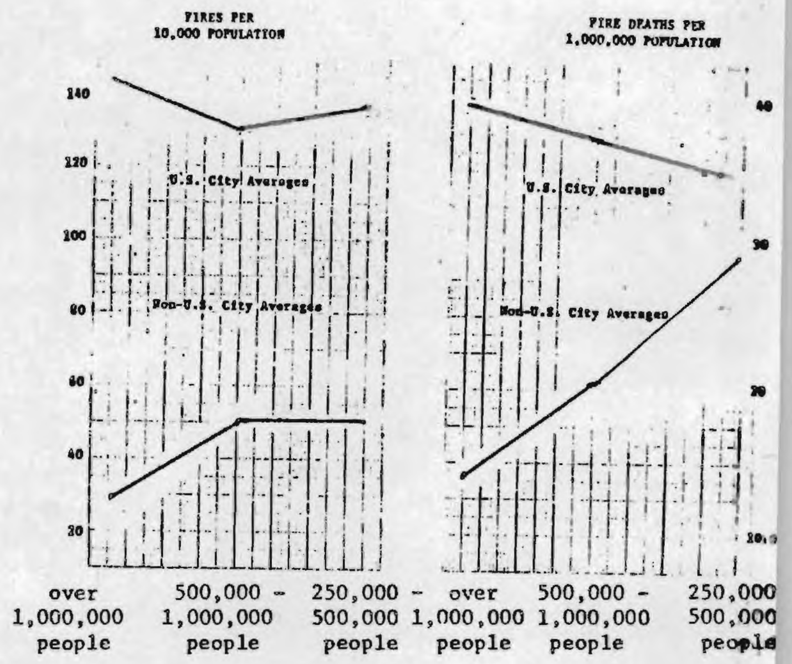


NON-RESIDENTIAL FIRES BY CAUSE
for 1975-77



Breakdowns of nonresidential building fires by cause are shown to the left. Incendiary and suspicious fires in the United States contribute heavily to the total number of fires. Their contribution far exceeds that of the other nations. However, approximately one-half of all the NetherlandS nonresidential building fires have unidentified causes.

- Where available, city fire incidence and fire rates were compared for United States cities ty-five other world cities. The results are the right. The per capita fire incidence in tates cities average significantly higher than le foreign cities. In the largest cities (over n) United States values are several times those cities. The fire fatality rates for the United ities are also much greater than those of foreign although the difference is not as high as for idence.



comparison between reported fire losses of different countries is beset by major incomparabilities in the data edures by which the statistics are calculated. When published results from individual countries are interpolated rm to a standard format, additional opportunities for confusion are introduced. Thus, a reader should treat all ons from the data presented only as indications of possible phenomena. Furthermore, all points of view or opinions d are those of the authors and should not be construed to represent the policies of the United States Fire Administration.

E-24-605

INTERNATIONAL COMPARISONS OF FIRE LOSS: A SUGGESTED REPORT PLAN

BY

JERRY BANKS

RONALD L. RARDIN

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

WITH THE SUPPORT OF THE

UNITED STATES FIRE ADMINISTRATION

NATIONAL FIRE DATA CENTER

GRANT NO. USFA-79065

OCTOBER 1980

TABLE OF CONTENTS

1. Introduction 1

1.1 Prior Comparative Reports 2

1.2 Standardization Efforts 3

1.3 This Report 5

2. Issues in International Fire Experience Reporting. 7

2.1 Levels of International Fire Reporting. 7

2.2 Fire Incidents Reflected 9

2.3 Fire Loss Measures 10

2.3.1 Number of Fires 11

2.3.2 Fire Fatalities 11

2.3.3 Fire Injuries 12

2.3.4 Monetary Property Loss 13

2.3.5 Other Loss Measures 14

2.4 Reporting of Trends 15

2.5 Reduction to Rates 16

2.5.1 Per Fire Rates 16

2.5.2 Elements at Risk 17

2.6 Classification Dimensions 20

3. Proposed Report Design 24

3.1 National Level I Analyses 24

3.2 Level I City Analysis 30

3.3 Level II-A Analysis 30

3.3.1 Main Property Type 32

3.3.2 Occupancy Sub-classes 35

3.3.3 Cause 36

3.3.4 Victim Grouping 39

3.3.5 Trends 39

3.4 Level II-B 39

3.5 Collected Recommendations 44

4. Data Aggregation 48

4.1 Techniques for Aggregation 48

4.2 Treatment of Causal Factors 50

4.3 Treatment of Property Use/Occupancy 58

5. Implementation 60

5.1 Responsible Organization 60

5.2 Fundamental Decisions 60

5.3 Data Submission 61

5.4 Report Preparation 63

5.5 Outlook 63

LIST OF TABLES

2-1 Recommended and Potential Ratios Yielding Constructive Fire Loss Rates 18

3-1 Example Tabulation of Overall Fire Loss Rates 25

3-2 Example Analysis of City Fire Losses 31

3-3 Example Table of Fire Loss by Major Property Type 33

3-4 Example Tabulation of Residential Fire Losses 37

3-5 Example Level II-A Tabulation of Fire Loss by Cause 40

3-6 Example of Level II-A Analysis of Death by Age and Sex 42

3-7 Possible Level II-B Dimension Pairings and Their Desirability 45

3-8 Example Level II-B Table Cross Classifying Residential Subclass . . . . and Cause 46

3-9 Summary of Recommended Report Tables and Figures 47

LIST OF FIGURES

1-1 Comparison of World Health Organization and National Report Fire Death Rates 4

3-1 Illustrative Time Trend Figure for Example Index 27

3-2 Example Two-Way Plot of Relationship Between Monetary Building Fire Loss and Gross National Product 28

3-3 An Example of a Derived Analysis 29

3-4 Typical Pie Chart Illustration of Percent Data in Table 3-3 34

3-5 Typical Pie Chart Illustration of Percent Data in Table 3-4 38

3-6 Typical Pie Chart Illustration of Percent Data in Table 3-5 41

3-7 Typical Pie Chart Illustration of Percent Data in Table 3-6 43

4-1 Summing Approach to Aggregation Within A Dimension 49

4-2 Priority Approach to Aggregation Across Dimensions 51

4-3 Priority Derivation Pattern for Cause Dimension Using Specific Dimensions 52

4-4 Priority Derivation of Ignition Heat Source Dimension From Equipment of Ignition and Form of Heat of Ignition 54

4-5 Priority Derivation of Material First Ignited Dimension From Form of Material First Ignited and Type of Material First Ignited 55

4-6 Priority Derivation of Cause Dimension From Ignition Factor and Ignition Heat Source 56

4-7 Priority Derivation of Cause Dimension From Ignition Factor, Ignition Heat Source and Material First Ignited 57

4-8 Aggregation Pattern for Property Use/Occupancy 59

1. INTRODUCTION

National summaries of fire loss statistics are published regularly by fire services and fire insurance organizations in many developed countries. Unfortunately, these national reports are subject to only very limited international standardization. The tables within reports are not consistent among reports, and those tables which appear in more than one report, fail to have columns and rows with similar headings. Even if the headings are similar, there is no way of determining whether the entries within the individual cells of the table contain the same information.

As a consequence, attempts to draw statistical comparisons at the international level result in errors of interpretation and the necessity to interpolate liberally from the individual reports. The language barrier is the least of the problems. One nation may treat a hotel as a residential structure while another treats it as an institution. Unscrambling and rescrambling the various categories requires intuition, experience, and judgement. The resulting comparisons certainly are not accurate, but only approximations of reality.

In addition to being nonstandardized, the reports vary in complexity. At one extreme are those nations that provide data aggregated into only one or two values; at the other extreme are reports so disaggregated that observation and analysis are impossible without much work on the part of the reader.

1.1 Prior Comparative Reports

On three occasions, Georgia Tech has attempted to compare nations with respect to their fire loss. The first was part of a systematic effort to understand what causes differences in reported fire loss, sponsored by the United States Fire Administration. The project, entitled Determinants of International Differences in Reported Fire Loss, sought to systematically enumerate and screen the various hypotheses and theories which have been advanced to explain fire loss differences among nations -- including social, economic, cultural, technological and fire policy variations, as well as differences in statistical reporting procedures. The principal results of this Georgia Tech project are a Final Technical Report [ ] and a Final Summary Report [ ] published in 1977.

As an extension of this work, the Georgia Tech research team undertook in 1978, to produce two more detailed reports. The first of these, Report on Fire Data Collection and Presentation [ ], more thoroughly analyzed the collection and analysis system used to prepare fire data in different countries. The second supplemental report, Selected International Comparisons of Fire Losses for 1972-75 [ ], provided more detailed analyses of the fire loss in a more limited set of countries.

Most recently Georgia Tech has prepared an update of this latter report for the years 1975-78 [ ]. The update was also sponsored by the United States Fire Administration. It extends earlier analyses and compares the results for trends or changes in the relative positions of the various countries.

Others have performed a similar comparative analyses of various national fire statistics. Wilmot [ ] examined European fire losses in work completed in April of 1979. Total fire costs in several categories were estimated for 12 separate countries. The Tokyo Fire Department annually collects fire statistics from major cities of the world [ ]. Their report compares the cities on the basis of numbers of fires, deaths, fire service personnel and fire equipment relative to population.

The single instance in which fire data is systematically collected according to an international standard is the fire fatality information published by the World Health Organization (WHO) [ ]. WHO values are derived from cause of death data on death certificates. They vary markedly from statistics reported by individual nations. Figure 1-1 shows some typical data. Disparities derive from handling of instances (e.g. deaths due to fires connected with motor vehicle collisions) that might or might not be called a fire death.

1.2 Standardization Efforts

Even if there were no disputes about incident definition, WHO statistics would provide only very aggregate fire death comparisons. The purpose of Georgia Tech's Report on Fire Data Collection and Presentation [ ] was to begin the search for a more detailed approach.

Although there are very great differences among reports produced by various nations, there were also similarities in the dimensions of fire incidents classified and the types of information reported. Georgia Tech's report systematically investigated those similarities, using reports and related data from nine nations. Based on the similarities, a common body of international data was identified that might be regularly reported for accurate international comparison of fire loss. Various classifiable dimensions of fire reporting were defined and standards proposed.

The development of the Report on Fire Data Collection and Presentation was partially motivated by the interest in international fire statistic reporting of Working Group VI/Subcommittee 19/Technical Committee 38 of the International Standards Organization (ISO). An effort is underway within ISO

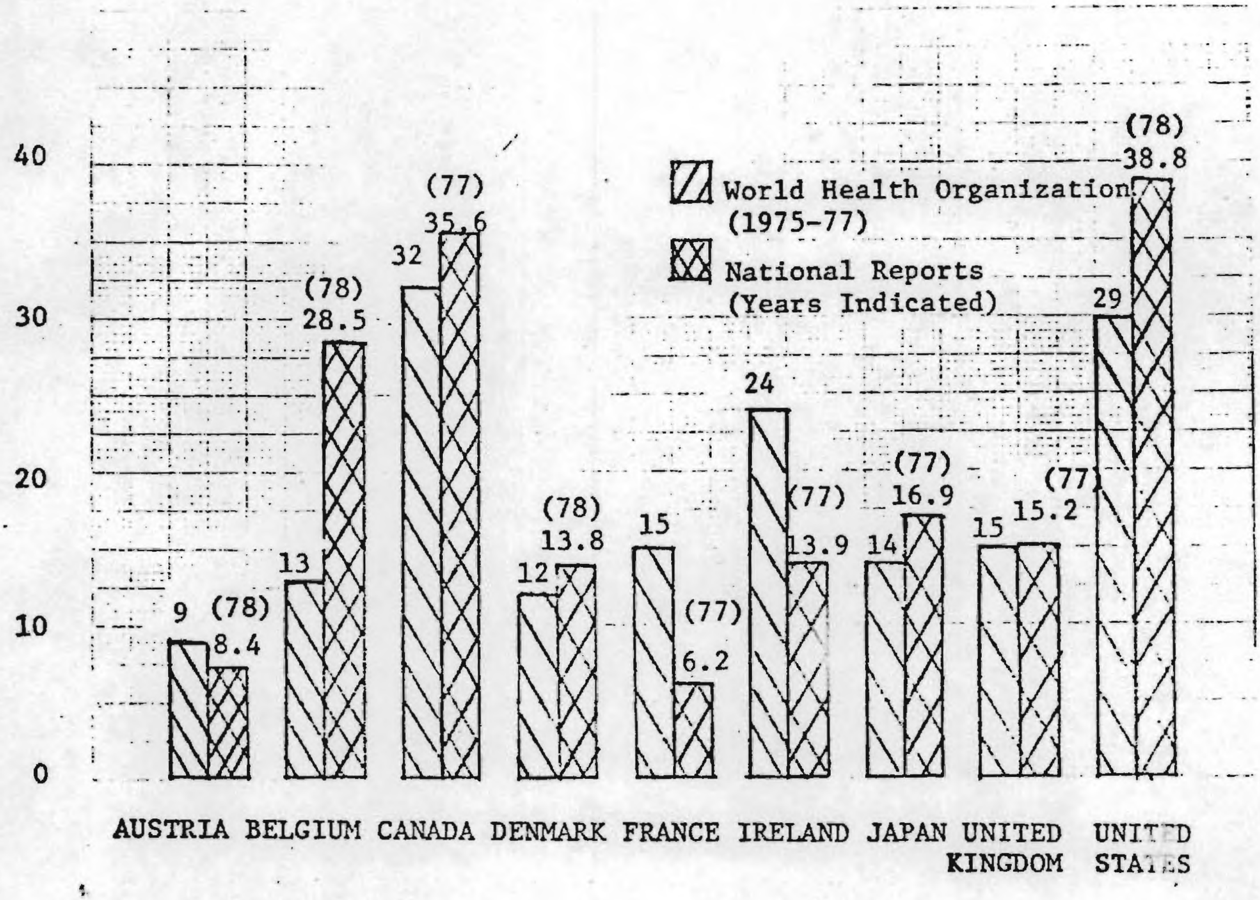


FIGURE 1-1. COMPARISON OF WORLD HEALTH ORGANIZATION AND NATIONAL REPORT FIRE DEATH RATES

to develop a standard international fire data system, and a draft proposal for such a system is now being circulated within committee [ ].

ISO is not the only organization with some interest in standardized fire reporting. Partially, as a result of Wilmot's [ ] study of European fire losses, insurance interests of the Association Internationale pour l'Etude de l'Economie de l' Assurance (Geneva Association) have expressed preliminary interest in establishing a mechanism for producing regular fire loss comparisons. The international building research organization, Conseil Internationale du Batiment pour la Recherche l'Etude et la Documentation (CIB) has undertaken its own survey of the need for an international fire statistical reporting system.

1.3 This Report

The purpose of this document is to take another step toward a standardized system of comparative international fire experience reporting. Specifically, a report format is developed that both satisfies many of the important fire statistical needs and conforms to efforts to standardize the classification system of different countries. The format is specifically designed so that it might initially be supported by estimated values computed by participating countries and later derive its information from standardly reported fire incidents.

The authors are neither omnicient nor omnipotent. Thus, many questions addressed in the development of the proposed report format might finally be resolved in a different way than the one proposed. Still, if a reporting system similar to the one proposed were adopted by a significant number of nations, the authors believe world understanding of fire experience would be considerably enhanced.

The remainder of the report is organized in four sections. Section 2 addresses broad issues in international reporting. Examples are the levels of questions and analyses, the loss measures and loss rates to be used, etc. Section 3 offers a proposed report design. The section describes various tables and figures that might be provided at three different levels of detail. At each level there are tables which cross-classify the fire statistics of nations along one or more dimensions. Section 4 concerns data structures. The principles for aggregating detail data into report statistics are described and methods presented for constructing information required in the report of Section 3. The last section, Section 5, discusses the implementation of the suggestions offered in this document.

2. ISSUES IN INTERNATIONAL FIRE EXPERIENCE REPORTING

The design of a comparative international report of fire experience requires the resolution of a number of important issues. What analyses should be provided? What loss measures are appropriate? How should information be classified? This section raises and discusses a variety of such issues. A specific report design follows in Section 3.

2.1 Levels of International Fire Reporting

The community of persons who might have interest in comparative international statistics on fire experience is a broad one. It includes government officials having general oversight of fire protection policies, fire service personnel with specific fire protection responsibilities, fire protection associations, fire researchers, fire research funders, fire resistance, detection and suppression product manufacturers, fire insurers, and public interest organizations including the news media.

Naturally, the types of information these many users might seek from a report are equally diverse. There are at least three levels:

- Level I uses of fire statistics seek broad, nation-versus-nation comparisons--either in one time period or over a long trend. Values compared are highly aggregated statistics such as the total national monetary fire loss per capita. The information is used by general government officials, news media and the public in crudely evaluating a country's fire safety performance.

- Level II analyses of fire statistics subdivide and classify fire experience into major causal, occupancy and other groupings. One typical grouping is fire attributed to arson in single-family homes. Fire policy makers at all levels use the relative experience of their nation in these categories to highlight strengths and isolate weaknesses needing programatic attention.
- Level III fire statistical studies provide detailed analyses of very specific fire problems. Often the purpose is to predict or evaluate the effect of a specific program. An example is a careful study of infant fire deaths said to have started by ignition of the victim's sleepwear. To the degree that different countries have different textile standards for infant sleepwear, such an analysis could aid government officials and textile manufacturers in evaluating present and proposed standards.

Although it could easily be argued that Level III analyses are the most productive use of fire statistical comparisons, the number of possibly relevant combinations of fire incident characteristics is enormous. A report displaying fire experience in such detailed cross-classifications would be confusing and cumbersome.

On the other hand, Level I and Level II needs do appear within the reach of a single report. Level I requires only aggregate statistics, and Level II adds only one or two further dimensions of classification.

For these reasons a report satisfying only Level I and Level II information needs is recommended. However, Level III should not be forgotten in an international fire statistical reporting system. It would be highly desirable if all participating nations collected reports of fire incidents in enough detail to support Level III investigations. Special cross-national studies of particular policies would then be feasible. In addition, the accuracy of Level I and Level II analyses would probably improve. If data were collected at Level III, a formal procedures would have to be provided for aggregating the data to higher levels. Such formalization would tend to insure that aggregate categories described in a Level I and II report were identically defined in all countries.

2.2 Fire Incidents Reflected

One of the many difficulties in developing comparable fire statistics in different countries arises with the definition of a fire incident of interest. Prior reports by Georgia Tech and others [, , ,] have identified a host of disparities:

- When fire reports are derived primarily from insurance sources, a claim may constitute an instance. When statistics come from the fire service, all damage connected with a single fire is usually treated as a single incident.
- Non-fire incidents, such as automobile accidents and explosions, are sometimes mixed with fires in reported statistics.
- Many small fires go unreported to any data collection system. Others, although reported, are deleted from most published statistics. Typical examples of the latter are chimney fires, rubbish fires, and small grass fires.
- Fires in rural areas, and government installations may not be included in statistics.
- Serious industrial fires may be wholly dealt with by private fire brigades and thus not reflected in public fire service reports.

Some of these difficulties can be resolved by an unambiguous definition of fire such as the one offered in Georgia Tech's earlier Report on Fire Data Collection and Presentation [ ]:

> Fire: a fire is an instance of destructive and uncontrolled burning, including explosion of combustible solids, liquids or gases if followed by burning. Fires do not include lightning, explosion of non-combustible substances, vehicular accidents or overheating, unless they result in uncontrolled burning.

Also, all damage caused by the same fire should be counted as one incident. Still, there remains the problem of establishing which fires should be reflected in a comparative international report. Very small, loss-free fires are not of much importance in analyses like those described in the previous section. Moreover, they are unlikely to ever be reported reliably and comparably in many countries.

For these reasons it is recommended that only fire incidents falling within a common and reliable core be reflected in fire incident data used for a comparative international report. This following definition of "serious fires" approximates such a core:

> Serious Fire: a serious fire is one attended by a trained fire suppression force (whether public or private) and resulting in a human injury requiring medical attention, a human fatality, or direct financial loss of more than an internationally agreed threshold (perhaps 100 U.S. dollars in 1980 values).

2.3 Fire Loss Measures

The magnitude of the fire problem in a country can be computed in terms of the number of incidents or by any of a variety of measures of the fire loss.

Each measure offers useful information, but presents data collectors with a number of definitional problems. Drawing on the previous analyses in Georgia Tech reports [ ] and [ ], and on reports by Wilmot [ ], the following discusses each measure and offers a recommendation on its use in a standard international fire experience report.

2.3.1 Number of Fires. The number of fire incidents is perhaps the most widely tabulated of all fire measures in different countries. If for no other reason than its wide availability, it should be included among the measures computed in a comparative international report. Section 2.2 has already described the many definitional problems in characterizing a fire incident of interest. For purposes of tabulation in a comparative international report, it is recommended that the number of "serious fires" defined as in Section 2.2 be adopted as the standard measure of the number of incidents.

2.3.2 Fire Fatalities. A second standard and widely reported measure of fire loss is the number of persons killed by fire. Because of the great importance attached to the loss of human life and the fact that fire deaths are usually tabulated by both the fire service and death certificate authorities, fire fatalities are probably the most uniformly reported of all fire measures. Still, there are some problems of definition:

- The followup period on a fire victim varies from jurisdiction to jurisdiction. If a person dies from complications of fire injuries 48 hours after a fire, some systems would record a fire death and others would attribute the death to the complications.
- When an accident results in a fire--typically a vehicle collision--resulting deaths may be attributed to either a collision or the fire.

Any comparative international report on fire should include fire fatality information. It also seems reasonable to resolve the above conflicts on the side of calling disputed cases fire fatalities; all could arguably have been avoided by suitable improvements in fire prevention and control. Such an inclusive definition is the following:

> Fire fatality: A fire fatality is a person whose death resulted principally from a fire, regardless of how the fire may have ignited. Included are persons dying in the process of a fire and those who may die afterwards because of injuries incurred during the fire.

2.3.3 Fire Injuries. Non-fatal fire casualties are widely reported in various fire statistical reports, but there are wide variations in definition. One set of problems mirrors those already discussed for fire deaths. Injuries caused principally by fire must be separated from those attributed to events before and after the fire.

As with fire deaths, it seems an appropriate internationally standard definition would be inclusive with respect to the cause of the injury. Any injury resulting principally from a fire should be called a fire injury, regardless of events that may have preceeded or followed.

A more significant problem arises in specifying the seriousness necessary for a recordable fire injury. In some systems all injuries, however small, are reported. Others show only those requiring medical attention, hospitalization, etc.

Very minor injuries are neither of much interest to fire policy makers, nor likely to be reliably reported. Thus, it is recommended that reporting be limited to serious injuries defined along the following lines:

> Serious non-fatal fire injury: A serious, non-fatal fire injury is a person who, principally as a result of a fire,

incurs non-fatal bodily injury sufficient to warrant medical treatment other than first aid.

2.3.4 Monetary Property Loss. The fourth measure that is commonly found in fire statistical reports is the monetary value of property destroyed. However, its estimation leads to a number of inconsistencies among countries:

- Some sources report only direct property loss while others include indirect consequences of the fire. A common example of the latter is the value of loss associated with business property rendered temporarily unusable by the fire.
- Some loss figures include only buildings and others reflect both buildings and contents.
- The accounting standard on which property value is to be assigned may vary. Some sources value property at replacement cost, others may use depreciated purchase price, etc.
- Some property losses--especially public forests and grasslands--do not have an easily determined monetary value.
- Damage due to the extinguishment--usually water damage--may not be included.

Initial estimates of property loss to fires are very often made by fire service personnel at the fire scene. Thus, if any international standard is to have any hope of being uniformly adhered to, it would seem that the standard should minimize the economic extrapolations required to compute it. Although indirect costs of fire are significant, only direct ones can be relatively easily estimated by reporting fire personnel. Also, the purchase price of a property would be unknown to fire personnel. Thus it is recommended that only the following direct property damages be included in an international report:

Direct fire property damage: Direct fire property damage is the monetary value for replacement to like kind and quality of property damaged by a fire or its associated smoke and extinguishment. Direct losses of both buildings and contents are included, but indirect consequences of fire are not.

Difficulties in estimating outside fire losses would persist under this definition. Thus, it is important that building and non-building fire losses be segregated in reports.

Unlike the other measures discussed so far, even a standard measure of direct property loss would not be denominated in the same units in different countries and different time periods. The value for any given country would be expressed in that country's currency of the year reported. The preparation of an international report would require adjustment to a standard currency unit. If time trends are to be considered, adjustments should also be made for inflation and deflation in currency values.

There are numerous sources of inflation rates and currency conversion factors. Previous Georgia Tech studies [, ,] have concluded that the most standardized and appropriate are those published by the United Nations in its Monthly Bulletin of United Nations Statistics [ ]. Currency conversion rates are averaged for an entire year in that source, and deflaters are available to reduce monetary values to standard years. These two adjustments are applied by first converting all monetary values to local currency in a standard year, and then applying currency exchange rates to obtain values in the same currency.

2.3.5 Other Loss Measures. Georgia Tech's Report on Fire Data Collection and Presentation [ ] found a number of less-standard fire loss measures tabulated in at least one country. Among these are the area damaged, the extent of fire spread, the number of persons assisted in escape, the number of dwelling units destroyed, the number of livestock killed, the number of households destroyed, and the number of persons negatively affected. However, none of these measures was found to be in wide enough use to be reliably collected and meaningfully interpreted in international fire statistics. Thus, it is recommended that the magnitude of fire loss be tabulated in comparative international fire reports only in terms of the number of serious fires, the number of fire fatalities, the number of serious non-fatal fire injuries, and the direct fire property loss.

2.4 Reporting of Trends

Any statistical analysis can be improved if data are reported for more than one time period. Trends are easily identified from comparisons over time. In the imprecise domaine of comparative international statistical reporting, trend analysis has some additional advantages. If reported values for different countries are derived on the same basis during each study period, the comparison of those values is meaningful--regardless of the completeness of the computational basis. To compare results among nations, standardization of the data base must also be assured.

For these reasons, period to period time comparisons should definitely be included in at least aggregate tables of a comparative international fire report. However, there are some difficulties that must be resolved. One, the need to adjust monetary values for inflation, has already been discussed. Others include the fact that some countries produce reports only every two or three years and the observation that single, massive fires or dry weather in a given year may suggest false trends.

A uniform finding of Georgia Tech [, ,] and other [,] studies of international fire loss is that relative standings do not change dramatically with time. Thus the above difficulties with obtaining data on a regular basis and treating atypical results could be satisfactorily resolved by averaging. It is recommended that the report be produced on a regular 2 to 4 year cycle, with reported statistics reflecting averages for the subject period. Three years is probably the best cycle. Time comparisons would be to similar averages for prior periods.

2.5 Reduction to Rates

The fire loss measures discussed in Section 2.3 are necessary ingredients in the development of comparative international fire statistics. Still, direct comparisons among, for example, the absolute number of fire fatalities in different countries are not very meaningful. Enormous differences in the populations, land areas and economies of the nations compared account for much of the disparity in fire loss.

To make fire loss statistics comparable across national boundaries, measures must be standardized into rates. Absolute amounts of fire loss must be divided by an appropriate denominator to obtain a rate that can be compared from country to country. An obvious example is the use of population as the denominator to obtain per capita rates.

2.5.1 Per Fire Rates. One way to develop rates that can be compared across nations is to compute ratios of fire loss measures. The most meaningful of such ratios are those corresponding to per fire rates. They are computed by dividing the number of fire fatalities, or the number seriously injured, or the direct property loss by the number of serious fires. Of course, the result is the ratio of two estimated measures; certainly it has more error than either measure by itself. Still, per fire measures are an indication of the size of fire incidents in different countries and of the effectiveness of fire suppression and control measures designed to inhibit fire growth. Thus, they are recommended for inclusion in a comparative international fire statistics report.

2.5.2 Elements at Risk. In developing other fire loss rates, a general principle to be observed is that the rate should reflect the amount of fire loss divided by the element at risk. For example, it would be desirable to compute the amount of property damage from fire divided by the total amount of property.

The denominators for such rates come from non-fire agencies. Thus, the principle that rates should reflect items at risk has to be tempered by the availability of reliable multinational candidates for denominators. Only those social, demographic and economic indices routinely published by international organizations can be expected to be uniformly derived and readily available for utilization in an international fire report. In the case of the property damage per total property example offered above, the result may be settling for the ratio of direct fire property loss to gross national product. The latter is (loosely) the change in national wealth, rather than wealth itself. Still, it is widely available, and total wealth is not.

With these ideals and limitations in mind, a list of available and potentially useful denominators for fire loss rates is provided below. Table 2-1 shows which rates are recommended for which types of fire losses in computing statistics for a comparative international fire loss report. An "X" entry in that table indicates the measure is definitely recommended, and an "O" suggests the measure might be meaningful.

TABLE 2-1

RECOMMENDED AND POTENTIAL RATIOS YIELDING CONSTRUCTIVE FIRE LOSS RATES 1/

Fire Loss Measures \ Rate Denominator	Number 2/ Serious Fires	Population	Gross Product	Technology Permeation	Vehicles and Vehicle Miles	Undeveloped Land Area
No. Serious Fires - All		X	O	O		
- Building Fires - All		X	O	O		
- Residential		X	O	O		
- Nonresidential		X	O	O		
- Vehicle Fires		O	O	O	X	
- Outside Fires		X	O	O		O
No. Fire Fatalities - All	X	X	O	O		
- Building Fires - All	X	X	O	O		
- Residential	X	X	O	O		
- Nonresidential	X	X	O	O		
- Vehicle Fires	X	O	O	O	X	
- Outside Fires	X	X	O	O		O
No. Serious Non-Fatal Casualties - All	X	X	O	O		
- Building Fires - All	X	X	O	O		
- Residential	X	X	O	O		
- Nonresidential	X	X	O	O		
- Vehicle Fires	X	O	O	O	X	
- Outside Fires	X	X	O	O		O
Direct Fire Property Damage - All	X	X	X	O		
- Building Fires - All	X	X	X	O		
- Residential	X	X	X	O		
- Nonresidential	X	X	X	O		
- Vehicle Fires	O	O	O	O	X	
- Outside Fires	O	O	O	O		O

1/ In the table X indicates recommended rates; O shows potential rates; blank rates are not recommended.

2/ Per fire rates should be computed by dividing other fire measures by the number of fires they reflect. For example, building fire loss would be divided by the number of building fires.

The denominators mentioned in the table are as follows:

- Number Serious Fires. Division by the number of serious fires gives per fire rates. Derivation of the number of serious fires was already discussed in Section 2.2. If per fire rates are computed by dividing other measures by the number of incidents, values should reflect the same base. For example, losses in building fires should be divided by the number of building fires.
- Population. Population is the most obvious and widely used basis for computation of loss rates. Its wide acceptance makes it almost essential in any standard international reporting. Moreover, people are certainly the element at risk in fire injuries and fatalities. Multinational population data are published by the United Nations in their Demographic Yearbook [ ].
- Gross Product. Gross National Product (GNP) and Gross Domestic Product (GDP) measure the total amount of economic activity in a country. They thus provide a useful scaling of fire losses in terms of the economic burden they represent. GNP and GDP differ only by goods and services received domestically, but paid for in another country. Such goods and services are accounted for in GDP, but not in GNP. Both GNP and GDP are computed by the United Nations and reported quarterly in the International Monetary Fund's International Financial Statistics [ ].
- Technology Permeation. One of the principal causes of fire in almost all countries is machinery and equipment used in homes and industry. Thus, it would be desirable to have available measures of the amount of such equipment in different countries. In preparing Georgia Tech's previous reports [, , ,], no single

measure was found to be internationally available. However, the number of televisions, the number of radios, and the number of telephones are available for most developed countries in the United Nations Statistical Yearbook [ ]. In Georgia Tech's report Selected International Comparisons of Fire Losses [ ], it proved instructive to use a weighted sum of these three values as a surrogate measure of the permeation of technological devices.

- Vehicles and Vehicle Miles. Obviously the elements at risk in vehicle fires are the vehicles themselves. For such fires it is logical to compute rates on a per vehicle or per vehicle mile basis. Both the number of motor vehicles and the number of motor vehicle miles driven are estimated regularly by the Motor Vehicle Manufacturers Association of the United States [ ].
- Land Area and Undeveloped Land Area. In grass, forest and other outside fires, the element at risk is approximately measured by the land area of a country--especially the undeveloped land area. The land area of any country can be obtained from a world atlas, and undeveloped land area is estimated in diplomatic sources such as the Central Intelligence Agency's National Basic Intelligence Factbook [ ].

2.6 Classification Dimensions

Fire incidents can be classified along many instructive dimensions such as occupancy, cause, victim, etc. In Georgia Tech's prior survey of classification and reporting techniques of developed countries [ ], the dimensions below were found to be in use in at least some countries.

- Property Use/Occupancy describes the nature of the property in which the fire began. For example, it may be fixed or mobile property, and the property may be used for residential or non-residential purposes.

- Area Where Fire Began classifies the nature of the part of the property where the fire was ignited. Examples are building structural components, boiler room and sleeping area.
- Fire Safety Defenses Available Where the Fire Began records the sprinklers, fire extinguishers, fire doors and similar fire defenses available at the fire scene.
- Equipment of Ignition describes the type of equipment that ignited the fire if equipment was involved.
- Form of Heat of Ignition distinguishes whether the heat of ignition came from electrical arcing, open flame, fuel-fired equipment operation, or similar heat form categories.
- Ignition Heat Source is a composite dimension, combining "Equipment of Ignition" and "Form of Heat of Ignition". Incidents are classified by equipment of ignition, if equipment was involved, and by heat form otherwise. (See Section 4 for details.)
- Type of Material First Ignited classifies the substance first ignited according to its material type. Examples are cotton fabric, flammable liquid, and plastic solid.
- Form of Material First Ignited distinguishes the use of the material in which a fire ignites. For example the material may be building structure, furniture, draperies, etc.
- Material First Ignited combines "Type of Material First Ignited" and "Form of Material First Ignited" into a composite classification of the material in which the fire ignited. Generally, the form of the material is used to classify items with a common form, and the type of material distinguishes bulk goods. (See Section 4 for details.)

- Ignition Factor describes the acts and omissions bringing the heat source of ignition into contact with the material first ignited. Important examples are arson, spontaneous combustion, and children playing.
- Cause provides a composite index of the cause of a fire combining "Ignition Heat Source," "Material First Ignited," and "Ignition Factor." Incidents are classified by "Ignition Factor" if one of several key ignition factors is involved. If not, "Ignition Heat Source" is used when equipment is involved in ignition, and "Material First Ignited" otherwise. (See Section 4 for details.)
- Victim Age describes the age of the victim of a fatal or non-fatal fire casualty.
- Victim Sex classifies according to the sex of the victim of a fatal or non-fatal fire casualty.

Certainly "Fire Safety Defenses Available Where the Fire Began" is an important descriptor of a fire to fire policy makers. However, the analysis of Georgia Tech's Report on Fire Data Collection and Presentation [ ] concluded that there was very little commonality in the classifications used by different countries. Thus, it seems doubtful that an international classification of this dimension could be easily devised or reliably implemented. The measure is not recommended for use in a standard international fire statistics report at this time.

Section 2.1 concluded that the goal of a comparative international report on fire experience should be support of Level I and Level II uses of fire statistics. These levels allow readers to compare the performance of their country to that of other developed ones on both overall fire losses and losses in a limited number of categories. However, the recommended levels do not include the very detailed combinations of classification dimensions necessary for the special studies defined as Level III.

In this context only the composite "Cause" dimension is recommended for treating causal factors in a comparative international report. Similarly the "Area Where Fire Began" dimension seems too detailed for use in the proposed report. That dimension and more specific causal information such as "Equipment of Ignition," "Form of Heat of Ignition," "Ignition Heat Source," "Type of Material First Ignited," "Form of Material First Ignited," "Material First Ignited," and "Ignition Factor" do provide a great deal of information useful for Level III studies. However, they would add unnecessary detail to Level I and II reporting. Instead, countries should classify their fire incidents along these more detailed dimensions, so that special studies are feasible, and aggregate for international reporting as described in Section 4.

3. PROPOSED REPORT DESIGN

The purpose of this section is to suggest a structure for the reporting of international fire loss comparisons responsive to the Level I and Level II needs described in Section 2.1. The report is a document based on the submissions of the various cooperating nations. The tables and figures described in this section generally outline structure rather than specify a rigid format to which complete adherence is required. In addition to the various tables and figures that are suggested, the need exists to prepare a narrative description that highlights the major findings.

3.1 National Level I Analyses

In Section 2.1 the various levels of comparisons were discussed. Level I relates to broad, national comparisons. The comparisons may be for one time period or relate to time trends. If time trends are of interest, the blocks will generally span a period of two to four years, with three years being the preferable block.

Since the comparisons are international in scope, one dimension of each exhibit (table or figure) will be the countries which are participating. If the time periods covered by the data of the various countries is different, it is useful to indicate the time periods which are included.

Table 3-1 shows the structure of a Level I comparison of representative fire loss rates selected from those in Table 2-1. Note that the numerators all contain a loss measure related to building fires only. Thus, mobile and outside fires are excluded. There are numerous reasons for excluding mobile and outside fires. Deaths from mobile fires may or may not be attributed properly. Outside fires are a function of terrain and climatic conditions,

TABLE 3-1

EXAMPLE TABULATION OF OVERALL FIRE LOSS RATES

Nation	Building Fires/ 1,000 Persons	Building Fire Loss Per Capita	Building Fire Loss As % of GNP	Building Fire Deaths/ 1,000,000 Persons	Building Fire Injuries/ 1,000,000 Persons	Building Fire Loss/ Building Fire	Building Fire Deaths/ 1,000 Building Fires	Building Fire Injuries/ 1,000 Building Fires

involve little injury and few deaths, and frequently go unreported. Monetary losses are also difficult to estimate.

The second column heading, "Building Fire Loss Per Capita," must be expressed in some standard currency such as the U.S. dollar, British pound sterling, etc. This also applies to the next to last column heading.

Each of the indices in Table 3-1 can be shown in a time sequence by reporting site. The time periods will be macro in nature, say three years as discussed previously. An example of such a graphic comparison is shown in Figure 3-1.

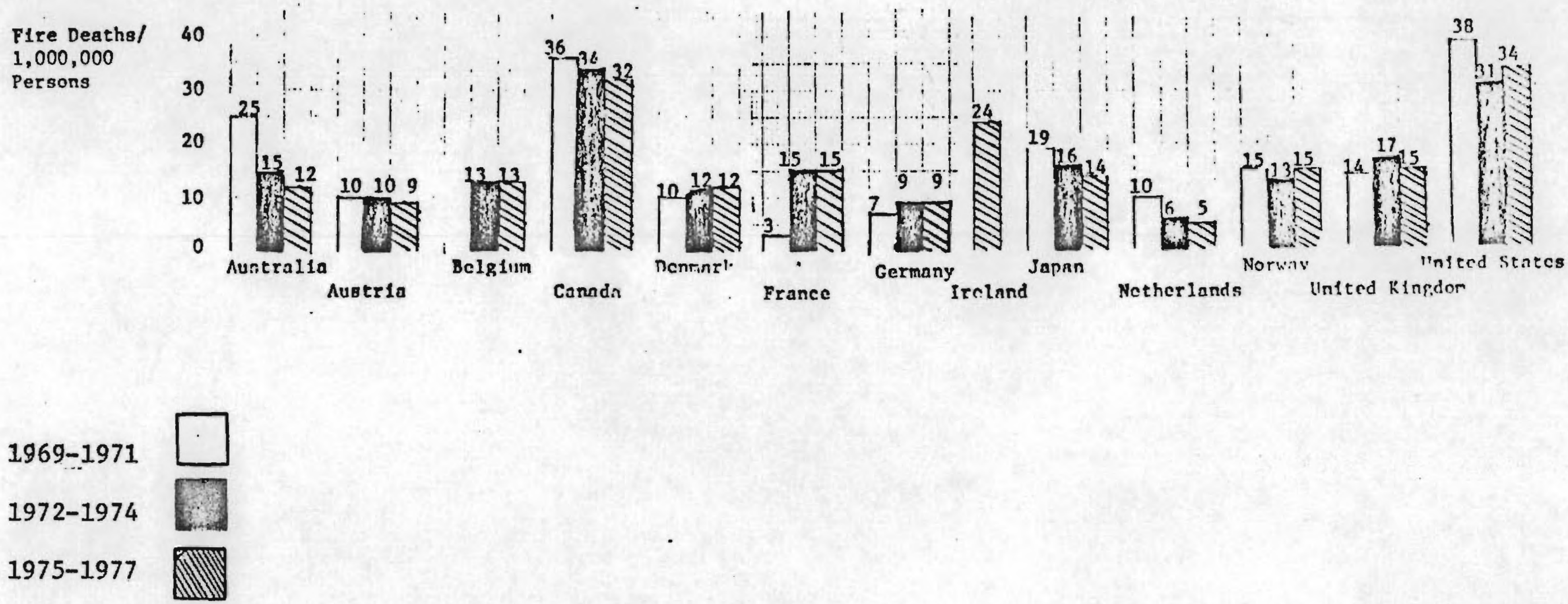
An alternative way of displaying the ratios in Table 3-1, or any of those in Table 2-1, is a two-way plot. Usually, the measure forming the numerator of the subject fire loss rate defines one axis; the rate's denominator supplies the other axis.

Figure 3-2 provides an example. Monetary building fire loss is plotted versus Gross National Product. A clear trend becomes immediately apparent to the reader.

The last example leads to a principle--that of innovation. New methods of display, new measures, and new indices should be investigated. Figure 3-3 is an example of a developed or derived analysis. Georgia Tech created a technological index for each nation from available statistics on the number of televisions, radios and telephones in various nations. Figure 3-3 plots the index versus a fire rate--fire deaths per million population. A suspicion that higher technology leads to increased chances of a fire and resulting death motivated the analysis. Since 3/4 of the countries have points in a cluster, no useful trend is indicated. Still, insight may be derived about connections between technological development and fire deaths.

FIGURE 3-1

ILLUSTRATIVE TIME TREND FIGURE FOR EXAMPLE INDEX



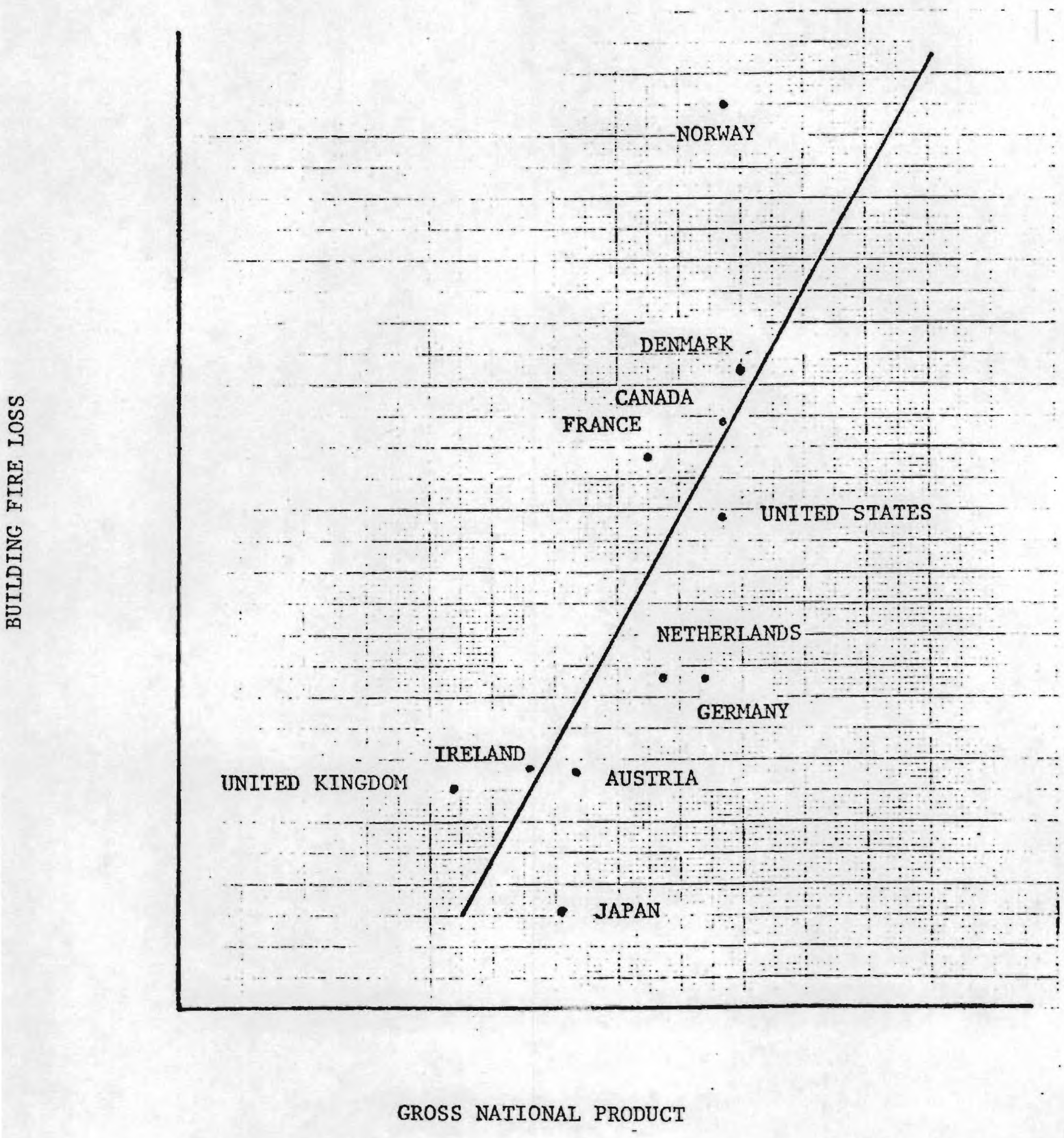


FIGURE 3-2: EXAMPLE TWO-WAY PLOT OF RELATIONSHIP BETWEEN MONETARY BUILDING FIRE LOSS & GROSS NATIONAL PRODUCT

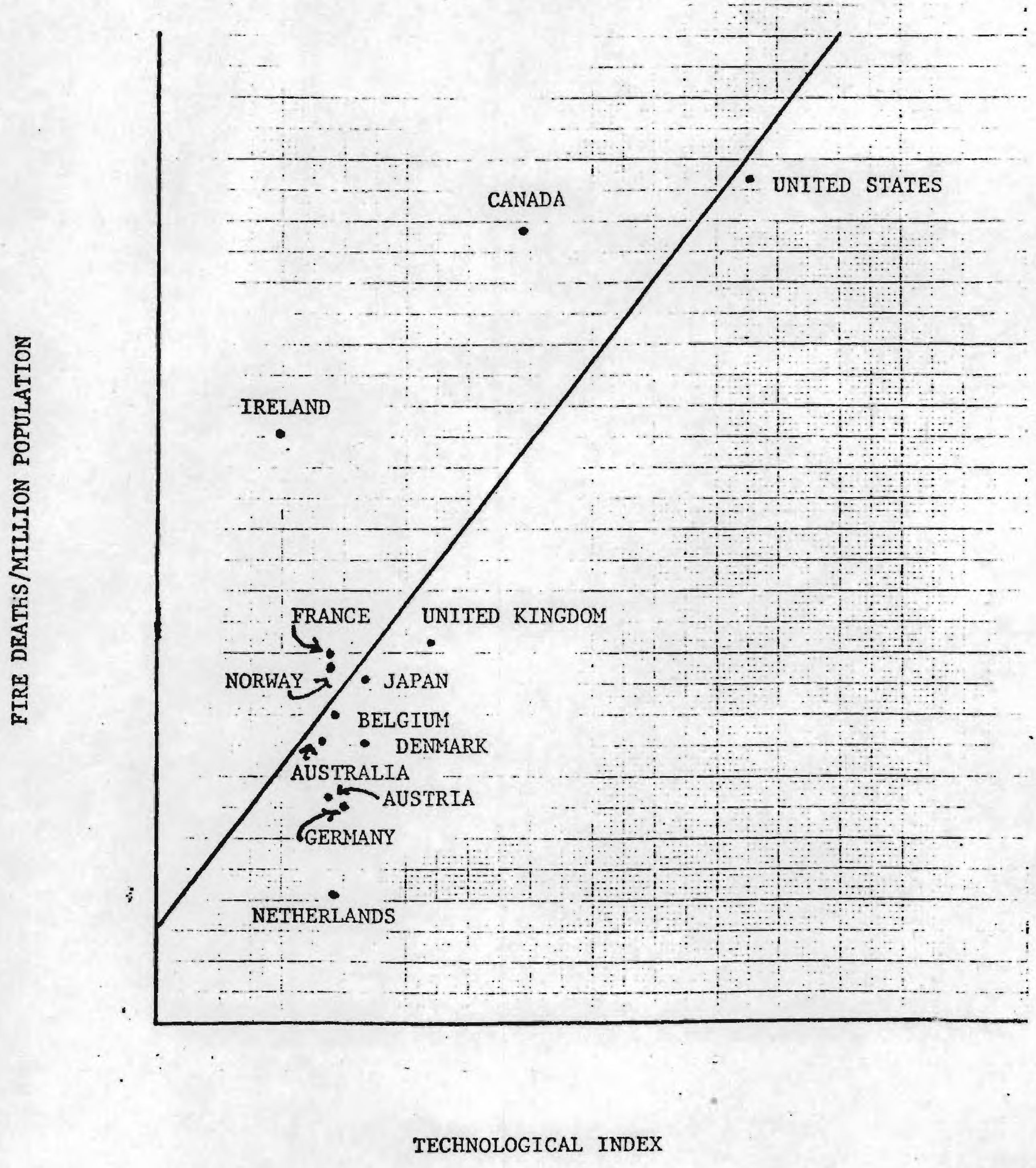


FIGURE 3-3: AN EXAMPLE OF A DERIVED ANALYSIS

3.2 Level I City Analysis

Nations are not the only geographic units for which fire losses can be internationally compared. Most fire loss occurs in urban areas, and many fire statistical agencies keep separate records by city.

If satisfactory data can be collected, the proposed report would profit from reporting of this city information. Volume would be too great to expand beyond Level I analysis, but city comparisons at that high level could be instructive.

Table 3-2 illustrates one city data format. A few fire loss rates are shown versus participating cities. To distinguish patterns in different types of cities, data are grouped by population class. Of course many other rates from Table 2-1 could be provided if data were available. Graphs like Figures 3-1 and 3-2 could also add understanding.

3.3 Level II-A Analysis

The discussion of Section 2.1 concluded that a proposed comparative international report on fire losses should extend beyond the broad tabulations of Level I to a more detailed Level II. Level II statistics are sufficiently classified to allow fire policy makers to isolate positive and negative elements of their national fire experience.

Level II analysis in the proposed report format would fall into two categories. Level II-A provides breakdowns along a number of axes, one at a time. Level II-B involves the pairing of these axes. This two-step approach not only aids the reader, but encourages participation. Some countries may be able to report only at Level II-A.

Drawing on the discussion of Section 2.6, four dimensions or axes are suggested for Level II-A analysis. These are "Property Use/Occupancy", "Cause", "Victim Age" and "Victim Sex".

TABLE 3-2

EXAMPLE ANALYSIS OF CITY FIRE LOSSES

CITY	PROTECTED POPULATION IN (1,000'S)	NUMBER OF REPORTED FIRES [1/]	NUMBER OF REPORTED FIRE DEATHS [1/]	FIRES PER 10,000 POPULATION	DEATHS PER MILLION POPULATION
Group A (over 1,000,000)					
Tokyo	11,247	7,759	146	7	13
London	7,083	42,077	111	59	16
New Delhi (1978)	6,500	3,234	63	5	10
Hong Kong	4,567	10,434	40	23	9
Istanbul (1976)	3,418	2,907	37	9	11
West Midlands (1977-78)	2,727	12,866	27	47	10
Greater Manchester	2,711	23,375	62	56	23
Melbourne (1976-77)	2,649	8,475	15	32	6
Manila	2,459	7,887	34	12	14
Singapore	2,317	4,048	37	17	16
Johannesburg	2,283	1,432	13	6	6
Berlin	2,047	6,377	29	31	14
Hamburg	1,697	4,988	10	29	6
Merseyside (1978)	1,576	1,887	21	12	13
Kent	1,465	5,378	22	38	15
Essex (1977-78)	1,456	6,392	17	44	12
Lancashire (1977-78)	1,348	7,819	26	58	19
Brussels (1977-78)	1,175	2,250	16	20	13
Montreal (1976, 1978)	1,060	6,193	43	58	39
Group A Average Rate				29.6	13.9
Group B (500,000 to 1,000,000)					
Hertfordshire (1976-77)	938	5,336	11	57	12
Lothian & Borders (1978)	930	6,396	26	69	28
Avon (1976, 1978)	918	4,678	10	51	11
Capetown	892	2,036	30	23	34
Amsterdam	727	2,637	17	36	24
Brisbane	709	3,488	7	50	10
Stockholm (1977-78)	656	5,628	29	86	44
Frankfurt (1976, 1978)	635	2,632	7	41	11
Rotterdam	600	2,867	7	48	12
Group B Average Rate				51.2	20.7
Group C (250,000 to 500,000)					
Helsinki (1977-78)	490	1,570	9	32	18
Edmonton	474	2,586	12	5	25
Oslo	460	1,366	7	30	15
Vancouver (1977-78)	410	2,866	13	70	32
Hamilton	312	2,363	14	76	45
Ottowa	306	3,793	8	124	26
Bonn (1976, 1978)	284	681	4	24	18
Group C Average Rate				51.6	25.6

[1/] Average for 1976-78 unless otherwise indicated.

3.3.1 Main Property Type. The first dimension is that of "Property Use/Occupancy". Occupancy can be considered in several ways. The primary separation concerns structure fires as follows:

- Building structures, both residential and non-residential.
- Non-building structures, including vehicles and outside property.

The two classifications above may be further divided in a four way format consisting of the following:

- Residential
- Non-residential
- Vehicle
- Outside

These four may be called the "Major Property Types". The rates of fires, deaths, injuries and monetary loss can now be displayed according to major property types. Table 3-3 displays a suggested format.

Although the raw numbers convey little to the reader, the rates are quite revealing. For example, one nation may have an excessively high residential death rate compared to another nation. This could be considered as a "weakness" and would serve to isolate the residential sector as a problem area that needs to be investigated further.

Table 3-3 contains columns showing the percent distribution of entries for each nation. As fire experience totals are subdivided into categories, such percents highlight differences in various nation's experience.

The percentages in Table 3-3 also invite a clarifying pictoral representation of the information. Pie charts can be created for each country showing how losses are distributed among occupancy classes. Figure 3-4 illustrates such charts for numbers of fires. Similar graphs should be included for all loss measures.

TABLE 3-3

EXAMPLE TABLE OF FIRE LOSS BY MAJOR PROPERTY TYPE

	NATION 1			...	NATION N		
	NUMBER	RATE 1/	PERCENT 2/	...	NUMBER	RATE 1/	PERCENT 2/
RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
NON-RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
VEHICLES							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
OUTSIDE PROPERTY							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
TOTAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							

1/ Rates are the same as those in Table 3-1

2/ Percents are formed from the ratio of number in property type divided by number in "Total" multiplied by 100.

3/ Monetary Losses must be stated in an accepted currency at a given year.

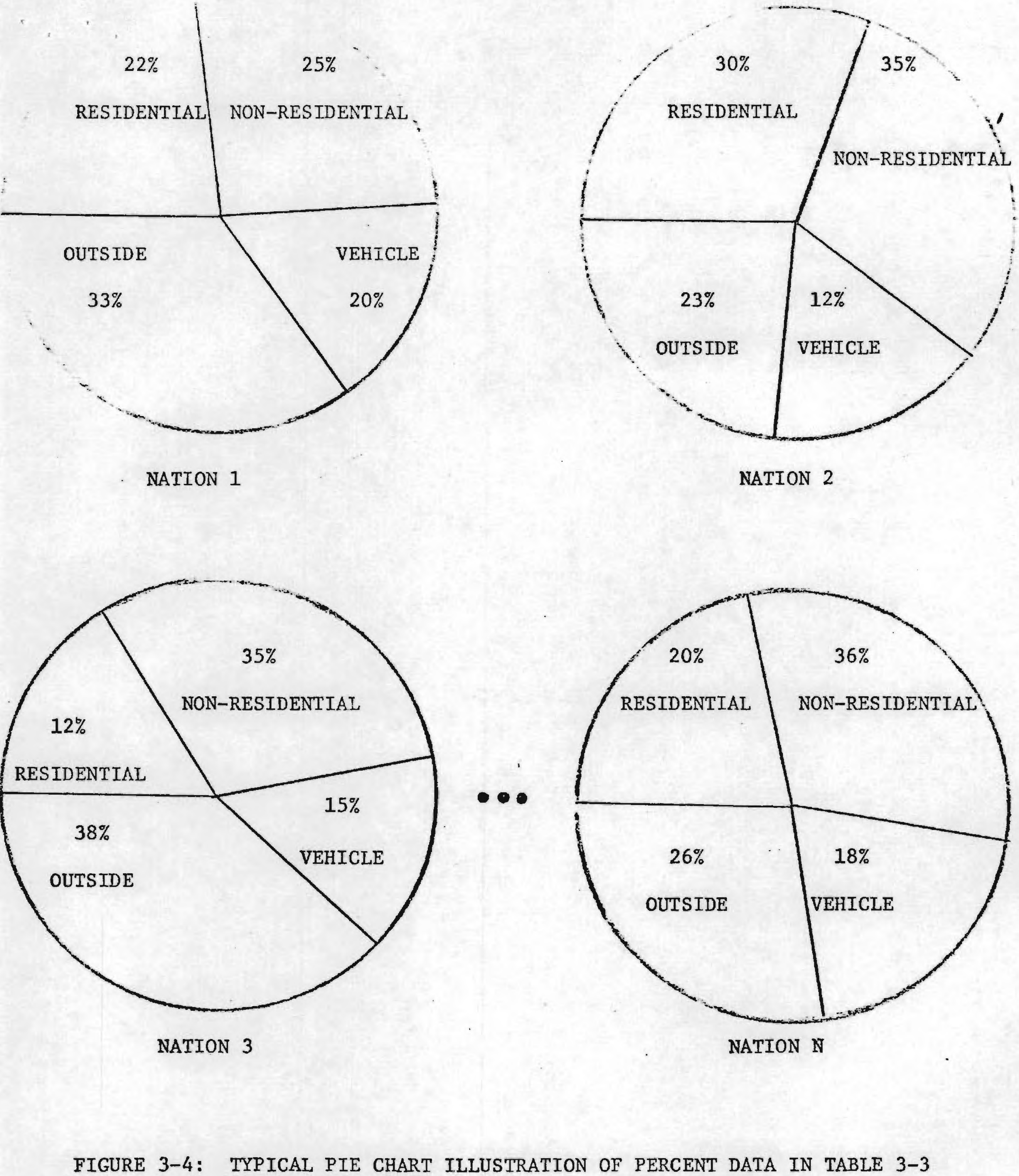


FIGURE 3-4: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-3

3.3.2 Occupancy Sub-classes. It is also possible, and recommended, that the four major occupancy classes be broken into sub-classes and the losses attached to each sub-class. This will yield an extension and refinement of Table 3-3.

There are numerous ways to break the classes into sub-classes. The following are suggested in Section 4:

- Residential
  - One and Two Family
  - Multi-Family
  - Mobile Homes
  - Hotels, Motels and Inns
  - Other Residential
- Non-Residential
  - Restaurants, Cafes and Bars
  - Theaters, Auditoriums
  - Education and Churches
  - Institutions
  - Stores
  - Offices
  - Basic Industry
  - Manufacturing
  - Storage
  - Vacant and Construction
  - Other Non-Residential
- Vehicle Fires
  - Automobiles
  - Other Highway Vehicles
  - Rail

- Water
- Air
- Other Mobile Property

- Outside
  - Refuse
  - Crops
  - Forests
  - Open Field and Brush
  - Other Outside

The next set of suggested tables would portray the losses (fires, deaths, injuries, and monetary) for each sub-class. An example of one of the four possible tables (this one for residential property) is shown as Table 3-4. A similar table would be prepared for non-residential, mobile, and outside property.

As with Table 3-3 above, the percent values in analyses like Table 3-4 can be illustrated with pie charts. Figure 3-5 shows the type of charts that would derive from the residential loss data of Table 3-4. Such charts are recommended for all four loss measures and all four major property types.

3.3.3 Cause. A second dimension to be considered in Level II-A is cause. Possible cause categories are developed in Section 4 of this report. They include

- Children Playing
- Incendiary and Suspicious
- Heating
- Cooking
- Appliances
- Industrial Machinery
- Electrical Distribution
- Smoking
- Open Flame or Spark

TABLE 3-4

EXAMPLE TABULATION OF RESIDENTIAL FIRE LOSSES

	NATION 1			...	NATION N		
	NUMBER	RATE[1/]	PERCENT[2/]	...	NUMBER	RATE[1/]	PERCENT[2/]
ONE AND TWO FAMILY							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
MULTI-FAMILY							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
MOBILE HOMES							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
HOTELS, MOTELS AND INNS							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
OTHER RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
TOTAL RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							

1/ Rates are the same as those in Table 3-1.

2/ Percents are formed from the ratio of number in property type divided by number in "Total" multiplied by 100.

3/ Monetary Losses must be stated in an accepted currency at a given year.

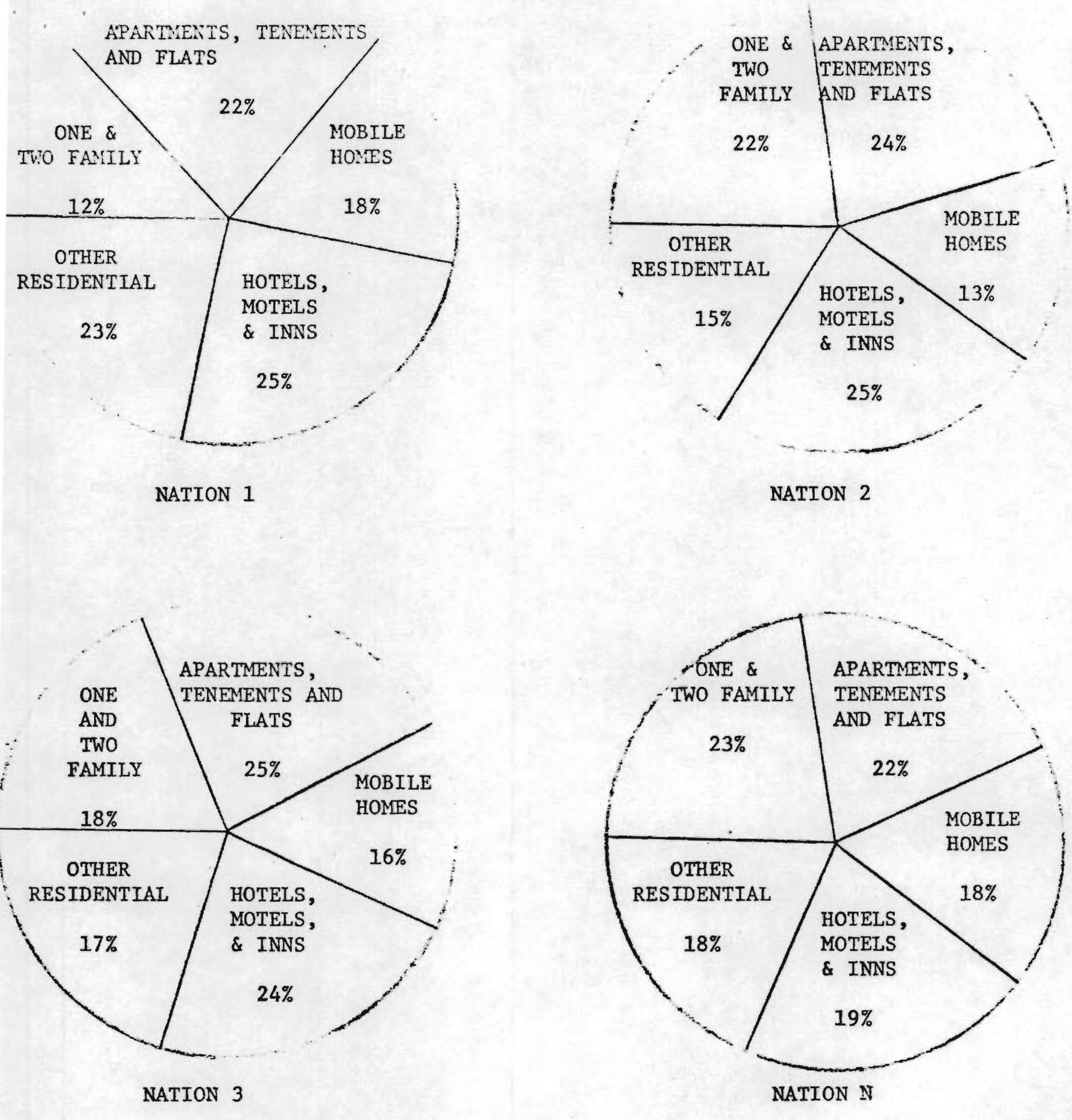


FIGURE 3-5: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-4

- Explosives and Fireworks
- Natural Sources
- Spread from Other Fire
- Other Causes

It is suggested that one table show all of the losses associated with the various causes. Such an exhibit might appear as in Table 3-5. Corresponding pie charts are shown in Figure 3-6.

3.3.4 Victim Grouping. The next set of Level II-A tables and figures concern victim groupings. The victim analysis shows the age and sex of persons killed or injured in fires. Two tables are suggested. These tables are of the same format except that one of them pertains to deaths while the other pertains to injuries. An example is shown as Table 3-6. Both age and sex are classified. Figure 3-7 illustrates the corresponding pie chart distributions.

3.3.5 Trends. Any of the foregoing Level II-A analyses could be supplemented by figures or tables reflecting time trends. However, the number of possibilities is enormous. There are up to four loss rates on ten to fifteen countries and numerous classifications for each. Even a bar graph treatment of the four main occupancy classifications could lead to 16 charts like Figure 3-1. Thus, although they might be informative, such time comparisons are not recommended at Level II-A.

3.4 Level II-B

Level II-B pairs the dimensions that were presented singly at Level II-A. For reasons of accuracy and reliability already described several times, it is proposed to limit such detail development to building fires.

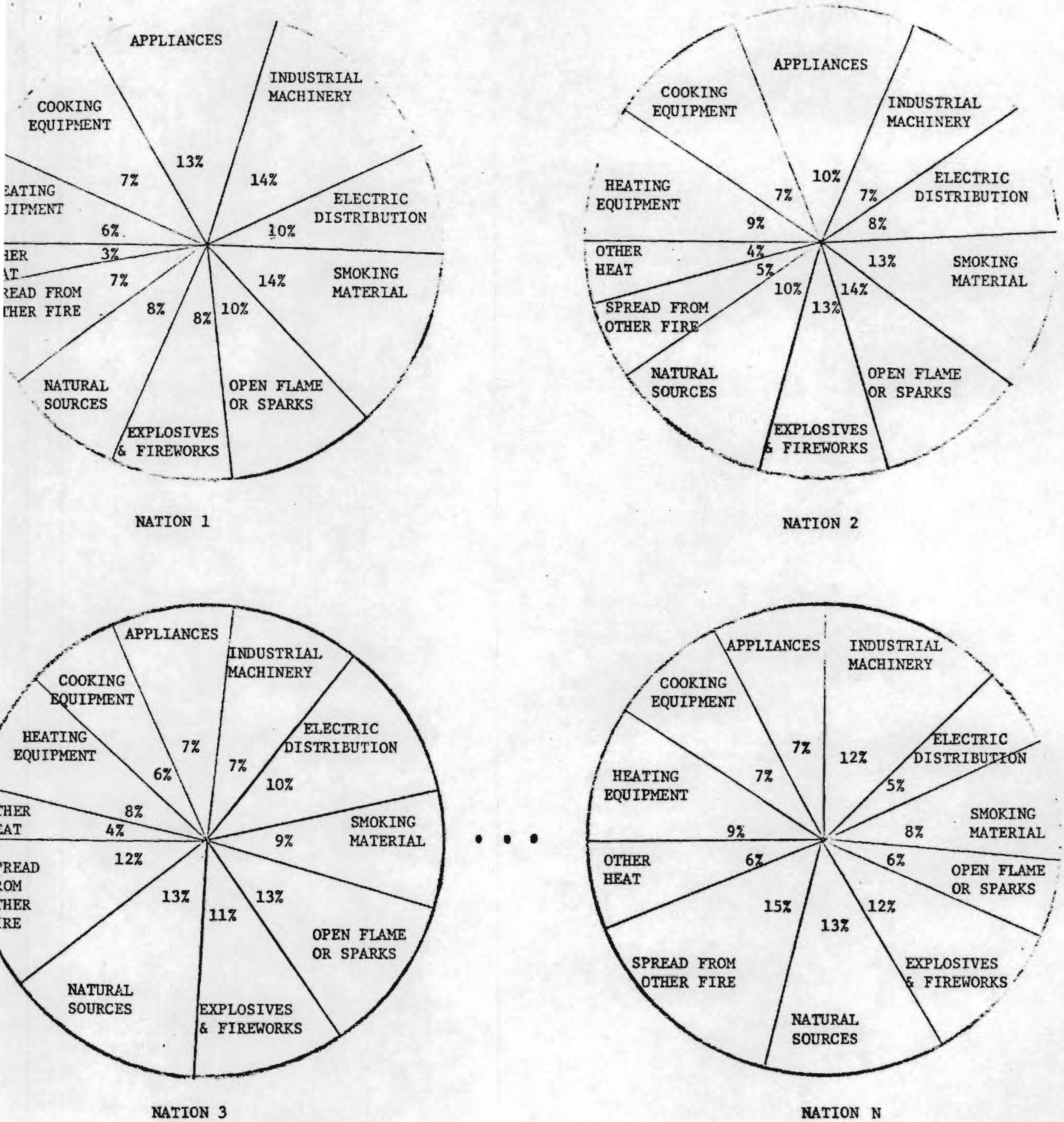


FIGURE 3-6: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-5

TABLE 3-5

EXAMPLE LEVEL II-A TABULATION OF FIRE LOSS BY CAUSE 4/ 5/

NATION	CHILDREN PLAYING Number	Rate 1/	Percent 2/	INCENDIARY & SUSPICIOUS Number	Rate 1/	Percent 2/	TOTAL Number	Rate 1/	Percent 2/
1.									
Fires									
Deaths									
Injuries									
Monetary Losses 3/									
2.									
Fires									
Deaths									
Injuries									
Monetary Losses 3/									
.									
.									
.									

1/ Rates are the same as those in Table 3-1.

2/ Percents are of total at right

3/ Monetary Losses must be stated in an accepted currency at a given year.

4/ Causes are those shown in Section 4.2.

5/ Unknown Causes are apportioned to remaining causes.

TABLE 3-6

EXAMPLE OF LEVEL II-A ANALYSIS OF
DEATH BY AGE AND SEX

	0-4			5-14			15-24			25-44			44-64			65+			Total		%
Nation	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/
1.																					
Male																					
Female																					
Total																					
2.																					
Male																					
Female																					
Total																					
.																					
.																					
.																					

1/ Rates are as in Table 3-1

2/ Percent is of total at right

3/ Percent is of total at bottom

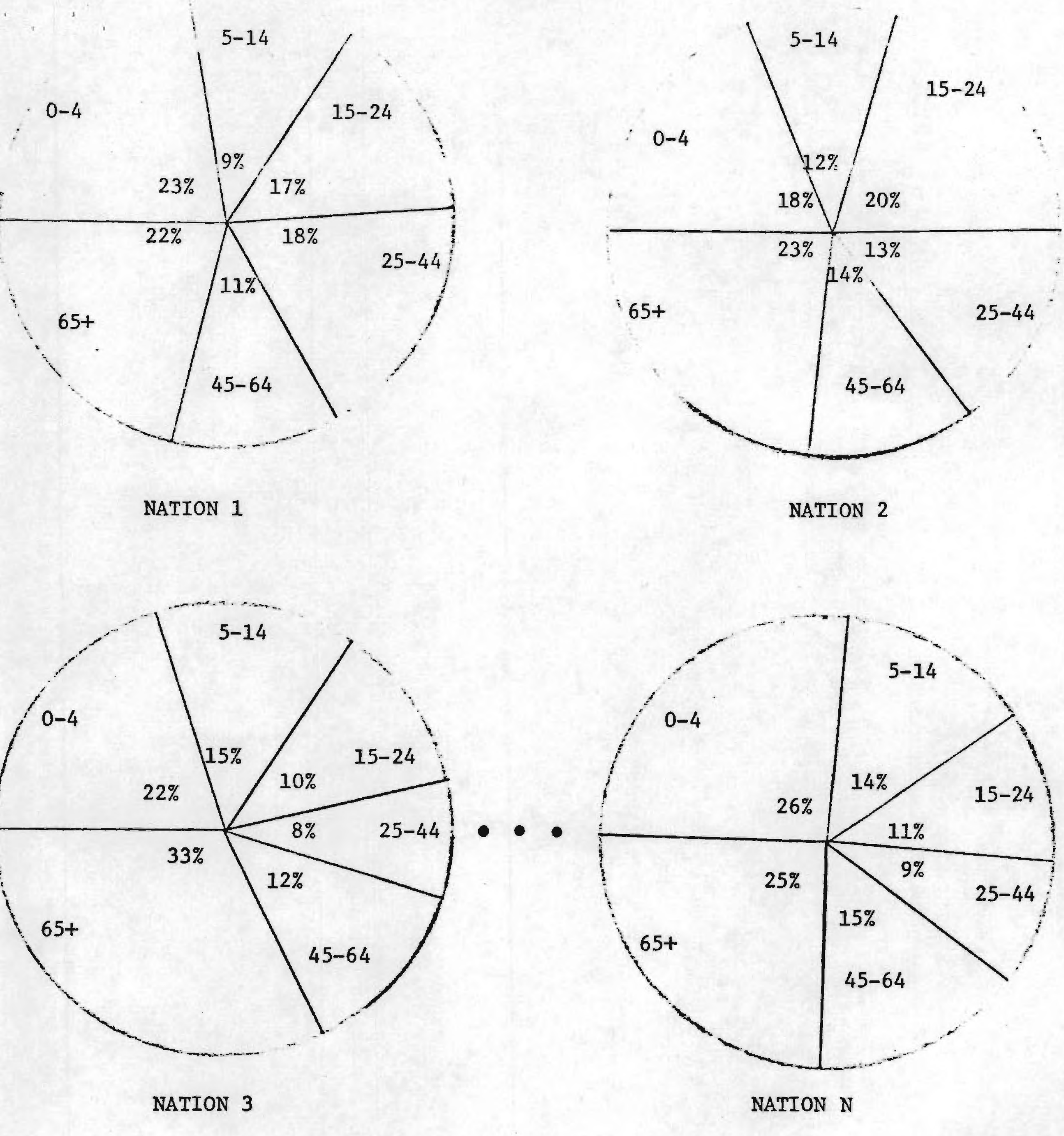


FIGURE 3-7: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-6

Table 3-7 shows possible pairings and their desirability. There are six possible pairings and four types of losses giving a possibility for 24 tables. However, occupancy can be either residential or non-residential. Thus, the total possible number of tables is 36. Victim breakdowns are meaningful only for deaths and injuries. This eliminates the twelve cells (24 tables) shown as blank in Table 3-7.

Eliminating these 24 tables still leaves 16. Eight (four cells) of these are marked with an "X" in Table 3-7 and are recommended. These are residential fires by cause and occupancy subclass and non-residential fires by cause and occupancy subclass versus each of the four fire measures. An example of such a table is shown in Table 3-8. This is an actual table taken from a recent report [ ]. The rates in Table 3-8 are per capita.

Eight cells (16 tables) in Table 3-7 are marked with an "O" to indicate that they are optional. They may be informative but are not required to have a sufficient report. Perhaps one table from the residential occupancy sub-class versus age could be prepared and one table from the cause versus age category.

3.5 Collected Recommendations

The tables and figures suggested throughout this section are summarized in Table 3-9. However, in some cases charts illustrating tabular data may not be instructive enough to merit inclusion. Also further cross-comparisons (those marked by circles in Table 3-7) might be added. Still, an outline similar to the one in Table 3-9 would provide an excellent comparative review of international fire loss.

TABLE 3-7

POSSIBLE LEVEL II-B DIMENSION PAIRINGS AND THEIR DESIRABILITY

PAIRING	TYPE OF LOSS			
	FIRES	DEATHS	INJURIES	MONETARY LOSSES
Occupancy Sub-Class (Building Only) Versus Cause	X	X	X	X
Occupancy Sub-Class (Building Only) Versus Age		O	O	
Occupancy Sub-Class (Building Only) Versus Sex		O	O	
Cause Versus Age		O	O	
Cause Versus Sex		O	O	
Age Versus Sex				

X - Recommended

O - Possibly Useful

blank - Not Recommended

E-24-605

SCHOOL OF INDUSTRIAL AND SYSTEMS ENGINEERING

Atlanta, Georgia 30332 (404) 894-2300

October 24, 1980

Dr. Henry Tovey
National Fire Data Center
United States Fire Administration
FEMA
Washington, DC 20472

Dear Henry:

This letter transmits five draft copies of our report

"International Comparisons of Fire Loss: A Suggested Plan"

and one draft copy of our

"Highlights of Selected International Comparisons of Reported Fire Loss".

These two reports are the remaining deliverables under our grant USFA-79065 "Determinants of International Differences in Reported Fire Loss: Update".

I am sure USFA will have some suggestions for improving the drafts. In the past it has proved useful to discuss such proposals face-to-face.

Accordingly, Jerry Banks and I would like to propose visiting USFA on Thursday, November 20, 1980. That date should give you time to circulate the two new drafts, and also to complete final review on the "Selected International Comparisons of Reported Fire Loss" report we submitted in September.

Please call me about the schedule when you have had a few moments to consider it.

Sincerely,

Ronald L. Rardin, Ph.D.
Principal Investigator

RLR:sb

cc: Jerry Banks
~~Dwayne~~ DUANE Hutchison

Enclosures

TABLE 3-8

EXAMPLE LEVEL II-B TABLE CROSS CLASSIFYING RESIDENTIAL SUBCLASS AND CAUSE

			COOKING	SMOKING	HEATING	INCENDIARY/ SUSPICIOUS	ELECTRICAL DISTRIBUTION	APPLIANCES	CHILDREN PLAYING	OPEN FLAMES, TORCHES	EXPOSURE	NATURAL	OTHER	TOTAL	PERCENT
ONE AND TWO FAMILY	UNITED STATES	-No.	91886	42442	128439	54803	49498	43609	34219	24192	15385	8276	37713	530522	75.2%
		-Rate	42.5	19.6	59.4	25.3	22.9	20.2	15.8	11.2	7.1	3.8	17.5	245.2	
	NEW SOUTH WALES	-No.	786	209	413	102	325	312	94	150	17	12	137	2557	73.4%
		-Rate	16.0	4.3	8.5	2.1	6.7	6.4	1.9	3.1	0.4	0.2	2.8	52.7	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	35444	65.7%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	63.5	
APARTMENTS, TENEMENTS AND FLATS	UNITED STATES	-No.	33685	25509	8444	18985	6511	7617	7617	5112	4145	687	8850	127162	18.0%
		-Rate	15.6	11.8	3.9	8.8	3.0	3.5	3.5	2.4	1.9	0.3	4.0	58.8	
	NEW SOUTH WALES	-No.	331	140	77	24	72	72	24	9	3	-	16	768	22.0%
		-Rate	6.8	2.9	1.6	0.5	1.8	1.5	0.5	0.2	0.1	-	0.3	15.8	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	14705	27.3%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	26.3	
MOBILE HOMES	UNITED STATES	-No.	3640	1848	5769	1958	4370	2043	783	949	1006	221	1201	23788	3.4%
		-Rate	1.7	0.9	2.7	0.9	2.0	0.9	0.4	0.4	0.5	0.1	0.6	11.0	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	107	123	237	50	-	84	240	-	5	302	1148	2.1%
		-Rate	-	0.2	0.2	0.4	0.1	-	0.2	0.4	-	0.1	0.5	2.1	
HOTELS, MOTELS, & INNS	UNITED STATES	-No.	1066	5110	954	3114	909	701	141	407	155	100	856	12613	1.8%
		-Rate	0.5	2.4	0.4	1.5	0.4	0.3	0.1	0.2	0.1	0.1	0.4	5.8	
	NEW SOUTH WALES	-No.	22	62	16	1	20	17	2	8	-	-	12	160	4.6%
		-Rate	0.5	1.3	0.3	0.1	0.4	0.4	0.1	0.2	-	-	0.3	3.3	
	UNITED KINGDOM	-No.	408	378	206	213	184	49	38	94	-	8	119	1697	3.1%
		-Rate	0.7	0.7	0.4	0.4	0.3	0.1	0.1	0.2	-	0.1	0.2	3.0	
OTHER RESIDENTIAL	UNITED STATES	-No.	1641	1314	2778	2179	805	730	610	760	177	102	548	11644	1.6%
		-Rate	0.8	0.6	1.3	1.0	0.4	0.3	0.3	0.4	0.1	0.1	0.3	5.4	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	931	1.7%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	1.7	
TOTAL RESIDENTIAL	UNITED STATES	-No.	131918	76223	146384	80139	62093	54700	43370	31420	20868	9386	49228	705729	
		-Rate	61.0	35.2	67.7	37.0	28.7	25.3	20.0	14.5	9.6	4.3	22.8	326.2	
		-Percent	18.7%	10.8%	20.7%	11.4%	8.8%	7.8%	6.1%	4.5%	3.0%	1.3%	7.0%	100%	
	NEW SOUTH WALES	-No.	1139	411	506	127	417	401	120	167	20	12	165	3485	
		-Rate	23.5	8.5	10.4	2.6	8.6	8.3	2.5	3.4	0.4	0.2	3.4	71.8	
		-Percent	32.7%	11.8%	14.5%	3.6%	12.0%	11.5%	3.4%	4.8%	0.5%	0.3%	4.7%	100%	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	53925	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	96.5	
		-Percent	-	-	-	-	-	-	-	-	-	-	-	100%	
	NETHERLANDS	-No.	1478	315	1255	432	372	227	1682	765	8	36	489	7059	
		-Rate	10.7	2.3	9.1	3.1	2.7	1.6	12.2	5.6	0.1	0.3	3.5	51.2	
		-Percent	20.9%	4.5%	17.8%	6.1%	5.3%	3.2%	23.8%	10.8%	0.1%	0.6%	6.9%	100%	

TABLE 3-9

SUMMARY OF RECOMMENDED REPORT TABLES AND FIGURES

		Presentation Form
1.	National Fire Loss Rates for (time period)	Table
2.	Trends in National Loss Rates for (time period)	Bar charts for each rate
3.	Relations Between National Fire Loss Measures and Appropriate Social and Economic Indices for (time period)	Appropriate two-way plots
4.	City Fire Loss Rates for (time period)	Table
5.	Fire Loss by Major Property Type for (time period)	Table and pie charts for each loss measu
6.	Residential Fire Loss for (time period)	Table and pie charts for each loss measu
7.	Non-Residential Fire Loss for (time period)	Table and pie charts for each loss measu
8.	Vehicle Fire Loss for (time period)	Table and pie charts for each loss measu
9.	Outside Fire Loss for (time period)	Table and pie charts for each loss measu
10.	Fire Loss by Cause for (time period)	Table and pie charts for each loss measu
11.	Fire Deaths by Victim Age and Sex for (time period)	Table and pie charts for each sex group
12.	Fire Injuries by Victim Age and Sex for (time period)	Table and pie charts for each sex group
13.	Residential Fires by Occupancy Sub-Class and Cause for (time period)	One table for each fire loss measure
14.	Non-Residential Fires by Occupancy Sub-Class and Cause for (time period)	One table for each fire loss measure

4. DATA AGGREGATION

Sections 2 and 3 of this report proposed that only a few of the many classifiable dimensions of fire incidents be used in a standard international report on fire experience, but that data be collected at the most disaggregated level. In this section, detail is added on methods for accumulating low level information into aggregate values for a report. All dimensions are treated that were used in the report design of Section 3.

The definitional strategies used are generally those developed in the earlier Georgia Tech Report on Fire Data Collection and Preparation [ ]. However, some changes have been introduced because of experience in preparing the more recent report Selected International Comparisons of Fire Loss for 1975-78 [ ]. It should also be emphasized that all details of classification definition are merely proposals. General strategies are unlikely to change, but many of the specifics could be resolved in any one of a variety of acceptable ways. Concepts of this section offer only one possibility.

4.1 Techniques for Aggregation

If information is collected at a detail level and presented at an aggregate one, specific techniques must be developed for aggregation. One approach is the straight-forward summing of categories. Figure 4-1 illustrates how low-level subcategories are summed into major categories that together sum to the overall total.

Summing is the fundamental scheme by which hundreds of detail codes along a single classification dimension are reduced to a few meaningful categories. However, summing along single classification dimensions cannot

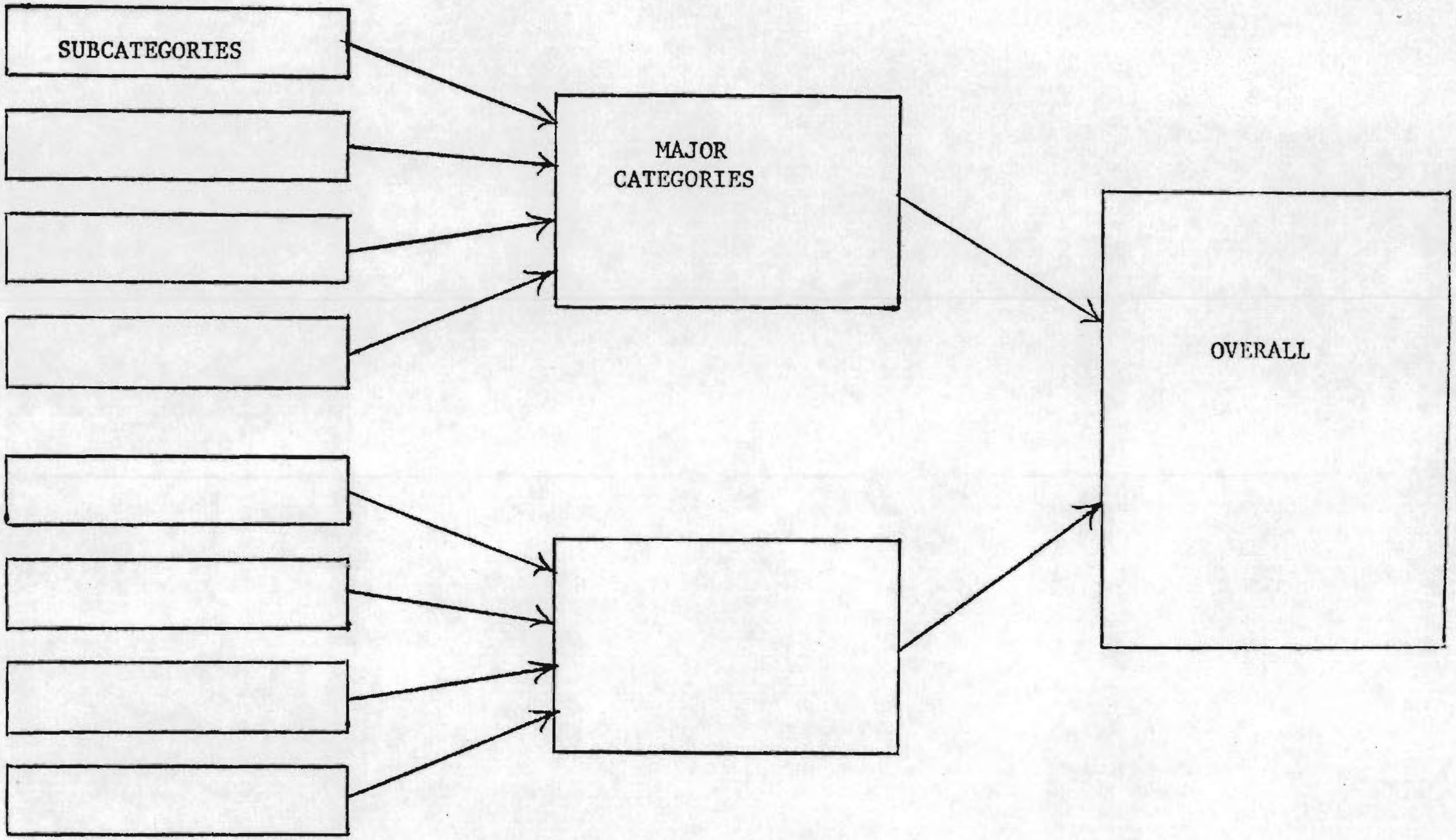


FIGURE 4-1: SUMMING APPROACH TO AGGREGATION WITHIN A DIMENSION

alone reduce multi-faceted fire experience data to a simple classification suitable for a standard international report. There are many available classification dimensions, Section 2.6 listed a number of these. If the information content of these many separate dimensions is to be reduced to one or two report dimensions, techniques must be conceived for combining dimensions.

Priority aggregation provides a natural method for combining dimensions. Figure 4-2 illustrates the idea. The population of fire incidents is represented by the double bordered diamond in that figure. All such incidents may be classified along either of two dimensions--primary and secondary. Priority aggregation takes these dimensions in a specified order. Incidents are first viewed from the primary dimension. Those that fall within any primary category of interest (a, b or c in Figure 4-2) are classified under that primary dimension category. Remaining incidents (primary categories d and e in this hypothetical example) are subdivided along the secondary classification dimension. The result is a composite dimension (of seven groups in Figure 4-2) reflecting some elements of both the primary and the secondary dimensions.

4.2 Treatment of Causal Factors

The principal use of priority aggregation in fire report preparation comes with the attribution of fire cause. Figure 4-3 illustrates the many possible schemes for viewing fire cause that were enumerated in Section 2.5. At the highest level is a single, composite "Cause" dimension. It is achieved by combining information about the ignition heat source, the ignition factor, and the material first ignited in the fire. Ignition heat source can, in turn, be viewed either in terms of the equipment of ignition

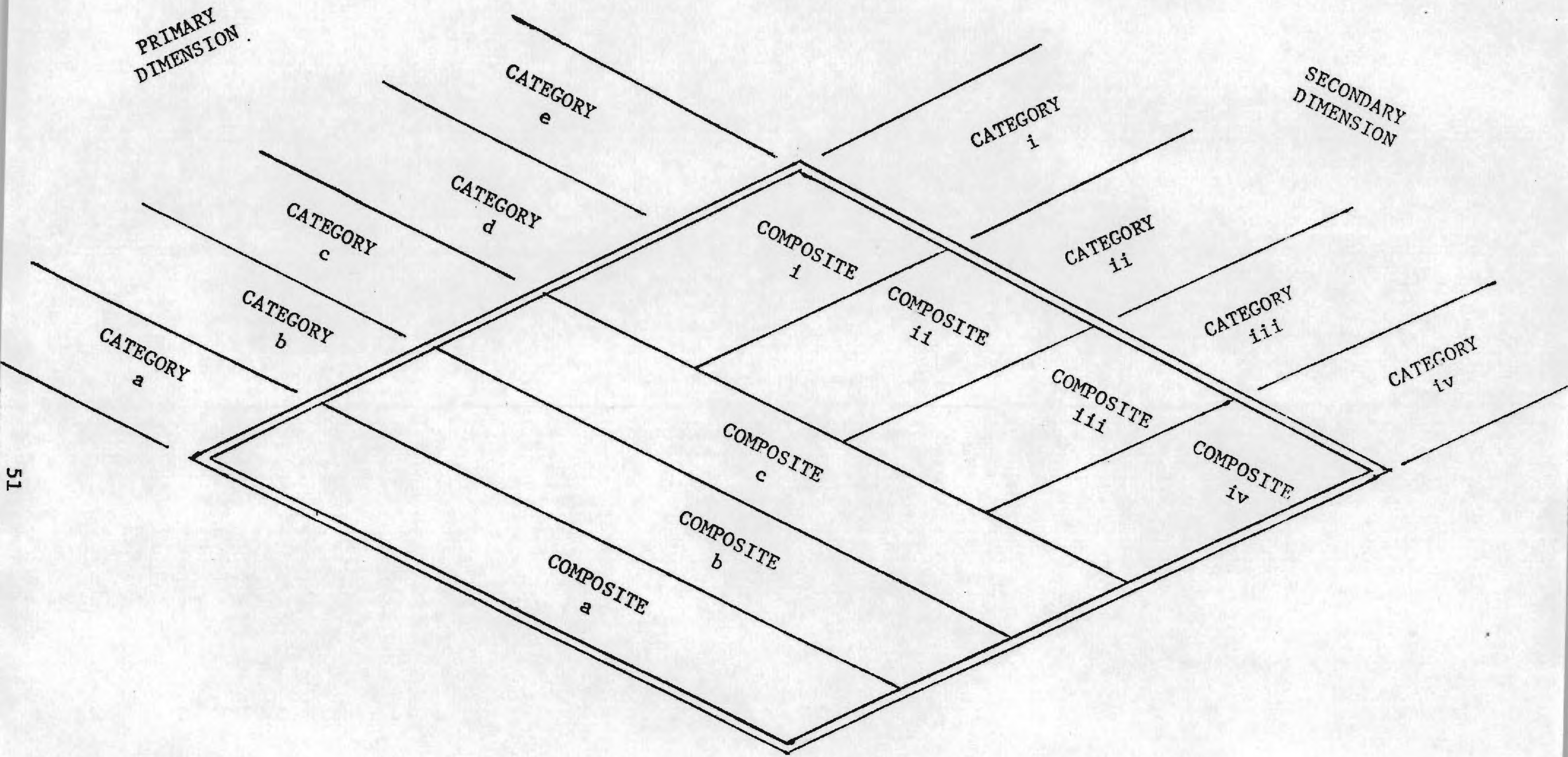


FIGURE 4-2: PRIORITY APPROACH TO AGGREGATION ACROSS DIMENSIONS

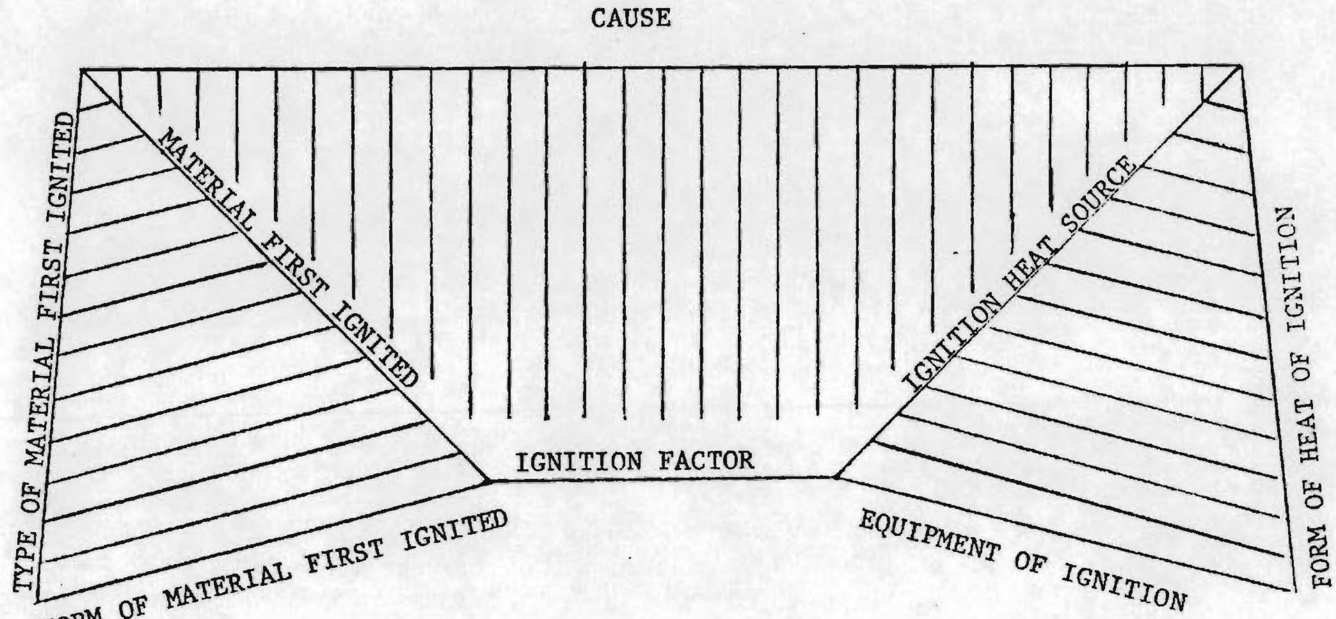


FIGURE 4-3: PRIORITY DERIVATION PATTERN FOR CAUSE DIMENSION USING SPECIFIC CAUSAL DIMENSIONS

or the form of the heat of ignition. Similarly, material first ignited has dimensions describing the form of the material and the type of material.

Georgia Tech's Report on Fire Data Collection and Presentation [ ] found individual countries using almost all combinations of these dimensions. Still, the only classification required in the proposed report of Section 3 is the composite "Cause". Thus, a scheme is required to obtain the needed "Cause" dimension from any likely combination of the causal factor dimensions.

Figure 4-4 through 4-7 detail a strategy providing just such flexibility. Figure 4-4 begins the process by offering a priority scheme for obtaining the composite "Ignition Heat Source" dimension from its component "Equipment of Ignition" and "Form of Heat of Ignition". Major equipment heat source categories are selected first, with remaining fire incidents being subdivided as to form of heat. The result is a composite "Ignition Heat Source" dimension that closely approximates those used by countries not classifying lower dimensions.

Figure 4-5 offers a similar scheme for obtaining material first ignited. The primary classification is the form of the material. Items not having a form of interest are organized according to the type of material.

Finally, Figures 4-6 and 4-7 show how a single "Cause" dimension is obtained from component "Ignition Factor", "Ignition Heat Source" and "Material First Ignited" axes. Certain ignition factors are selected first--incendiary and suspicious, and children playing. Most remaining incidents are classified according to the "Ignition Heat Source." In fact, Figure 4-6 presents an alternative using only those two dimensions. If further classification is desired "Material First Ignited" may be used as a tertiary classification dimension. Figure 4-7 illustrates the latter alternative. Either would appear satisfactory for purposes of a standard international report.

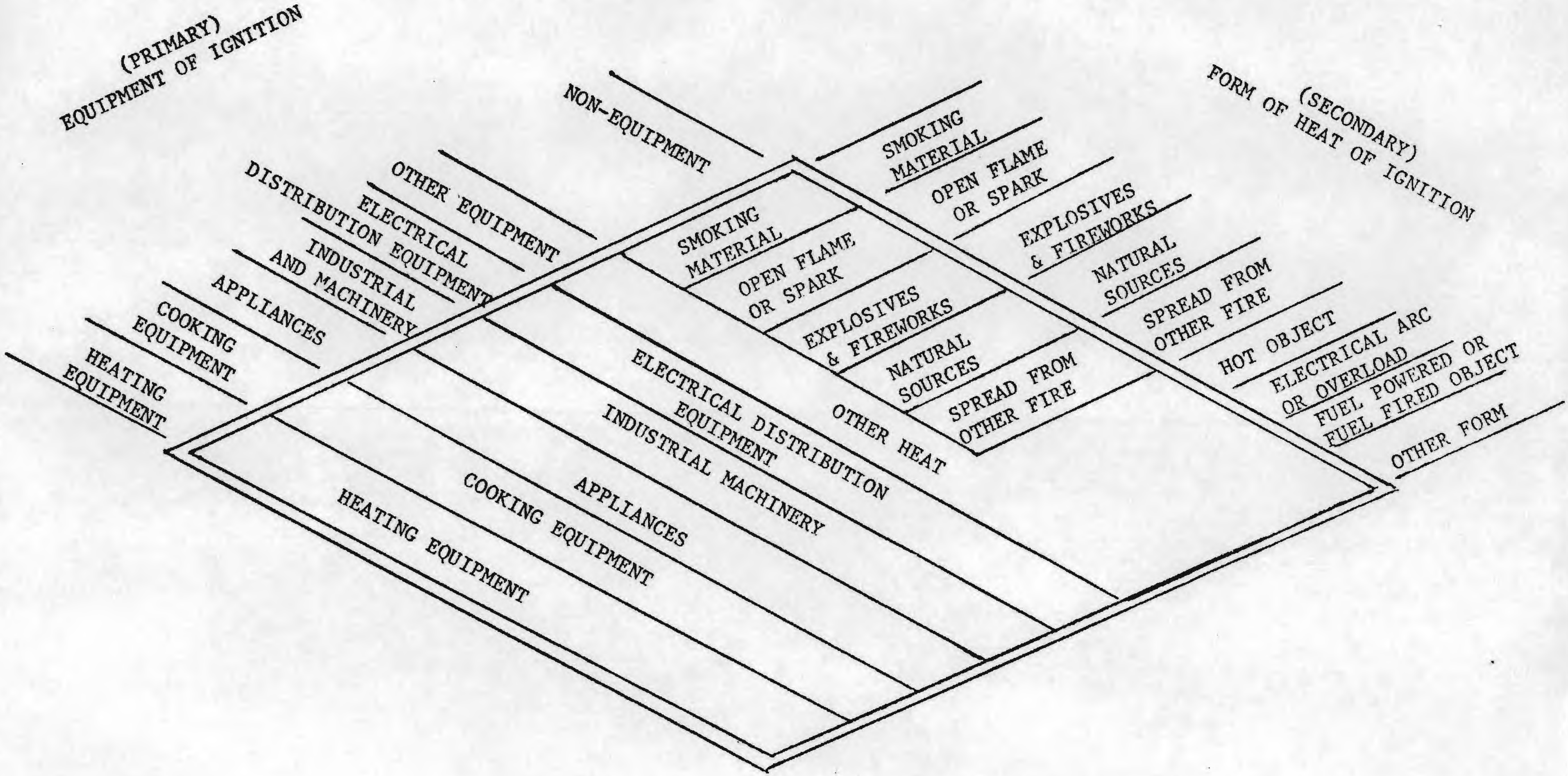


FIGURE 4-4: PRIORITY DERIVATION OF IGNITION HEAT SOURCE DIMENSION FROM EQUIPMENT OF IGNITION AND FORM OF HEAT OF IGNITION

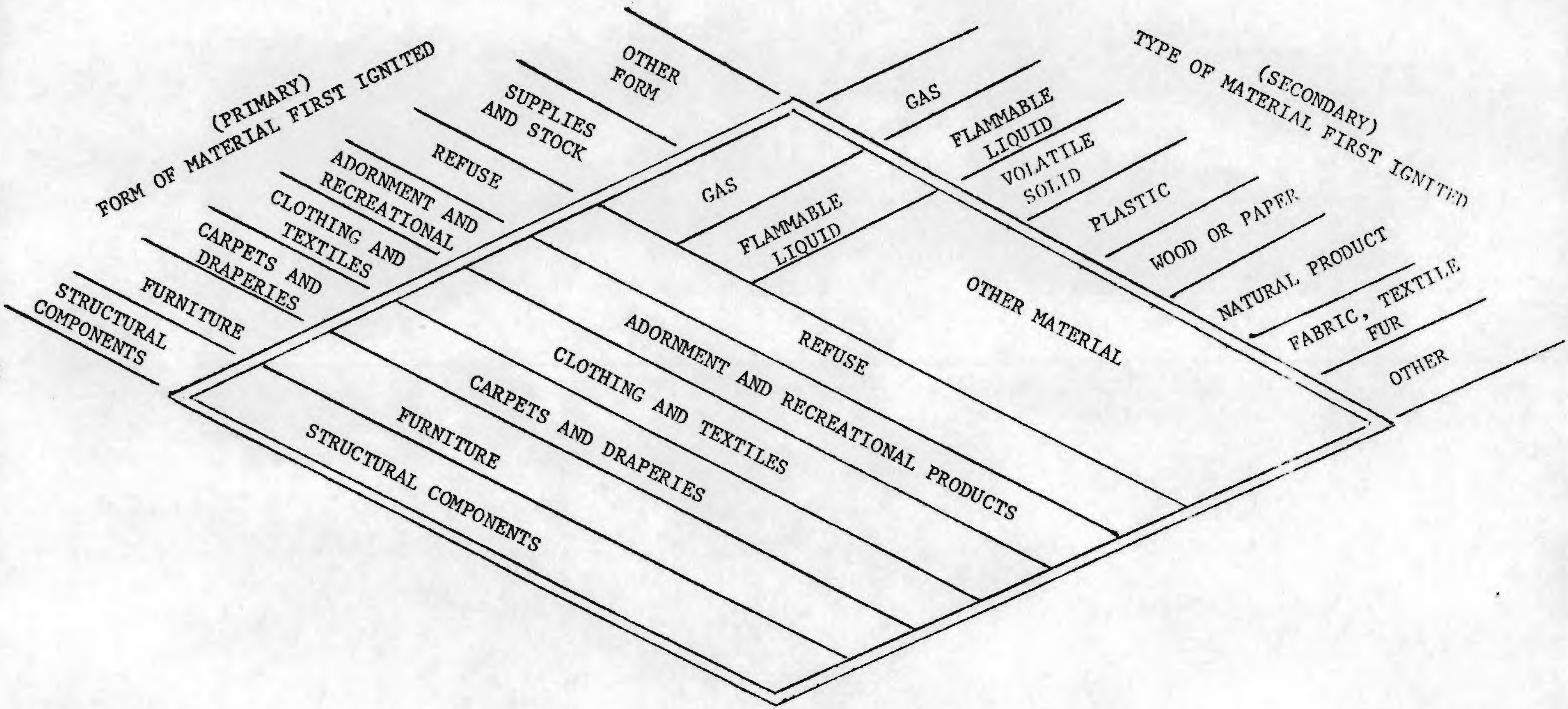


FIGURE 4-5: PRIORITY DERIVATION OF MATERIAL FIRST IGNITED DIMENSION FROM FORM OF MATERIAL FIRST IGNITED AND TYPE OF MATERIAL FIRST IGNITED

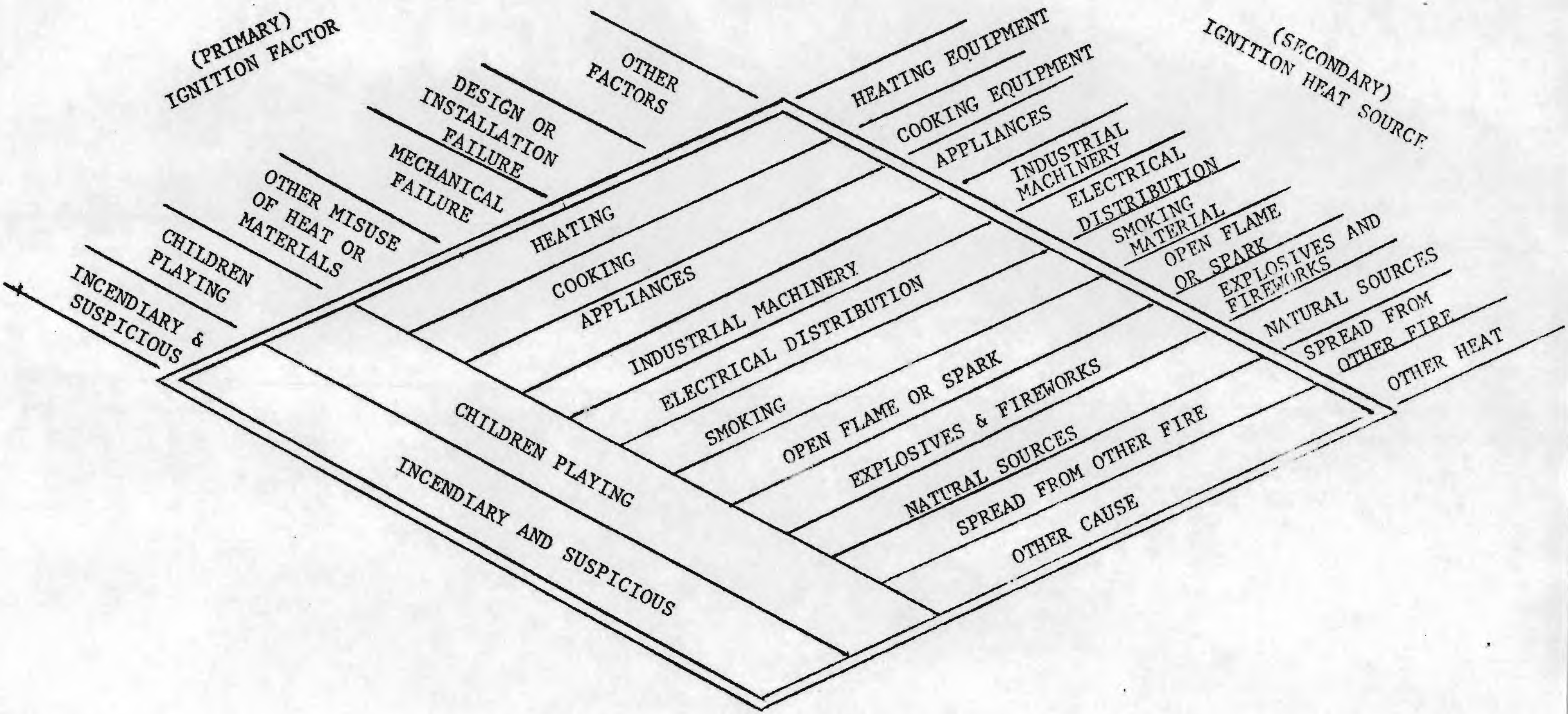


FIGURE 4-6: PRIORITY DERIVATION OF CAUSE DIMENSION FROM IGNITION FACTOR AND IGNITION HEAT SOURCE

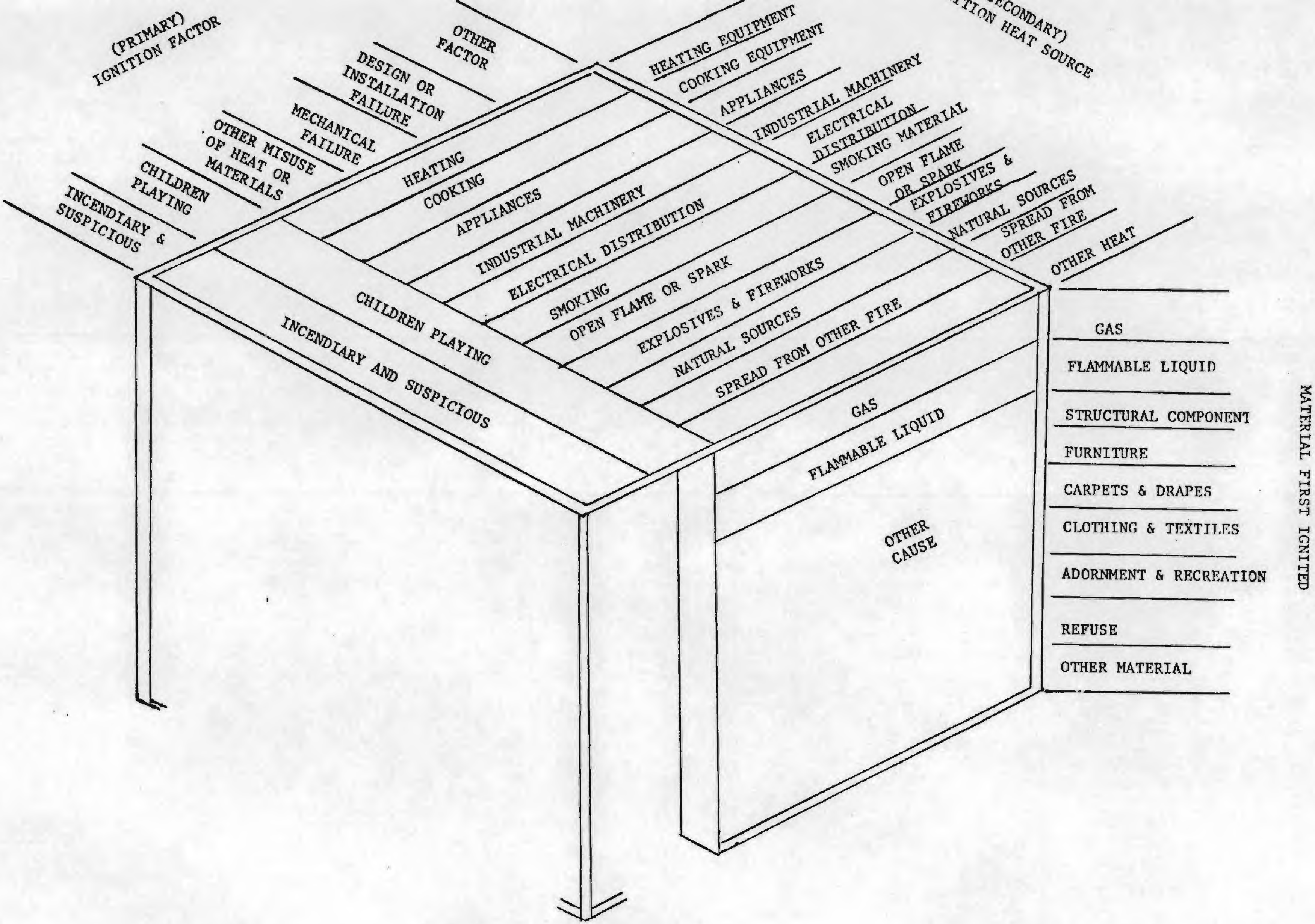


FIGURE 4-7: PRIORITY DERIVATION OF CAUSE DIMENSION FROM IGNITION FACTOR, IGNITION HEAT SOURCE AND MATERIAL FIRST IGNITED

4.3 Treatment of Property Use/Occupancy

Classification of the use or occupancy of property where a fire begins requires only summing. All aggregation is along a single classification dimension.

Figure 4-8 presents the specific classification approach developed for this report. Various tabulations in the designed report of Section 3 use any of the four levels of aggregation shown.

As noted in the Report on Fire Data Collection of Presentation [ ] there are a number of details in the aggregation plan of Figure 4-8 that are resolved in different ways by one or another nation. One example is hotels and motels. Figure 4-8 groups them within residential property, but other systems treat them as institutions under non-residential. Another disparity arises with mobile home fires. Such fires are sometimes called residential fires and other times treated as vehicle fires. Although Figure 4-8 offers one reasonable resolution of these conflicts, any other would be equally acceptable.

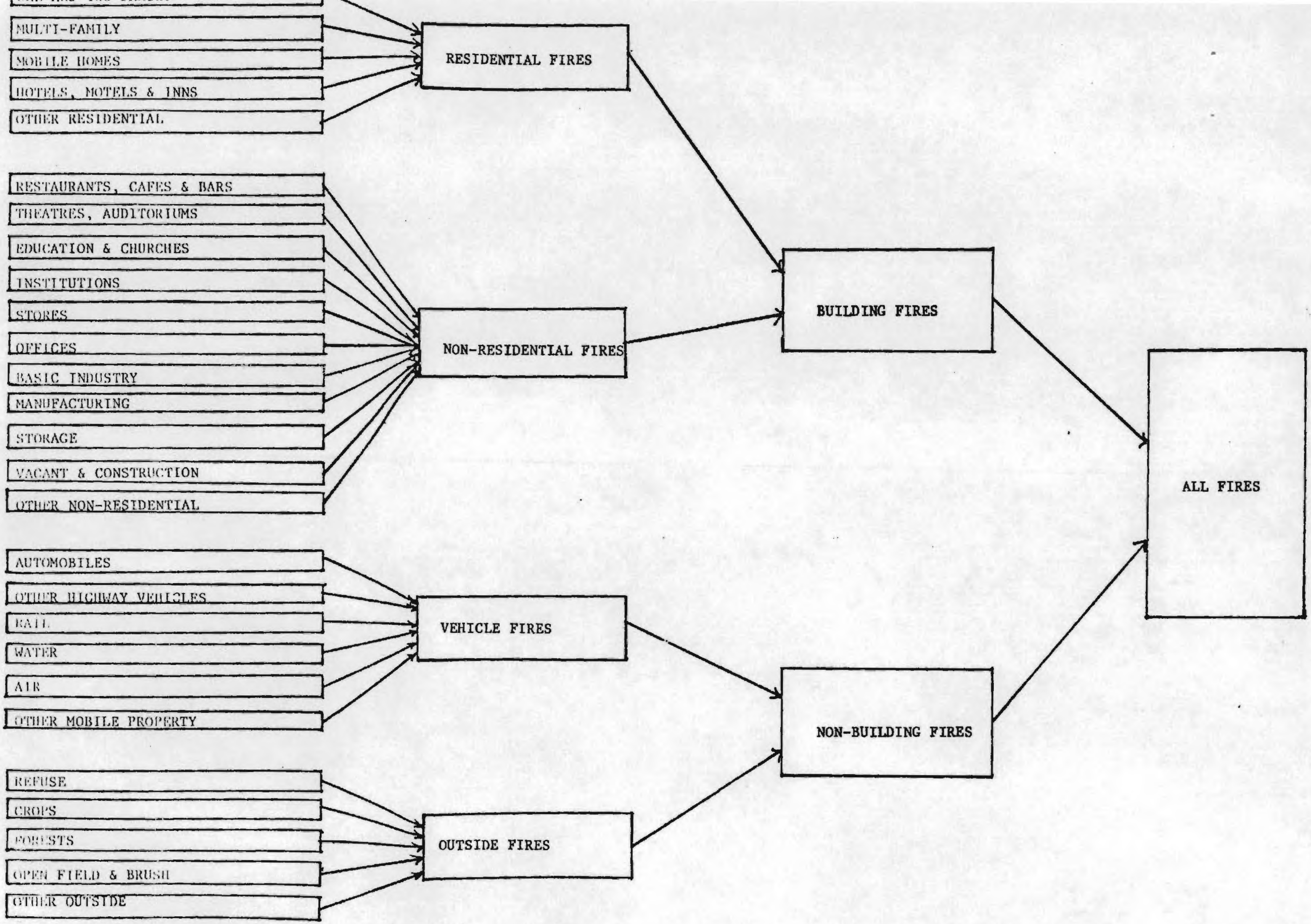


FIGURE 4-8: AGGREGATION PATTERN FOR PROPERTY USE/OCCUPANCY

5. IMPLEMENTATION

Establishment of a regular system for producing comparative international fire loss reports like the one proposed above requires a number of implementing actions. In this section the principal ones are briefly discussed.

5.1 Responsible Organization

A task which must preceed almost all others is the selection of an international organization to take responsibility for all other implementation activities. Until some group resolves the many open questions in fire reporting, very little progress can be expected. It is not necessary that the organization be a new one. Section 1.2 has already mentioned several existing organizations that are moving in the direction of international fire reporting; others might become interested.

5.2 Fundamental Decisions

Once some organizational mechanism is developed for resolving issues in the development of an international fire reporting system, several specific decisions need to be addressed:

- Report Level. It is clear from the discussion above that the level of detail expected to be included in a comparative international fire report has a dramatic effect on the amount of material that would be required from participating countries. An issue requiring early resolution is whether the Level I and II recommendation in this report is adopted, or whether some other level of detail is desired.

- Measure Definition. Section 2.3 reviewed the likely measures of fire loss and proposed definitions for each. Before standard international reporting can begin, decisions must be taken on which measures to include and how to define them.

- Classification Dimensions. Section 2.6 described several classification dimensions of fire experience and proposed a few for use in a standard report. Before standard reporting can begin, decisions must be reached on which of these axes are needed.

- Data Structures. Those dimensions of classification that are adopted for international reporting must have well defined categories. Although it would be desirable to have an internationally agreed classification manual such as the National Fire Protection Association's 901 [ ], much less would suffice. Assuming that reporting is to be limited to the Level I and II domains recommended above, agreement on aggregation plans like those of Figures 4-4 through 4-8 would provide a sound reporting basis. It is not necessary that the most detailed level of classification be exactly defined, so long as more aggregated ones are the only one of interest. Aggregation schemes like those of Section 4 provide implicit definitions of high level categories.

5.3 Data Submission

If an international fire statistics report is prepared, at least all fire-related data for the report will have to be submitted by participating agencies within individual countries. The agency taking international responsibility for reporting would have to devise and implement forms and procedures for such submissions.

Georgia Tech's prior studies of international fire statistics [, ,], have shown that some countries are able to supply very detailed information on their fire experience, while others have only aggregate numbers. Also, some have precise information about, for example, the number of fires, or the monetary loss, but cannot supply injury or death data.

Installation of a standard international reporting system is likely to encourage countries to collect data in more detail. Still, to encourage the widest possible participation, it is strongly recommended that the data collection system for any international report offer maximum flexibility to participating nations. Specifically, submissions should be welcome at whatever level of detail is available. For example, in the occupancy breakdown of Figure 4-8, either an "All Fire" total, or a breakdown by "Building" and "Non-Building" fires, or information at the four major occupancy groupings, or data for the occupancy subcategories should be accepted. Moreover, different levels of detail should be accepted on different fire measures.

Whether data is submitted at aggregate or at detailed levels, numerous adjustments are certain to be necessary. If, for example, only a "Building Fire" total is submitted, then the participating national agency would need to be sure it had been adjusted to closely approximate the international definition of a building fire. At lower levels of classification, information may only be available from certain political subdivisions of a country. The reporting national agency should apply appropriate adjustments to make their submission accurately estimate experience for the whole nation.

Georgia Tech's experience in preparing two previous statistical comparisons [,] leads to a recommendation that responsibility for adjustments of these types should reside with the national agency submitting data. It is very difficult for a group preparing an international report to determine what adjustments are appropriate. Some international agency should inform each nation concerning what information is required, but the nation alone should prepare it.

5.4 Report Preparation

Actual preparation of the report form would be a recurring task. Recommendations above call for it to occur once every three years.

The preparation task is not a small one. Individual submissions must be collected and integrated into a data base. Parallel information on population, gross national product and other rate bases must also be assembled. Numerous tables must be computed. Graphic artists must be employed to prepare the many illustrations. Perhaps most important, qualified analysts must review the many numbers in the report and prepare text interpreting their significance.

Because of this very considerable effort, it is important that the organization assigned report preparation responsibility have satisfactory budget support. Its staff, or the staff of its contractors, must also include experienced fire analysts capable of interpreting statistics in the report.

5.5 Outlook

Although many issues like those reviewed above need to be resolved, there do not appear to be any serious barriers preventing development of a very constructive system of international fire reporting. Many nations presently have a sound basis for estimating some or all of the required fire loss values. Report development awaits mainly some group's taking the initiative to define an international system.

INTERNATIONAL COMPARISONS OF FIRE LOSS: A SUGGESTED REPORT PLAN

Prepared for the
United States Fire Administration
National Fire Data Center

GEORGIA INSTITUTE OF TECHNOLOGY

December 1980

The fire mark illustrated on the cover of this report and on the title page is an important part of the history of fire fighting. Such insignias were first issued by British fire insurance companies after the disastrous London fire of 1666 to serve as a guide to the insurance company's fire fighting brigade. If a burning home displayed the fire mark, paid firefighters fought to extinguish the blaze. If it did not, the firefighters would not lift a hand to help the unfortunate owner.

In early America, volunteer fire departments received financial rewards from the fire insurance companies for extinguishment effort. To identify their insured properties, the fire insurance companies each adopted an insignia made of lead or cast iron and placed it on the front of the building. This fire mark indicated that the building was insured and by what company. Volunteer firefighters, seeing such a mark on a burning house, knew that they would be paid and, presumably, were inspired to fight the fire with extra effort.

This is a replica of one such fire mark.

INTERNATIONAL COMPARISONS OF FIRE LOSS: A SUGGESTED REPORT PLAN

By

Jerry Banks

Ronald L. Rardin

GEORGIA INSTITUTE OF TECHNOLOGY

Atlanta, Georgia 30332

With The Support Of The
United States Fire Administration
National Fire Data Center
Grant No. USFA–79065

DECEMBER 1980

TABLE OF CONTENTS

Table of Contents iii
List of Figures v
List of Tables. vii

1. Introduction. 1

2. Issues in Internationa Fire Experience Report Design. 5

2.1 Depth of Detail in International Fire Reports. 5

2.2 Incidents Covered. 7

2.3 Fire Loss Measures 7

2.4 Reporting of Trends. 9

2.5 Reduction to Rates 10

2.5.1 Per Fire Rates. 10

2.5.2 Elements at Risk. 11

2.6 Classification Dimensions. 15

3. Proposed Report Design. 17

3.1 National Depth I Analysis. 17

3.2 Depth I City Analysis. 23

3.3 Depth II Analysis. 23

3.4 Depth II-A: One Dimensional Classification. 25

3.4.1 Main Occupancy Type 25

3.4.2 Type of Occupancy Sub-classes 27

3.4.3 Cause 30

3.4.4 Victim Age and Sex. 33

3.4.5 Area Where Fire Began 33

3.4.6 Trends. 33

3.5 Depth II-B 33

3.6 Depth II-C Analyses. 40

3.7 Collected Recommendations. 43

4. Data Aggregation. 47

5. Outlook 55

References. 57

LIST OF FIGURES

3-1 Illustrative Time Trend Figure for Example Index 20

3-2 Example Two-way Plot of Relationship Between Monetary Building Fire Loss & Gross National Product in Standard Monetary Units 21

3-3 An Example of a Derived Analysis 22

3-4 Typical Pie Chart Illustration of Percent Data in Table 3-3. . 28

3-5 Typical Pie Chart Illustration of Percent Data in Table 3-4. . 32

3-6 Typical Pie Chart Illustration of Percent Data in Table 3-5. . 35

3-7 Typical Pie Chart Illustration of Percent Data in Table 3-6. . 37

3-8 Typical Pie Chart Illustration of Percent Data in Table 3-7. . 39

4-1 Summing Approach to Aggregation Within a Dimension 48

4-2 Aggregation Pattern for Type of Occupancy. 49

4-3 Priority Approach to Aggregation Across Dimensions 51

4-4 Priority Derivation of Cause Dimension From Act or Omission Bringing About Ignition and Heat of Ignition 52

4-5 Priority Derivation of Cause Dimension From Act or Omission Bringing About Ignition and Heat of Ignition and Material First Ignited. 53

LIST OF TABLES

2-1 Recommended and Potential Ratios Yielding Constructive Fire Loss Rates. 12

3-1 Example Tabulation of Overall Fire Loss Rates. 18

3-2 Example Analysis of City Fire Losses 24

3-3 Example Table of Fire Loss by Major Occupancy Type 26

3-4 Example Tabulation of Residential Fire Losses. 31

3-5 Example Depth II-A Tabulation of Fire Loss by Cause. 34

3-6 Example of Depth II-A Analysis of Death by Age and Sex 36

3-7 Example Depth II-A Tabulation of Area Where Fire Began for Residential Fires. 38

3-8 Possible Depth II-B Dimension Pairings and Their Desirability. 41

3-9 Example Depth II-B Table Cross Classifying Residential Subclass and Cause 42

3-10 Sample Depth II-C Table Cross-Classifying Residential Smoking Fires by Occupancy Sub-Class and Material First Ignited. 44

3-11 Review of Recommended Report Tables and Figures. 45

1. INTRODUCTION

National summaries of fire loss statistics are published regularly by fire services and fire insurance organizations in many developed countries. Unfortunately, these national reports are subject to only very limited international standardization. Different countries do not always agree on which fire characteristics are worth reporting and if two reports address the same subject, they often use different categories to display their data. Even if two tables seem to address the same subject, using the same categories, differences in the precise definitions of those categories often mean that the entries within corresponding cells of the two tables do not contain fully comparable information.

As a consequence, attempts to draw statistical comparisons at the international level result in errors of interpretation and the necessity to interpolate liberally from the individual reports. The language barrier is the least of the problems. One nation may treat a hotel as a residential structure while another treats it as an institution. Unscrambling and rescrambling the various categories requires intuition, experience, and judgement. Even then, one must examine the resulting comparisons with a healthy awareness of the assumptions and compromises that lie behind the simple printed statistics.

Although there are very great differences among the data collection and presentation systems used by various nations, there are many similarities in the dimensions of fire incidents classified and the types of analyses presented. Georgia Tech's prior Report on Fire Data Collection and Presentation [6] systematically investigated these similarities, drawing on reports and related documents from nine countries. Based on the similarities, a common body of international data was identified that could reasonably and usefully be collected by most advanced nations. Specific classifiable dimensions were proposed and incident definitions offered.

Drawing on the recommendations in that Georgia Tech report, a proposal [9] has been circulated to the International Standards Organization to set specific standards for fire incident reporting in member nations. The proposed standard is a bi-level one, with information suggested in the Georgia Tech report being collected on all fire incidents and special program-oriented data being obtained only as needed for studies of specific problems.

It is self-evident that data need not be collected unless they are to be analyzed and reported, and that data need not be standardized unless they are to be compared. This report addresses such concerns in terms of the earlier Georgia Tech recommendations now under consideration by the International Standards Organization. A plan is developed for an international report comparing fire losses in those countries classifying fire experience according to the proposed standard. Each data item in the proposed reporting system is utilized in the analysis; and all analytic reports are derivable from the fire loss data reported through the proposed system.

Although the need for standardization grows out of a desire for international comparability, the principal use of any conforming fire data collection system will be in studying experience within the collecting country. The report design developed below is also meant to be of assistance in planning such national reporting. Almost all the same issues must be confronted in developing national reports. Of course, for national reporting, "nations" would be deleted as one of the classification dimensions in each of the tables and figures proposed.

The remainder of the report is organized in three sections. Section 2 addresses broad issues in international report design. Examples are the degree of detail in analyses, the loss measures and loss rates to be used, etc. Section 3 offers a proposed report design. The section describes various tables and figures that might be provided at four different degrees of depth. At each degree there are tables which cross-classify the fire statistics of nations along one or more dimensions. Section 4 concerns data structures. The principles for aggregating detail data (collected according to the proposed standard) into statistics are described and methods are presented for constructing information required in the report of Section 3.

2. ISSUES IN INTERNATIONAL FIRE EXPERIENCE REPORT DESIGN

The design of a comparative international report of fire experience requires the resolution of a number of important issues. What analyses should be provided? What loss measures are appropriate? How should information be classified? This section raises and discusses a variety of such issues. A specific report design follows in Section 3.

2.1 Depth of Detail in International Fire Reports

The community of persons who might have interest in comparative international statistics on fire experience is a broad one. It includes government officials having general oversight of fire protection policies, fire service personnel with specific fire protection responsibilities, fire protection associations, fire researchers, fire research funders, fire resistance, detection and suppression product manufacturers, fire insurers, and public interest organizations including the news media.

Naturally, the types of information these many users might seek from a report are equally diverse. There are at least three degrees of depth:

- Depth I fire statistics provide broad, nation-versus-nation comparisons--either in one time period or over a long trend. Values compared are highly aggregated statistics such as the total national monetary fire loss per capita. The information is used by general government officials, news media and the public in crudely evaluating a country's fire safety performance.

- Depth II analyses of fire statistics subdivide and classify fire experience into major causal, occupancy and other groupings. An example is arson fires in single-family homes. Fire policy makers at all levels use the relative experience of their nation in these categories to highlight strengths and isolate weaknesses needing programatic attention.
- Depth III fire statistical studies provide detailed analyses of very specific fire problems. An example is a study of the frequency and causes of infant fire deaths resulting from ignition of the victim's sleepwear. Such information is required to determine the need for new or improved flammability standards, public education campaigns, and other fire safety efforts, and to provide guidance on the content and nature of these efforts.

Depths I and II analyses are appropriate for routine reports because they give the best tradeoff between (a) desire for statistics detailed enough to show policy implications, and (b) the recognition that space constraints and definitional differences will prevent routine reporting of very detailed analyses. Therefore, under the data collection standard presently being considered by the International Standards Organization [9], Depth III analyses are to be supported by Level 2 special purpose data collection systems. Although some such special analyses might have some place in a standard comparative international fire statistics report, considerable selectivity would have to be used in choosing the particular analyses to be included.

The focus of any comparative report will be on Depths I and II. These are supported directly by Level 1 of the proposed standard data collection system to be applied to all fire incidents in participating countries.

2.2 Incidents Covered

The earlier Georgia Tech Report on Fire Data Collection and Presentation [6] now under consideration as a reporting standard by the International Standards Organization recommended that a fire be defined as follows:

> Fire: a fire is an instance of destructive and uncontrolled burning, including explosion of combustible solids, liquids, or gases if followed by burning. Fires do not include lightning, explosion of non-combustible substances, vehicular accidents or overheating, unless they result in uncontrolled burning.

To improve the consistency of incident reporting it is further recommended that the following class of fires by separately tabulated:

> Serious Attended Fires: a fire is a serious attended one if it is attended by fire brigades and it results in an injury requiring medical attention, a fatality, or direct financial loss of more than an internationally agreed limit (perhaps 100 U.S. dollars at 1978 values adjusted to equivalent local currency and inflation rates).

The logic behind the latter recommendation is that minor fires and fires not attended by fire brigades are unlikely to be reliably and comparably reported. For the same reason it seems appropriate to limit the coverage of an international report derived from this standard data to "Serious Attended Fires". Such a limitation is recommended.

2.3 Fire Loss Measures

The magnitude of the fire problem in a country can be computed in terms of the number of incidents or by any of a variety of measures of the fire loss.

Each measure offers useful information, but presents data collectors with a number of definitional problems.

The proposed standard fire data collection system would tabulate three specific measures of loss in addition to the number of serious incidents defined above: fire fatalities, seriously injured persons, and direct property loss. An exact definition of a fire fatality was not provided in the earlier report [6]. One is offered below, along with the proposed definitions of the other two measures:

> Fire fatality: A fire fatality is a person whose death resulted principally from a fire, regardless of how the fire may have ignited. Included are persons who may die sometime after a fire if the death was caused by injuries incurred during the fire.
>
> Seriously injured persons: A seriously injured person is a person who, as a direct result of a fire, incurs non-fatal bodily damage sufficiently serious to warrant medical treatment other than first aid, whether such services were actually rendered or not.
>
> Direct property loss: The monetary value for replacement to like kind and quality of property damaged by a fire or its associated smoke and extinguishment. Direct losses of both buildings and contents are included, but indirect consequences of fire are not.

Certainly all three of these loss measures and the number of serious attended fires should be tabulated in a comparative report whenever they are available. However, special processing is required on "Direct Property Loss". Unlike the other measures, direct property loss would not be denominated in the same units in different countries and in the same country for different time periods. The value for any given country would be expressed in that country's currency of the year reported. The preparation of an international report would require adjustment to a standard currency unit. If time trends are to be considered, adjustments should also be made for inflation and deflation in currency values.

There are numerous sources of inflation rates and currency conversion factors. Previous Georgia Tech studies [4 , 5 , 7] have concluded that the most standardized and appropriate are those published by the United Nations in its Monthly Bulletin of United Nations Statistics [10]. Currency conversion rates are averaged for an entire year in that source, and deflaters are available to reduce monetary values to standard years. These two adjustments are applied by first converting all monetary values to local currency in a standard year, and then applying currency exchange rates to obtain values in the same currency.

2.4 Reporting of Trends

Any statistical analysis can be improved if data are reported for more than one time period. Trends are easily identified from comparisons over time. In the imprecise domain of comparative international statistical reports, trend analysis has some additional advantages. If reported values for different countries are derived on the same basis during each study period, the comparison of those values is meaningful--regardless of the completeness of the computational basis. To compare results among nations, standardization of the data base must also be assured.

For these reasons, period to period time comparisons should definitely be included in at least aggregate tables of a comparative international fire report. However, there are some difficulties that must be resolved. One, the need to adjust monetary values for inflation, has already been discussed. Others include the facts that some countries submit data only every two or three years and that single, massive fires or dry weather in a given year may suggest false trends.

A uniform finding of Georgia Tech [4 , 5 , 7] and other [1 , 8] studies of international fire loss is that relative standings do not change dramatically with time. Thus the above difficulties with obtaining data on a regular basis and treating atypical results could be satisfactorily resolved by averaging. It is recommended that the report be produced on a regular 2 to 4 year cycle, with reported statistics reflecting averages for the subject period. Three years is probably the best cycle. Time comparisons would be to similar averages for prior periods.

2.5 Reduction to Rates

The fire loss measures discussed in Section 2.3 are necessary ingredients in the development of comparative international fire statistics. However, direct comparisons among, for example, the absolute number of fire fatalities in different countries are not very meaningful. Enormous diferences in the populations, land areas and economies of the nations compared account for much of the disparity in fire loss.

To make fire loss statistics comparable across national boundaries, and for that matter among different cities or regions in the same country, loss measures must be standardized into rates. Absolute amounts of fire loss must be divided by an appropriate denominator to obtain a rate that can be compared from country to country or region to region. An obvious example is the use of population as the denominator to obtain per capita rates.

2.5.1 Per Fire Rates. One way to develop rates that can be compared across nations is to compute ratios of fire loss measures. The most meaningful of such ratios are those corresponding to per fire rates. They are computed by dividing the number of fire fatalities, or the number seriously injured, or the direct property loss by the number of serious fires. Of course, the result is the ratio of two estimates calculated from the same incident reports; certainly it has more error than either measure by itself. Still, per fire measures are an indication of the size of fire incidents in different countries and of the effectiveness of fire suppression and control measures designed to inhibit fire growth. Thus, they are recommended for inclusion in a comparative international fire statistics report.

2.5.2 Elements at Risk. In developing other fire loss rates, a general principle to be observed is that the rate should reflect the amount of fire loss divided by the element at risk. For example, it would be desirable to compute the amount of property damage from fire divided by the total amount of property.

The denominators for such rates come from non-fire agencies. Thus, the principle that rates should reflect items at risk has to be tempered by the availability of reliable multinational candidates for denominators. Only those social, demographic and economic indices routinely published by international organizations can be expected to be uniformly derived and readily available for utilization in an international fire report. In the case of the property damage per total property example offered above, the result may be settling for the ratio of direct fire property loss to gross national product. The latter is (loosely) the change in national wealth, rather than wealth itself. Still, it is widely available, and total wealth is not.

With these ideals and limitations in mind, a list of available and potentially useful denominators for fire loss rates is provided below. Table 2-1 shows which rates are recommended for which types of fire losses in computing statistics for a comparative international fire loss report.

TABLE 2-1

RECOMMENDED AND POTENTIAL RATIOS YIELDING CONSTRUCTIVE FIRE LOSS RATES [1/]

Fire Loss Measures \ Rate Denominator	Number Serious Attended Fires [2/]	Population	Gross Product	Technology Permeation	Vehicles and Vehicle Miles	Undeveloped Land Area
No. Serious Attended Fires - All		X	O	O		
- Building Fires - All		X	O	O		
- Residential		X	O	O		
- Nonresidential		X	O	O		
- Vehicle Fires		O	O	O	X	
- Outside Fires		X	O	O		O
No. Fire Fatalities - All	X	X	O	O		
- Building Fires - All	X	X	O	O		
- Residential	X	X	O	O		
- Nonresidential	X	X	O	O		
- Vehicle Fires	X	O	O	O	X	
- Outside Fires	X	X	O	O		O
No. Seriously Injured Persons - All	X	X	O	O		
- Building Fires - All	X	X	O	O		
- Residential	X	X	O	O		
- Nonresidential	X	X	O	O		
- Vehicle Fires	X	O	O	O	X	
- Outside Fires	X	X	O	O		O
Direct Property Loss - All	X	X	X	O		
- Building Fires - All	X	X	X	O		
- Residential	X	X	X	O		
- Nonresidential	X	X	X	O		
- Vehicle Fires	O	O	O	O	X	
- Outside Fires	O	O	O	O		O

1/ In the table X indicates recommended rates; O shows potentially useful rates; blank rates are not recommended.

2/ Per fire rates should be computed by dividing other fire measures by the number of fires they reflect. For example, building fire loss would be divided by the number of building fires.

An "X" entry in that table indicates the measure is definitely recommended, and an "O" suggests the measure might be meaningful. The denominators mentioned in the table are as follows:

- Number Serious Attended Fires. Division by the number of serious attended fires gives per fire rates. Definition of the number of such fires was already discussed in Section 2.2. If per fire rates are computed by dividing other measures by the number of incidents, values should reflect the same base. For example, losses in building fires should be divided by the number of building fires.
- Population. Population is the most obvious and widely used basis for computation of loss rates. Its wide acceptance makes it almost essential in any standard international reporting. Moreover, people are certainly the element at risk in fire injuries and fatalities. Multinational population data are published by the United Nations in their Demographic Yearbook [12].
- Gross Product. Gross National Product (GNP) and Gross Domestic Product (GDP) measure the total amount of economic activity in a country. They thus provide a useful scaling of fire losses in terms of the economic burden they represent. GNP and GDP differ only by goods and services consumed within the subject country, but paid for in another country. Such goods and services are accounted for in GDP, but not in GNP. Both GNP and GDP are computed by the United Nations and reported quarterly in the International Monetary Fund's International Financial Statistics [2].

- Technology Permeation. One of the principal causes of fire in almost all countries is machinery and equipment used in homes and industry. Thus, it would be desirable to have available measures of the amount of such equipment in different countries. In preparing Georgia Tech's previous reports [4, 5, 7], no single measure was found to be internationally available. However, the number of televisions, the number of radios, and the number of telephones are available for most developed countries in the United Nations Statistical Yearbook [11]. In Georgia Tech's report Selected International Comparisons of Fire Losses [4], it proved instructive to use a weighted sum of these three values as a surrogate measure of the permeation of technological devices.
- Vehicles and Vehicle Miles. Obviously the elements at risk in vehicle fires are the vehicles themselves. For such fires it is logical to compute rates on a per vehicle or per vehicle mile basis. Both the number of motor vehicles and the number of motor vehicle miles driven in various countries are estimated regularly by the Motor Vehicle Manufacturers Association of the United States [3].
- Land Area and Undeveloped Land Area. In grass, forest and other outside fires, the element at risk is approximately measured by the land area of a country--especially the undeveloped land area. The land area of any country can be obtained from a world atlas, and undeveloped land area is estimated in diplomatic sources such as the Central Intelligence Agency's National Basic Intelligence Factbook [13].

2.6 Classification Dimensions

Fire incidents can be classified along many instructive dimensions such as occupancy, cause, victim, etc. In Georgia Tech's prior survey of classification and reporting techniques of developed countries [6], the dimensions below were recommended for standard incident reporting:

- Type of Occupancy describes the nature of the property use in which the fire began. For example, it may be fixed or mobile property, and the property may be used for residential or non-residential purposes.
- Area Where Fire Began classifies the nature of the part of the property where the fire was ignited. Examples are building structural components, boiler room and sleeping area.
- Heat of Ignition is a composite dimension showing the heat source igniting the fire. Incidents are classified by equipment of ignition, if equipment was involved, and by heat form otherwise.
- Material First Ignited is a composite classification of the item in which the fire ignited first. Incidents are classified by the form of the material (furniture, drapes, etc.), if a common form is involved, and otherwise by the type of material (textiles, flammable liquid, etc.).
- Acts and Omissions Bringing About Ignition describes the acts and omissions bringing the heat source of ignition into contact with the material first ignited. Important examples are arson, spontaneous combustion, and children playing.

Two other dimensions were only implicitly treated:

- Victim Age describes the age of the victim of a fatal or non-fatal fire casualty.
- Victim Sex classifies according to the sex of the victim of a fatal or non-fatal casualty.

All these dimensions have some role in a comparative international report of fire experience. However, it is clear that simplifying aggregations will often be required if the report is not to be over-burdened with unnecessary detail. Often it is only necessary to compute and report subtotals of several categories. Section 4 shows how such subtotalling is recommended for the "Type of Occupancy" dimension.

In one case, however, a different style of aggregation is recommended. For most analyses, the three causal dimensions "Heat of Ignition", "Material First Ignited", and "Acts and Omissions Bringing About Ignition" should be combined into a composite index of "Cause". Generally, the "Cause" of incidents would be established by "Acts and Omissions Bringing About Ignition" if arson or some similarly important case is involved. If not, "Heat of Ignition" would be used to assign incidents to equipment groupings in fires started by equipment, and "Material First Ignited" to subdivide remaining incidents. Details of this assignment of "Cause" are provided in Section 4.

3. PROPOSED REPORT DESIGN

The purpose of this section is to suggest a structure for the reporting of international fire loss comparisons responsive to the Depth I and Depth II needs described in Section 2.1. The report is a document based on the submissions of the various cooperating nations. The tables and figures described in this section generally outline structure rather than specify a rigid format to which complete adherence is required. In addition to the various tables and figures that are suggested, the need exists to prepare a narrative description that highlights the major findings.

3.1 National Depth I Analysis

In Section 2.1 the various levels of comparisons were discussed. Depth I relates to broad, national comparisons. The comparisons may be for one time period or relate to time trends. If time trends are of interest, the blocks will generally span a period of two to four years, with three years being the perferable block.

Since the comparisons are international in scope, one dimension of each exhibit (table or figure) will be the countries which are participating (as already mentioned for national level reporting this dimension would not be used). If the time periods covered by the data of the various countries is different, it is useful to indicate the time periods which are included.

Table 3-1 shows the structure of a Depth I comparison of representative fire loss rates selected from those in Table 2-1. Note that the numerators all contain a loss measure related to building fires only. Thus, mobile and

TABLE 3-1

EXAMPLE TABULATION OF OVERALL FIRE LOSS RATES

Nation	Building Fires/ 1,000 Persons	Building Fire Loss Per Capita	Building Fire Loss As % of GNP	Building Fire Deaths/ 1,000,000 Persons	Building Fire Injuries/ 1,000,000 Persons	Building Fire Loss/ Building Fire	Building Fire Deaths/ 1,000 Building Fires	Building Fire Injuries/ 1,000 Building Fires
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

outside fires are excluded. There are numerous reasons for excluding mobile and outside fires. Deaths from mobile fires may or may not be attributed properly because of difficulties in determining whether deaths result from vehicle accidents or accompanying fires. Outside fires involve little injury and few deaths, and frequently go unreported. Monetary losses are also difficult to estimate.

The second column heading, "Building Fire Loss Per Capita," must be expressed in some standard currency such as the U.S. dollar, British pound sterling, etc. This also applies to the next to last column heading.

Each of the indices in Table 3-1 can be shown in a time sequence by reporting country. The time periods will be macro in nature, say three years as discussed previously. An example of such a graphic comparison is shown in Figure 3-1.

An alternative way of displaying the ratios in Table 3-1, or any of those in Table 2-1, is a two-way plot. Usually, the measure forming the numerator of the subject fire loss rate defines one axis; the rate's denominator supplies the other axis.

Figure 3-2 provides an example. Monetary building fire loss is plotted versus Gross National Product. A clear trend becomes immediately apparent to the reader.

The last example leads to a principle--that of innovation. New methods of display, new measures, and new indices should be investigated. Figure 3-3 is an example of a developed or derived analysis. Georgia Tech created a technological index for each nation from available statistics on the number of televisions, radios and telephones per capita in various nations. Figure 3-3 plots the index versus a fire rate--fire deaths per million population.

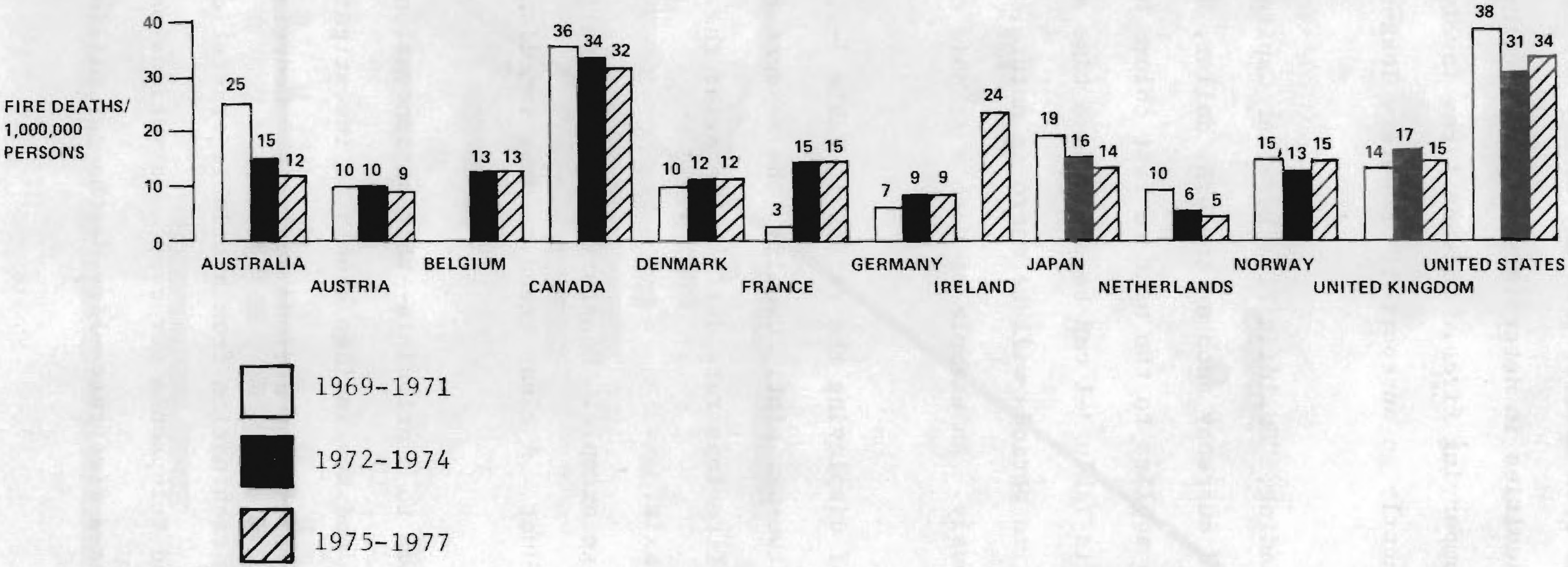


FIGURE 3-1

ILLUSTRATIVE TIME TREND FIGURE FOR EXAMPLE INDEX

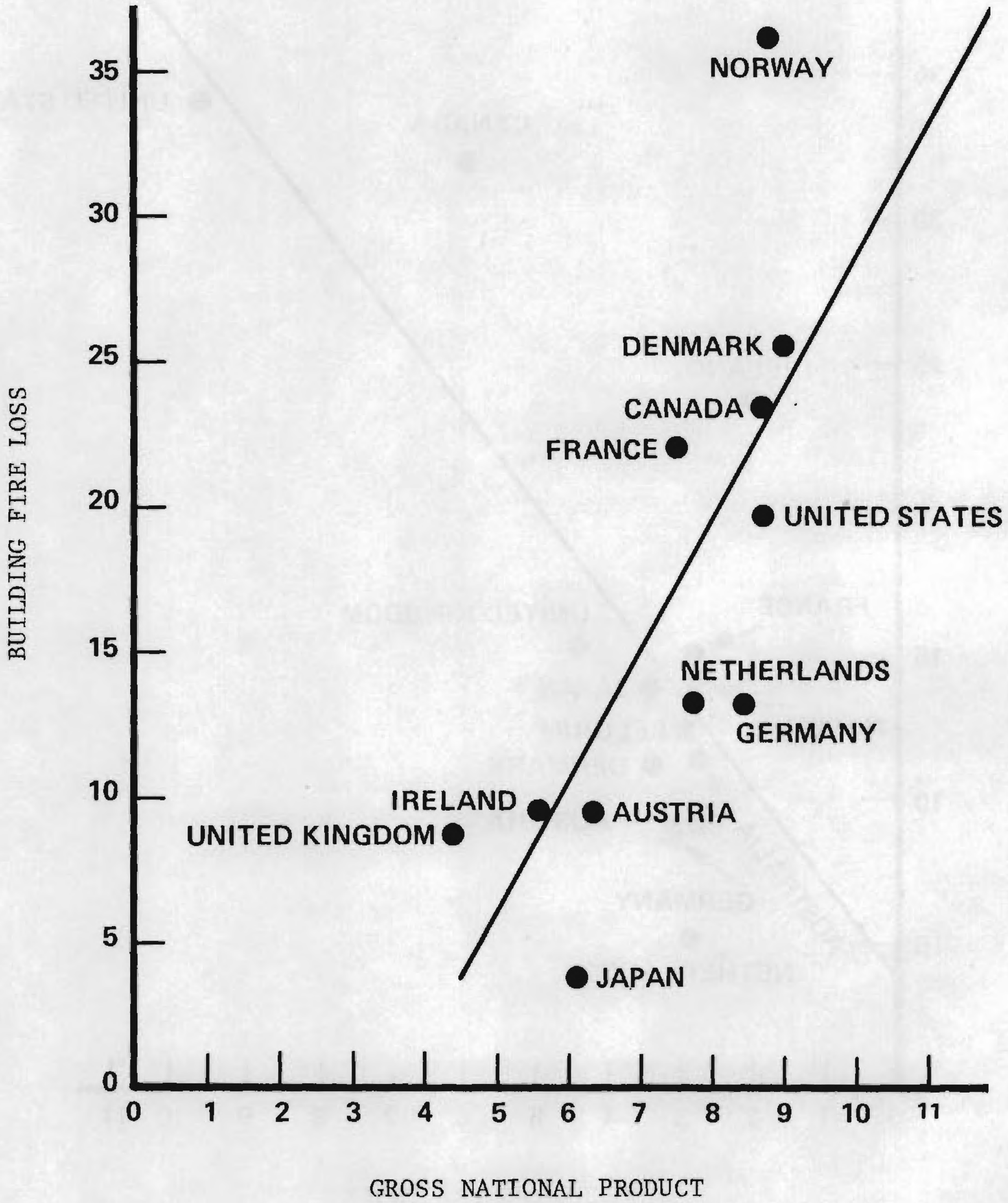


FIGURE 3-2: EXAMPLE TWO-WAY PLOT OF RELATIONSHIP BETWEEN MONETARY BUILDING FIRE LOSS & GROSS NATIONAL PRODUCT IN STANDARD MONETARY UNITS

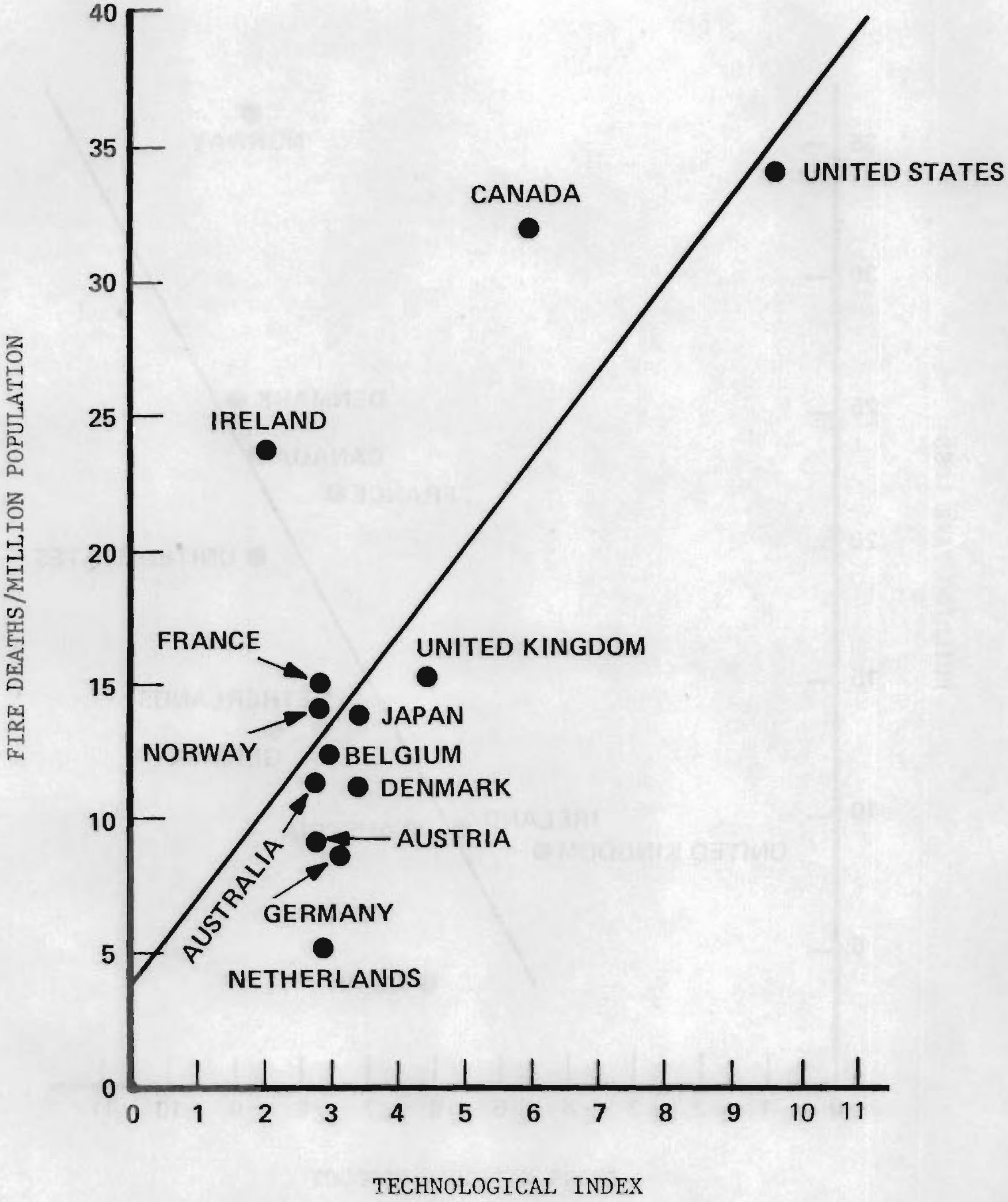


FIGURE 3-3: AN EXAMPLE OF A DERIVED ANALYSIS

A suspicion that higher technology leads to increased chandes of a fire and resulting death motivated the analysis. Since 3/4 of the countries have points in a cluster, no useful trend is indicated. Still, insight may be derived about connections between technological development and fire deaths.

3.2 Depth I City Analysis

Nations are not the only geographic units for which fire losses can be internationally compared. Most fire loss occurs in urban areas, and many fire statistical agencies would keep separate records by city.

If satisfactory data can be collected, the proposed report would profit from reporting of this city information. Volume would be too great to expand beyond Depth I analysis, but city comparisons at that high level could be instructive.

Table 3-2 illustrates one city data format. A few fire loss rates are shown versus participating cities. To distinguish patterns in different types of cities, data are grouped by population class. Of course many other rates from Table 2-1 could be provided if data were available. Graphs like Figures 3-1 and 3-2 could also add understanding.

3.3 Depth II Analysis

The discussion of Section 2.1 concluded that a proposed comparative international report on fire losses should extend beyond the broad tabulations of Depth I to a more detailed Depth II. Depth II statistics are sufficiently classified to allow fire policy makers to isolate positive and negative elements of their national fire experience.

TABLE 3-2

EXAMPLE ANALYSIS OF CITY FIRE LOSSES

CITY	PROTECTED POPULATION IN (1,000'S)	NUMBER OF REPORTED FIRES [1/]	NUMBER OF REPORTED FIRE DEATHS [1/]	FIRES PER 10,000 POPULATION	DEATHS PER MILLION POPULATION
Group A (over 1,000,000)					
Tokyo	11,247	7,759	146	7	13
London	7,083	42,077	111	59	16
New Delhi (1978)	6,500	3,234	63	5	10
Hong Kong	4,567	10,434	40	23	9
Istanbul (1976)	3,418	2,907	37	9	11
West Midlands (1977-78)	2,727	12,866	27	47	10
Greater Manchester	2,711	23,375	62	56	23
Melbourne (1976-77)	2,649	8,475	15	32	6
Manila	2,459	7,887	34	12	14
Singapore	2,317	4,048	37	17	16
Johannesburg	2,283	1,432	13	6	6
Berlin	2,047	6,377	29	31	14
Hamburg	1,697	4,988	10	29	6
Merseyside (1978)	1,576	1,887	21	12	13
Kent	1,465	5,378	22	38	15
Essex (1977-78)	1,456	6,392	17	44	12
Lancashire (1977-78)	1,348	7,819	26	58	19
Brussels (1977-78)	1,175	2,250	16	20	13
Montreal (1976, 1978)	1,060	6,193	43	58	39
Group A Average Rate				29.6	13.9
Group B (500,000 to 1,000,000)					
Hertfordshire (1976-77)	938	5,336	11	57	12
Lothian & Borders (1978)	930	6,396	26	69	28
Avon (1976, 1978)	918	4,678	10	51	11
Capetown	892	2,036	30	23	34
Amsterdam	727	2,637	17	36	24
Brisbane	709	3,488	7	50	10
Stockholm (1977-78)	656	5,628	29	86	44
Frankfurt (1976, 1978)	635	2,632	7	41	11
Rotterdam	600	2,867	7	48	12
Group B Average Rate				51.2	20.7
Group C (250,000 to 500,000)					
Helsinki (1977-78)	490	1,570	9	32	18
Edmonton	474	2,586	12	5	25
Oslo	460	1,366	7	30	15
Vancouver (1977-78)	410	2,866	13	70	32
Hamilton	312	2,363	14	76	45
Ottowa	306	3,793	8	124	26
Bonn (1976, 1978)	284	681	4	24	18
Group C Average Rate				51.6	25.6

1/ Average for 1976-78 unless otherwise indicated.

Depth II analysis in the proposed report format would fall into three categories. Depth II-A provides breakdowns along a number of dimensions (cause, occupancy, victim, etc.) one at a time. Depth II-B involves the pairing of these dimensions. Depth II-C pairs two dimensions on incidents selected by a third. This three-step approach not only aids the reader, but encourages participation. For example, countries may be able to report only at Depth II-A.

3.4 Depth II-A: One Dimensional Classification

Drawing on the discussion of Section 2.6, five dimensions are suggested for Depth II-A analysis. These are "Type of Occupancy", "Cause", "Victim Age", "Victim Sex" and "Area Where Fire Began".

3.4.1 Main Occupancy Type. The first dimension is that of "Type of Occupancy". Occupancy can be considered in several ways. The primary separation concerns structure fires as follows:

- Building structures, both residential and non-residential.
- Non-building, including vehicles and outside property.

The two classifications above may be further divided in a four way format consisting of the following:

- Residential
- Non-residential
- Vehicle
- Outside

These four may be called the "Major Occupancy Types". The rates of fires deaths, injuries and monetary loss can now be displayed according to major occupancy types. Table 3-3 shows a suggested format.

TABLE 3-3

EXAMPLE TABLE OF FIRE LOSS BY MAJOR OCCUPANCY TYPE

	NATION 1			...	NATION N		
	NUMBER	RATE 1/	PERCENT 2/	...	NUMBER	RATE 1/	PERCENT
RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
NON-RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
VEHICLES							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
OUTSIDE							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							
TOTAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses 3/							

1/ Rates are the same as those in Table 3-1

2/ Percents are formed from the ratio of number in Occupancy type divided by number in "Total" multiplied by 100.

3/ Monetary Losses must be stated in an accepted currency at a given year.

Although the raw numbers convey little to the reader, the rates are quite revealing. For example, one nation may have an excessively high residential death rate compared to another nation. This could be considered as a "weakness" and would serve to isolate the residential sector as a problem area that needs to be investigated further.

Table 3-3 contains columns showing the percent distribution of entries for each nation. As fire experience totals are subdivided into categories, such percents highlight differences in various nation's experience.

The percentages in Table 3-3 also invite a clarifying pictoral representation of the information. Pie charts can be created for each country showing how losses are distributed among occupancy classes. Figure 3-4 illustrates such charts for numbers of fires. Similar graphs should be included for all loss measures.

3.4.2 Type of Occupancy Sub-classes. It is also possible, and recommended, that the four major occupancy classes be broken into sub-classes and the losses attached to each sub-class. This will yield an extension and refinement of Table 3-3.

There are numerous ways to break the classes into sub-classes. The following are suggested in Section 4:

- Residential
  - One and Two Family
  - Multi-Family
  - Mobile Homes
  - Hotels, Motels and Inns
  - Other Residential

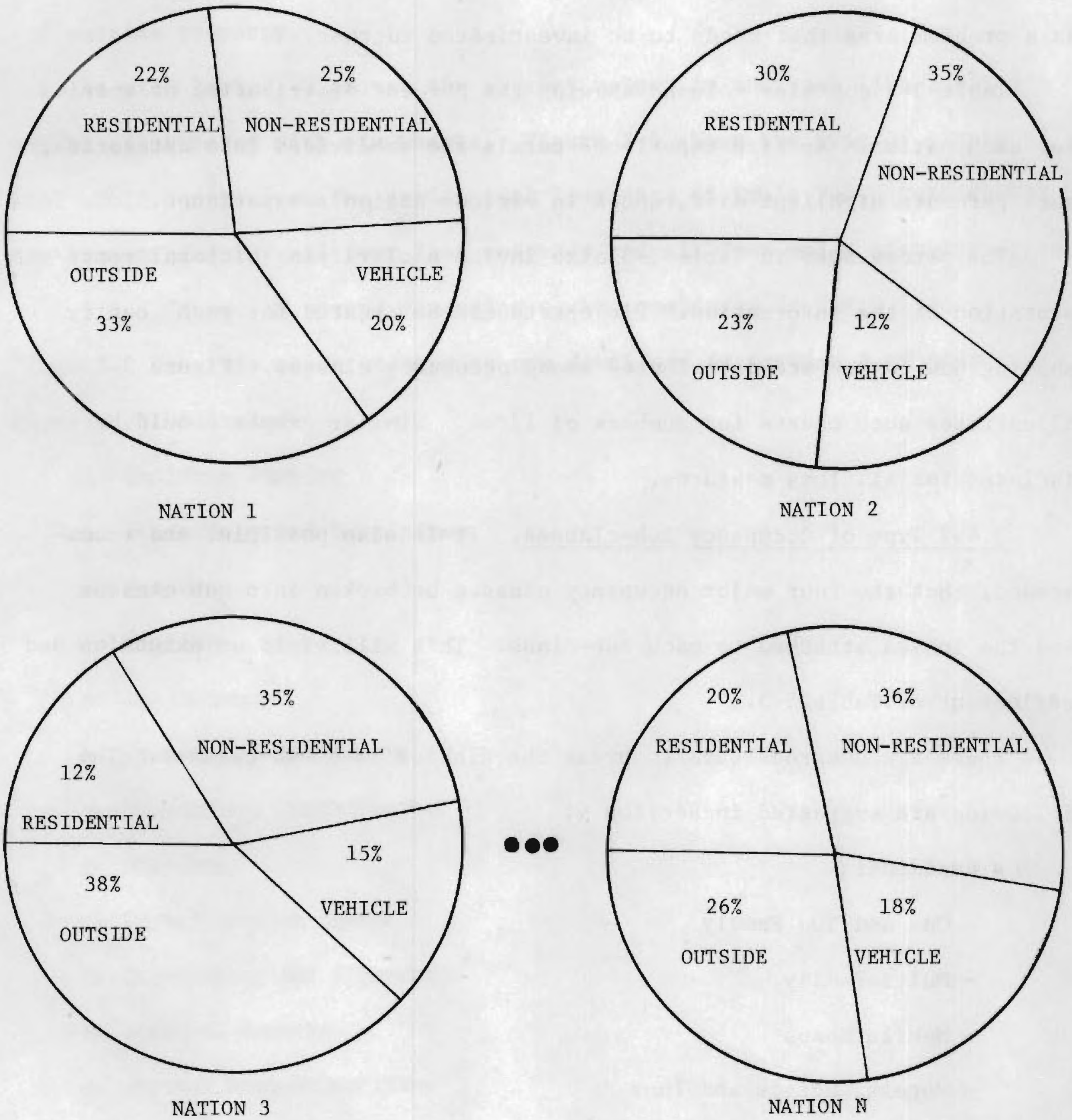


FIGURE 3-4: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-3

- Non-Residential
  - Restaurants, Cafes and Bars
  - Theaters, Auditoriums
  - Education and Churches
  - Institutions
  - Stores
  - Offices
  - Basic Industry
  - Manufacturing
  - Storage
  - Vacant and Construction
  - Other Non-Residential
- Vehicle Fires
  - Automobiles
  - Other Highway Vehicles
  - Rail
  - Water
  - Air
  - Other Mobile Property
- Outside
  - Refuse
  - Crops
  - Forests
  - Open Field and Brush
  - Other Outside

The next set of suggested tables would portray the losses (fires, deaths, injuries, and monetary) for each sub-class. An example of one of the four possible tables (this one for residential property) is shown as Table 3-4. A similar table would be prepared for non-residential, mobile, and outside property.

As with Table 3-3 above, the percent values in analyses like Table 3-4 can be illustrated with pie charts. Figure 3-5 shows the type of charts that would derive from the residential loss data of Table 3-4. Such charts are recommended for all four loss measures and all four major property types.

3.4.3 Cause. A second dimension to be considered in Depth II-A is "Cause". Possible cause categories are developed in Section 4 of this report. They include

- Children Playing
- Incendiary and Suspicious
- Heating
- Cooking
- Appliances
- Industrial Machinery
- Electrical Distribution
- Smoking
- Open Flame or Spark
- Explosives and Fireworks
- Natural Sources
- Spread from Other Fire
- Other Causes

TABLE 3-4

EXAMPLE TABULATION OF RESIDENTIAL FIRE LOSSES

	NATION 1				NATION N		
	NUMBER	RATE[1/]	PERCENT[2/]	...	NUMBER	RATE[1/]	PERCENT[2/]
ONE AND TWO FAMILY							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
MULTI-FAMILY							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
MOBILE HOMES							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
HOTELS, MOTELS AND INNS							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
OTHER RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							
TOTAL RESIDENTIAL							
Fires (1,000's)							
Deaths							
Injuries							
Monetary Losses[3/]							

1/ Rates are the same as those in Table 3-1.

2/ Percents are formed from the ratio of number in property type divided by number in "Total" multiplied by 100.

3/ Monetary Losses must be stated in an accepted currency at a given year.

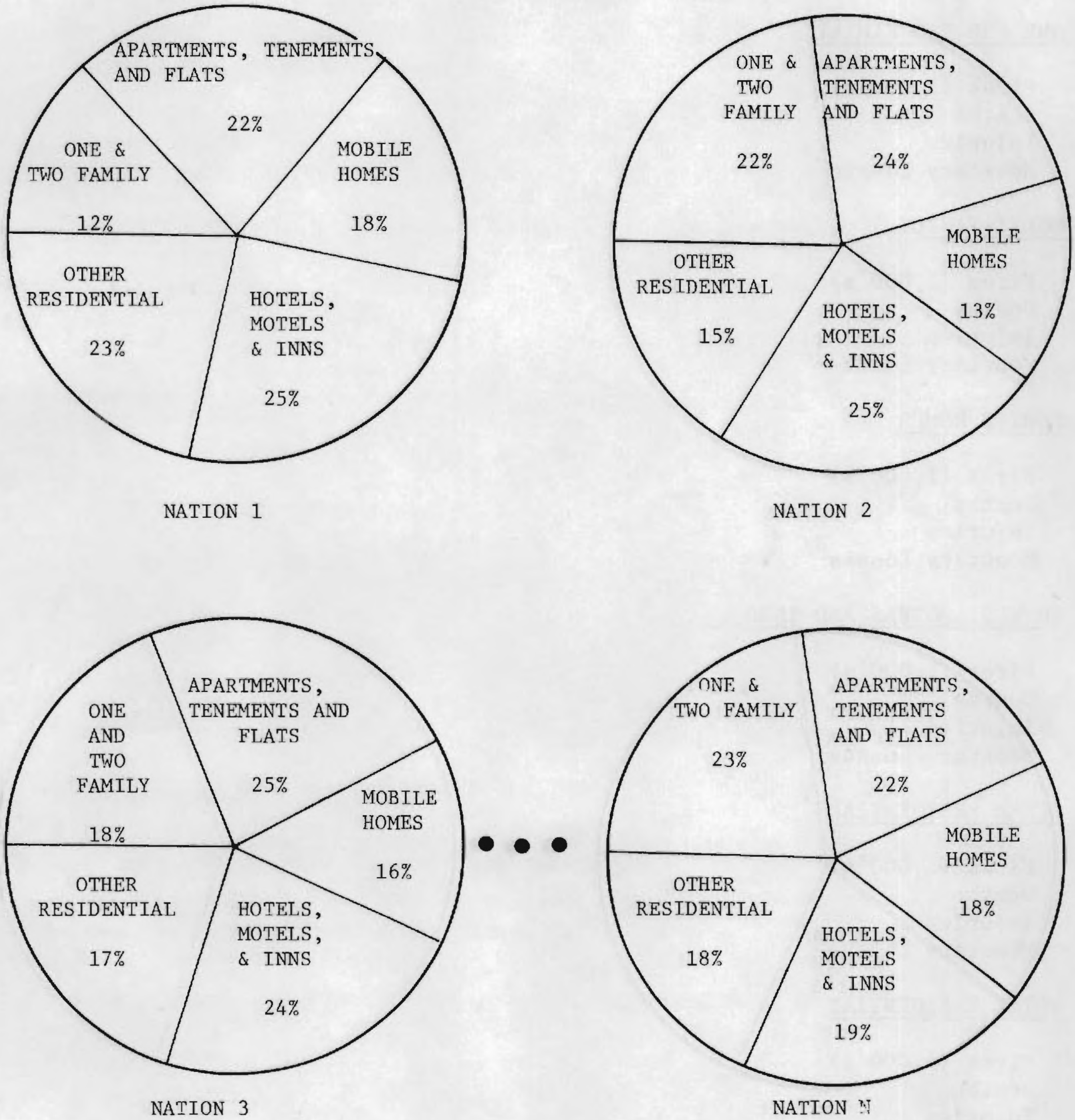


FIGURE 3-5: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-4

It is suggested that one table show all of the losses associated with the various causes. Such an exhibit might appear as in Table 3-5. Corresponding pie charts are shown in Figure 3-6.

3.4.4 Victim Age and Sex. The next set of Depth II-A tables and figures concern victim groupings. The victim analysis shows the age and sex of persons killed or injured in fires. Two tables are suggested. These tables are of the same format except that one of them pertains to deaths while the other pertains to injuries. An example is shown as Table 3-6. Both age and sex are classified. Figure 3-7 illustrates the corresponding pie chart distributions.

3.4.5 Area Where Fire Began. Although not of equal importance with some other Depth II-A analyses, concentrations of fires by "Area Where Fire Began" should also be explored, especially when comparing specific types of occupancies. Table 3-7 illustrates how such information might be presented. Figure 3-8 is a corresponding pie chart.

3.4.6 Trends. Any of the foregoing Depth II-A analyses could be supplemented by figures or tables reflecting time trends. However, the number of possibilities is enormous. There are up to four loss rates on ten to fifteen countries and numerous classifications for each. Even a bar graph treatment of the four main occupancy classifications could lead to 16 charts like Figure 3-1. Thus, although they might be informative, such time comparisons are not recommended at Depth II-A.

3.5 Depth II-B

Depth II-B pairs the dimensions that were presented singly at Depth II-A. For reasons of accuracy and reliability already described several times, it is proposed to limit such detail development to building fires.

TABLE 3-5

EXAMPLE DEPTH II-A TABULATION OF FIRE LOSS BY CAUSE [4/] [5/]

NATION	CHILDREN PLAYING Number	Rate [1/]	Percent [2/]	INCENDIARY & SUSPICIOUS Number	Rate [1/]	Percent [2/]	TOTAL Number	Rate [1/]	Percent [2/]
1.									
Fires									
Deaths									
Injuries									
Monetary Losses [3/]									
2.									
Fires									
Deaths									
Injuries									
Monetary Losses [3/]									
.									
.									
.									

1/ Rates are the same as those in Table 3-1.

2/ Percents are of total at right

3/ Monetary Losses must be stated in an accepted currency at a given year.

4/ Causes are those shown in Section 4.2.

5/ Unknown Causes are apportioned to remaining causes.

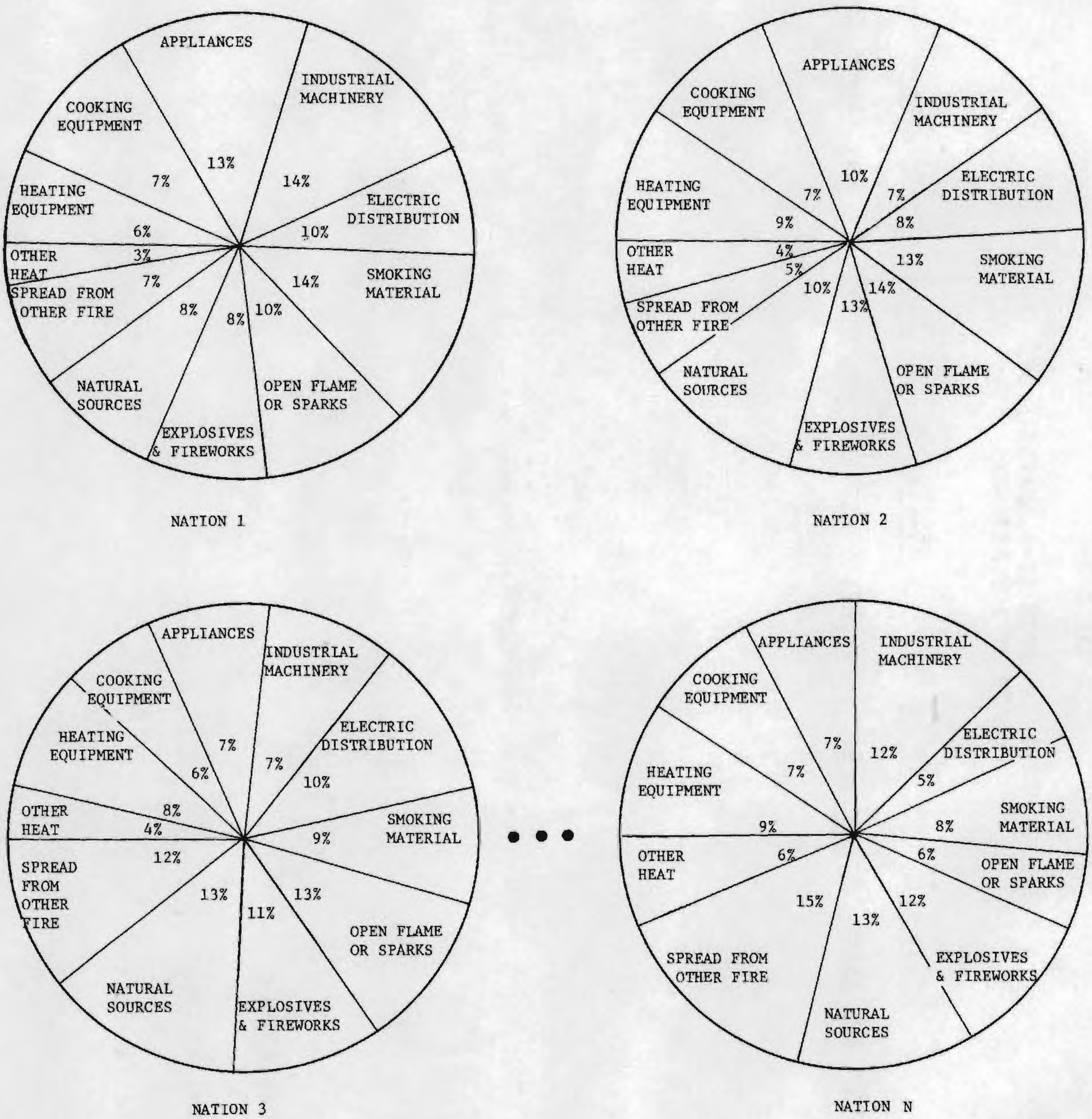


FIGURE 3-6: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-5

TABLE 3-6

EXAMPLE OF DEPTH II-A ANALYSIS OF
DEATH BY AGE AND SEX

	0-4			5-14			15-24			25-44			44-64			65+			Total		%
Nation	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/	No.	Rate 1/	% 2/
1.																					
Male																					
Female																					
Total																					
2.																					
Male																					
Female																					
Total																					
.																					
.																					
.																					

1/ Rates are as in Table 3-1

2/ Percent is of total at right

3/ Percent is of total at bottom

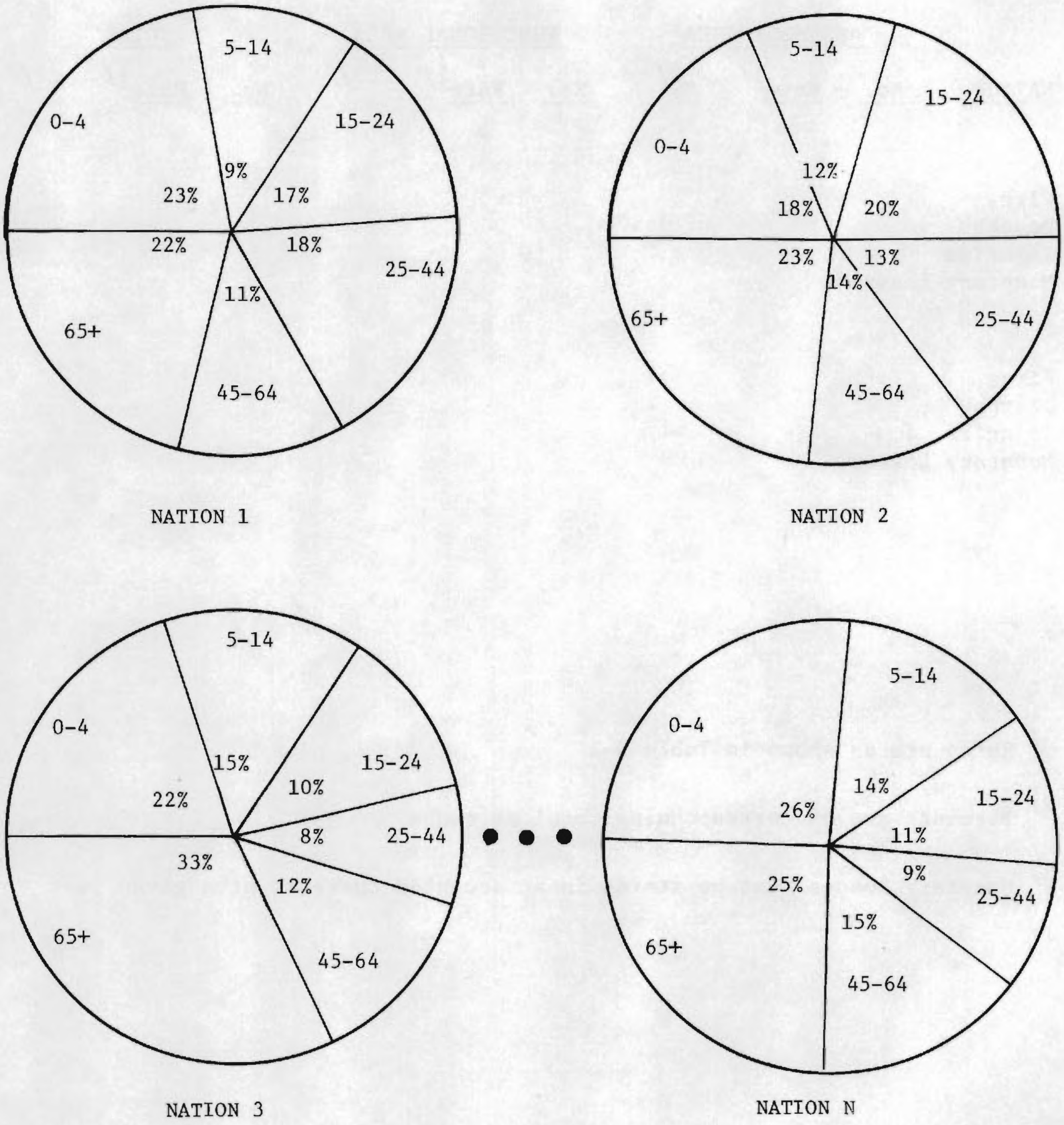


FIGURE 3-7: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-6

TABLE 3-7

EXAMPLE DEPTH II-A TABULATION OF AREA
WHERE FIRE BEGAN FOR RESIDENTIAL FIRES

	ASSEMBLY AREA			FUNCTIONAL AREA			. . .	TOTAL		
NATION	No.	Rate[1/]	%[2/]	No.	Rate[1/]	%[2/]		No.	Rate[1/]	%[2/]
1.										
Fires										
Deaths										
Injuries										
Monetary Losses[3/]										
2.										
Fires										
Deaths										
Injuries										
Monetary Losses[3/]										
.										
.										
.										

1/ Rates are as shown in Table 3-1

2/ Percents are of corresponding total at right

3/ Monetary Losses must be stated in an accepted currency at a given year

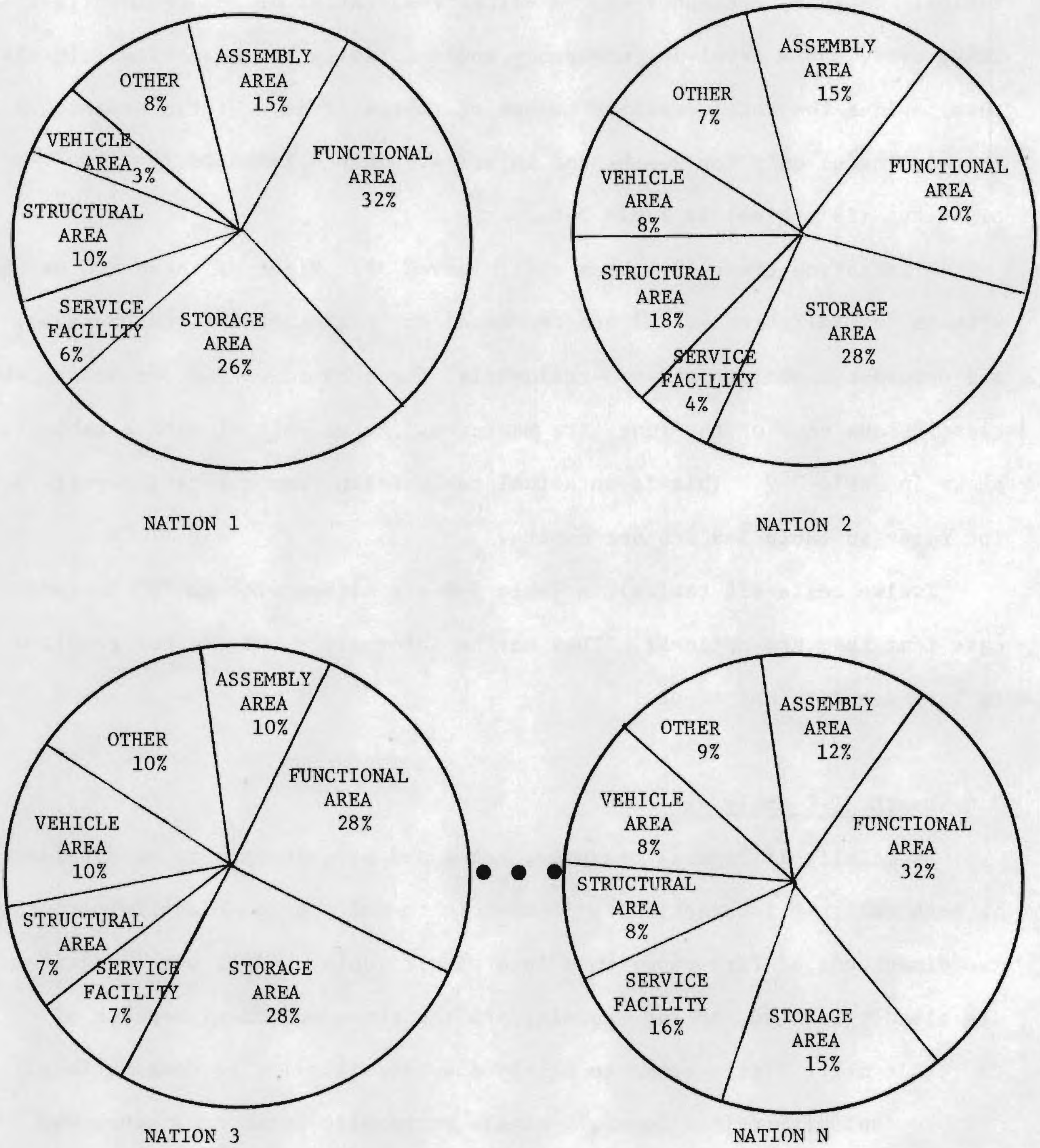


FIGURE 3-8: TYPICAL PIE CHART ILLUSTRATION OF PERCENT DATA IN TABLE 3-7

Table 3-8 shows possible pairings and their desirability. There are ten possible pairings and four types of losses giving a possibility for 40 tables. However, occupancy can be either residential or non-residential. Thus, every table involving occupancy would actually be two tables. In all this implies the total possible number of tables is 56. Victim breakdowns are meaningful only for deaths and injuries. This eliminates fourteen combinations (18 tables) in Table 3-8.

Eliminating these 18 tables still leaves 38. Eight of these are marked with an "X" in Table 3-8 and are recommended: residential fires by cause and occupancy subclass and non-residential fires by cause and occupancy subclass versus each of the four fire measures. An example of such a table is shown in Table 3-9. This is an actual table taken from a recent report [4]. The rates in Table 3-9 are per capita.

Twelve cells (16 tables) in Table 3-8 are marked with an "O" to indicate that they are optional. They may be informative but are not required to have a sufficient report.

3.6 Depth II-C Analyses

Especially if several measures, rates and percents are to be displayed in each cell, it is practically impossible to fully cross-classify more than two dimensions of fire experience in a single table. Also, when concepts are closely related, as for example, are the three component aspects of cause, it makes little sense to merely display all pairwise combinations.

To deal with this dilemma, a single, composite measure of cause was used in all the analyses presented so far. "Heat of Ignition", "Material First Ignited" and "Act or Omission Causing Ignition" were used in computing

TABLE 3-8

POSSIBLE DEPTH II-B DIMENSION PAIRINGS AND THEIR DESIRABILITY

PAIRING	TYPE OF LOSS			
	FIRES	DEATHS	INJURIES	MONETARY LOSSES
Occupancy Sub-Class (Residential, Non-Residential) Versus Cause	X	X	X	X
Occupancy Sub-Class (Residential, Non-Residential) Versus Age		O	O	
Occupancy Sub-Class (Residential, Non-Residential) Versus Sex		O	O	
Occupancy Sub-Class (Residential, Non-Residential) Versus Area Where Fire Began				
Cause Versus Age		O	O	
Cause Versus Sex		O	O	
Cause Versus Area Where Fire Began	O	O	O	O
Age Versus Sex				
Age Versus Area Where Fire Began				
Sex Versus Area Where Fire Began				

X - Recommended

O - Possibly Useful

blank - Not Recommended

TABLE 3-9

EXAMPLE DEPTH II-B TABLE CROSS CLASSIFYING RESIDENTIAL SUBCLASS AND CAUSE

			COOKING	SMOKING	HEATING	INCENDIARY/ SUSPICIOUS	ELECTRICAL DISTRIBUTION	APPLIANCES	CHILDREN PLAYING	OPEN FLAMES, TORCHES	EXPOSURE	NATURAL	OTHER	TOTAL	PERCENT
ONE AND TWO FAMILY	UNITED STATES	-No.	91886	42442	128439	54803	49498	43609	34219	24192	15385	8276	37773	530522	75.2%
		-Rate	42.5	19.6	59.4	25.3	22.9	20.2	15.8	11.2	7.1	3.8	17.5	245.2	
	NEW SOUTH WALES	-No.	786	209	413	102	325	312	94	150	17	12	137	2557	73.4%
		-Rate	16.0	4.3	8.5	2.1	6.7	6.4	1.9	3.1	0.4	0.2	2.8	52.7	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	35444	65.7%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	63.5	
APARTMENTS, TENEMENTS AND FLATS	UNITED STATES	-No.	33685	25509	8444	18985	6511	7617	7617	5112	4145	687	8850	127162	18.0%
		-Rate	15.6	11.8	3.9	8.8	3.0	3.5	3.5	2.4	1.9	0.3	4.0	58.8	
	NEW SOUTH WALES	-No.	331	140	77	24	72	72	24	9	3	-	16	768	22.0%
		-Rate	6.8	2.9	1.6	0.5	1.8	1.5	0.5	0.2	0.1	-	0.3	15.8	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	14705	27.3%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	26.3	
MOBILE HOMES	UNITED STATES	-No.	3640	1848	5769	1958	4370	2043	783	949	1006	221	1201	23788	3.4%
		-Rate	1.7	0.9	2.7	0.9	2.0	0.9	0.4	0.4	0.5	0.1	0.6	11.0	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	107	123	237	50	-	84	240	-	5	302	1148	2.1%
		-Rate	-	0.2	0.2	0.4	0.1	-	0.2	0.4	-	0.1	0.5	2.1	
HOTELS, MOTELS, & INNS	UNITED STATES	-No.	1066	5110	954	3114	909	701	141	407	155	100	856	12613	1.8%
		-Rate	0.5	2.4	0.4	1.5	0.4	0.3	0.1	0.2	0.1	0.1	0.4	5.8	
	NEW SOUTH WALES	-No.	22	62	16	1	20	17	2	8	-	-	12	160	4.6%
		-Rate	0.5	1.3	0.3	0.1	0.4	0.4	0.1	0.2	-	-	0.3	3.3	
	UNITED KINGDOM	-No.	408	378	206	213	184	49	38	94	-	8	119	1697	3.1%
		-Rate	0.7	0.7	0.4	0.4	0.3	0.1	0.1	0.2	-	0.1	0.2	3.0	
OTHER RESIDENTIAL	UNITED STATES	-No.	1641	1314	2778	2179	805	730	610	760	177	102	548	11644	1.6%
		-Rate	0.8	0.6	1.3	1.0	0.4	0.3	0.3	0.4	0.1	0.1	0.3	5.4	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	931	1.7%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	1.7	
TOTAL RESIDENTIAL	UNITED STATES	-No.	131918	76223	146384	80139	62093	54700	43370	31420	20868	9386	49228	705729	
		-Rate	61.0	35.2	67.7	37.0	28.7	25.3	20.0	14.5	9.6	4.3	22.8	326.2	
		-Percent	18.7%	10.8%	20.7%	11.4%	8.8%	7.8%	6.1%	4.5%	3.0%	1.3%	7.0%	100%	
	NEW SOUTH WALES	-No.	1139	411	506	127	417	401	120	167	20	12	165	3485	
		-Rate	23.5	8.5	10.4	2.6	8.6	8.3	2.5	3.4	0.4	0.2	3.4	71.8	
		-Percent	32.7%	11.8%	14.5%	3.6%	12.0%	11.5%	3.4%	4.8%	0.5%	0.3%	4.7%	100%	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	53925	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	96.5	
		-Percent	-	-	-	-	-	-	-	-	-	-	-	100%	
	NETHERLANDS	-No.	1478	315	1255	432	372	227	1682	765	8	36	489	7059	
		-Rate	10.7	2.3	9.1	3.1	2.7	1.6	12.2	5.6	0.1	0.3	3.5	51.2	
		-Percent	20.9%	4.5%	17.8%	6.1%	5.3%	3.2%	23.8%	10.8%	0.1%	0.6%	6.9%	100%	

"Cause", but they were not spearately reported.

It is in the most detailed level of reports--Depth II-C--that explicit analyses by these causal elements are recommended. Depth II-C tabulations pick some category of interest on one or more classification dimensions and display all incidents in that category according to two other dimensions. One possibility is illustrated in Table 3-10. There the focus is on residential fires ignited from smoking materials. Such fires are subdivided by categories of residential occupancy and by material first ignited to gain insight on how smoking leads to residential fires.

The number of possible Depth II-C tabulations is almost endless. The general format of all such analyses would be that of Table 3-10, but an exact choice of dimensions to display would have to be made at the time of report preparation. Generally, report designers would want to include such analyses whenever a significant problem area stands out in Depths I, II-A and II-B and when that problem requires further definition and clarification.

3.7 Collected Recommendations

The tables and figures suggested throughout this section are summarized in Table 3-11. However, in some cases charts illustrating tabular data may not be instructive enough to merit inclusion. Also further cross-comparisons (those marked by circles in Table 3-8) might be added. Still, an outline similar to the one in Table 3-11 would provide an excellent comparative review of international fire loss.

TABLE 3-10

SAMPLE DEPTH II-C TABLE CROSS-CLASSIFYING RESIDENTIAL SMOKING FIRES BY OCCUPANCY SUB-CLASS AND MATERIAL FIRST IGNITED

	GAS			FLAMMABLE LIQUID			. . .	TOTAL		
	No.	Rate	%	No.	Rate	%		No.	Rate	%
One and Two Family										
Nation 1										
Nation 2										
.										
.										
.										
Nation N										
Multi-Family										
Nation 1										
Nation 2										
.										
.										
.			(RESIDENTIAL SMOKING FIRE RESULTS ONLY)							
Nation N										
.										
.										
.										
.										
.										
Total										
Nation 1										
Nation 2										
.										
.										
.										
Nation N										

TABLE 3-11

REVIEW OF RECOMMENDED REPORT TABLES AND FIGURES

		Presentation Form
1.	National Fire Loss Rates for (time period)	Table
2.	Trends in National Loss Rates for (time period)	Bar charts for each rate
3.	Relations Between National Fire Loss Measures and Appropriate Social and Economic Indices for (time period)	Appropriate two-way plots
4.	City Fire Loss Rates for (time period)	Table
5.	Fire Loss by Major Property Type for (time period)	Table and pie charts for each loss measure
6.	Residential Fire Loss for (time period)	Table and pie charts for each loss measure
7.	Non-Residential Fire Loss for (time period)	Table and pie charts for each loss measure
8.	Vehicle Fire Loss for (time period)	Table and pie charts for each loss measure
9.	Outside Fire Loss for (time period)	Table and pie charts for each loss measure
0.	Fire Loss by Cause for (time period)	Table and pie charts for each loss measure
1.	Fire Deaths by Victim Age and Sex for (time period)	Table and pie charts for each sex group
2.	Fire Injuries by Victim Age and Sex for (time period)	Table and pie charts for each sex group
3.	Residential Fires by Occupancy Sub-Class and Cause for (time period)	One table for each fire loss measure
4.	Non-Residential Fires by Occupancy Sub-Class and Cause for (time period)	One table for each fire loss measure
5.	Special Depth II-C Analyses of Problem Areas for (time period)	One table for each fire loss measure and each anlaysis

OTE: Loss "measures" are number of serious fires, number of fire fatalities, number of seriously injured persons, or direct property loss. "Rates" are as shown in Tables 3-1 and 2-1.

4. DATA AGGREGATION

In preparing reports, it usually is necessary to do some data aggregation, that is, to display the data in terms of a few major categories instead of the dozens of categories that are used in coding individual incidents. Cause, Occupancy and Victim Age are only the most obvious examples of dimensions that have dozens of coding categories. Data aggregation is needed not only to permit the display to fit on a printed page but also because major patterns will not emerge if the data is subdivided too finely.

Sections 2 and 3 of this document discussed not only the classifiable dimensions of fire experience recommended in Georgia Tech's earlier Report on Fire Death Collection and Presentation [6], but also some aggregations of those dimensions. In this section, detail is added on methods for accumulating low level information into aggregate values. It should also be emphasized that all details of classification definition are merely proposals. General strategies are unlikely to change, but many of the specifics could be resolved in any one of a variety of acceptable ways. Concepts of this section offer only one possibility.

For single classification dimensions, data aggregation can be done by summing, that is, defining each major category to be the sum of several coding categories and arranging that every coding category fits into one and only one major cateogry. Figure 4-1 illustrates the principle involved, and Figure 4-2 shows how the principle can be applied to occupancy.

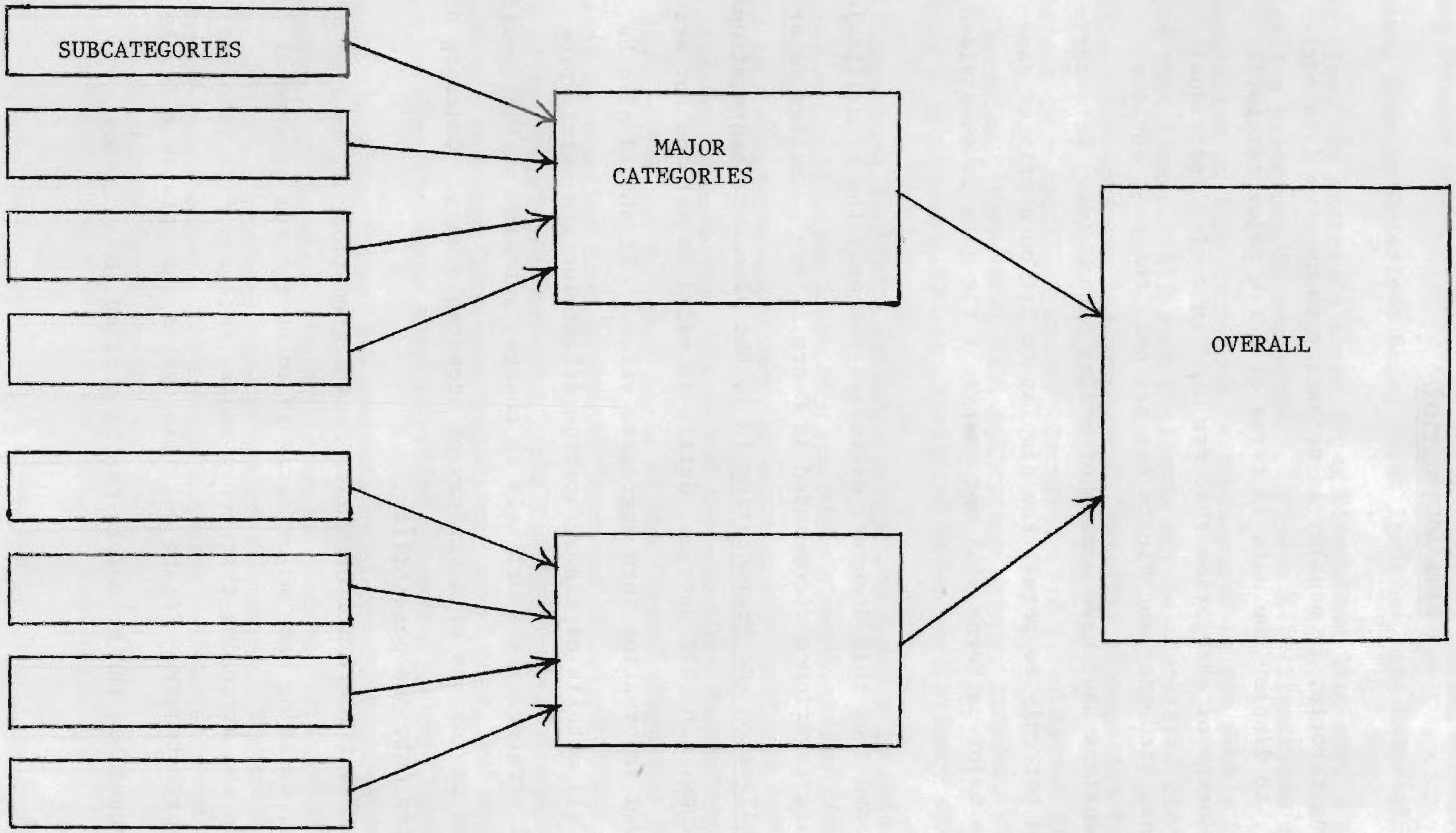


FIGURE 4-1: SUMMING APPROACH TO AGGREGATION WITHIN A DIMENSION

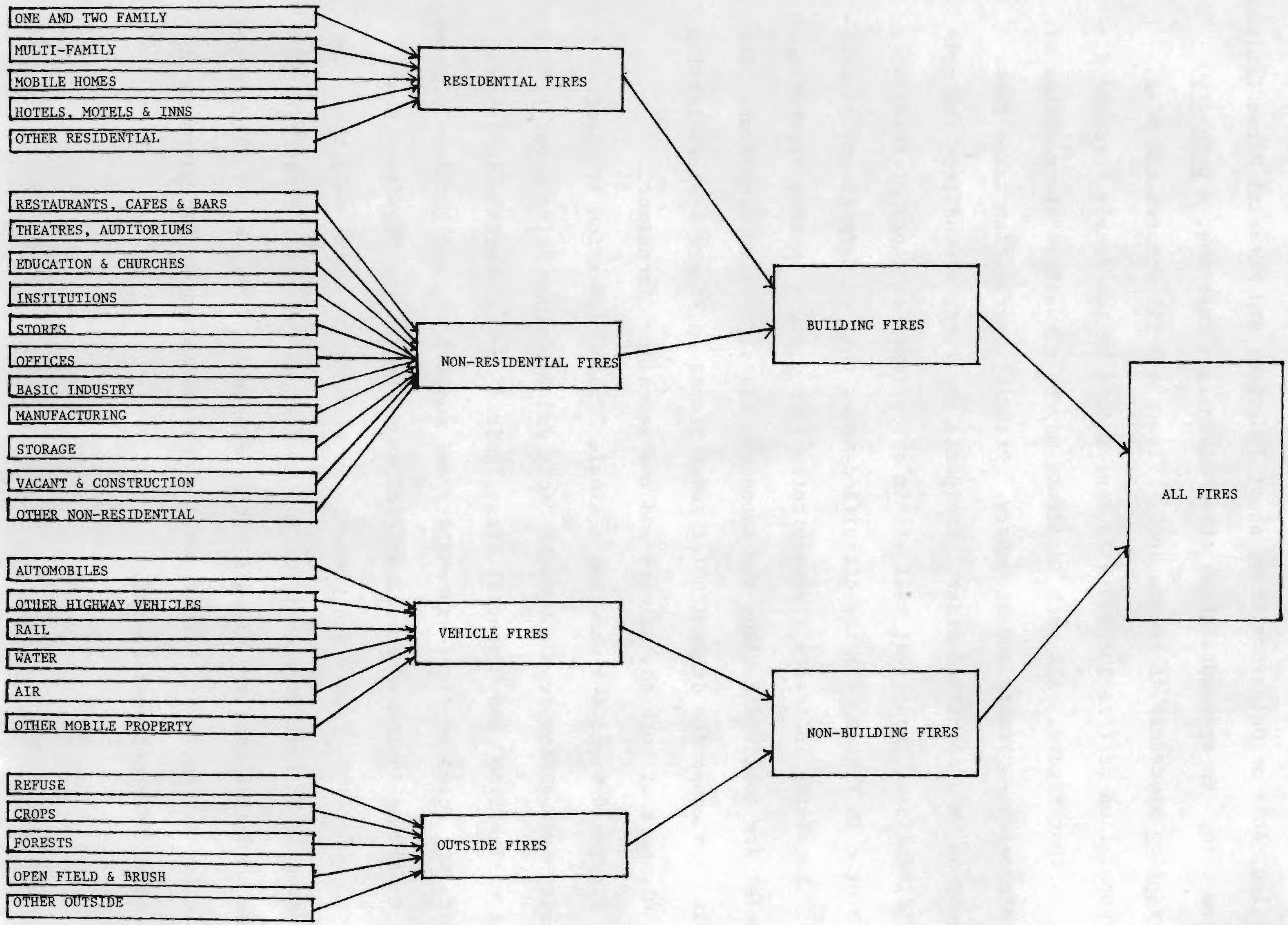


FIGURE 4-2: AGGREGATION PATTERN FOR TYPE OF OCCUPANCY

The major categories of cause, however, cannot be defined by simple summing because cause is based on three separate coding dimensions--Heat of Ignition, Acts or Omissions Bring about Ignition, and Material First Ignited in the fire. To aggregate these three dimensions into one, a priority aggregation procedure is recommended. Figure 4-3 illustrates the idea. The population of fire incidents is represented by the double bordered diamond in that figure. All such incidents may be classified along either of two dimensions--primary and secondary. Priority aggregation takes these dimensions in a specified order. Incidents are first viewed from the primary dimension. Those that fall within any primary category of interest (a, b or c in Figure 4-3) are classified under that primary dimension category. Remaining incidents (primary categories d and e in this hypothetical example) are subdivided along the secondary classification dimension. The result is a composite dimension (of seven groups in Figure 4-3) reflecting some elements of both the primary and the secondary dimensions.

Figures 4-4 and 4-5 show how a single "Cause" dimension is obtained via priority aggregation from component "Acts and Omissions Bring about Ignition" "Heat of Ignition" and "Material First Ignited" axes. Certain ignition factors are selected first--incendiary and suspicious, and children playing. Most remaining incidents are classified according to the "Ignition Heat Source". In fact, Figure 4-4 presents an alternative using only those two dimensions. If further classification is desired "Material First Ignited" may be used as a tertiary classification dimension. Figure 4-5 illustrates the latter alternative. Either would appear satisfactory for purposes of a standard international report.

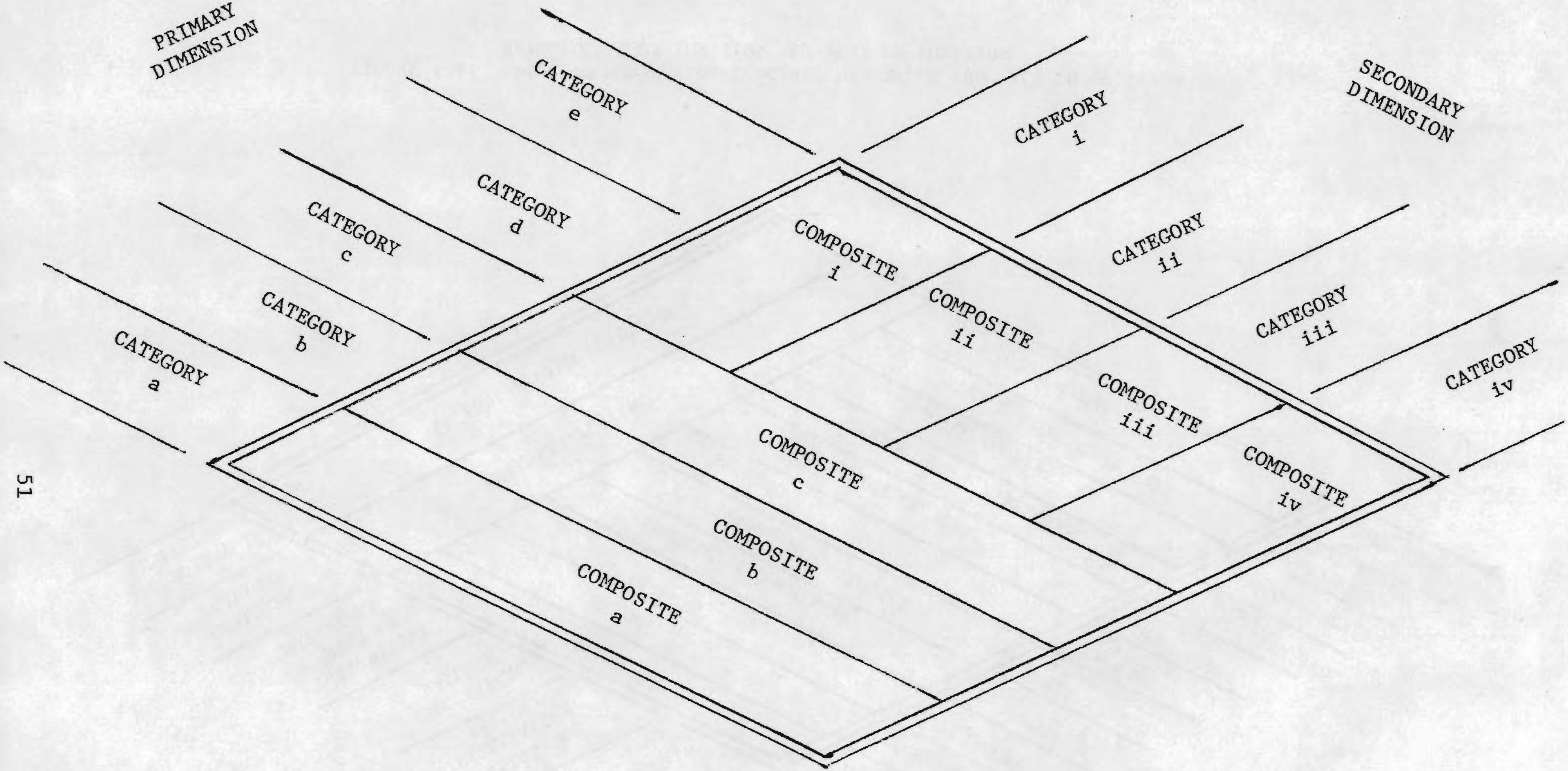


FIGURE 4-3: PRIORITY APPROACH TO AGGREGATION ACROSS DIMENSIONS

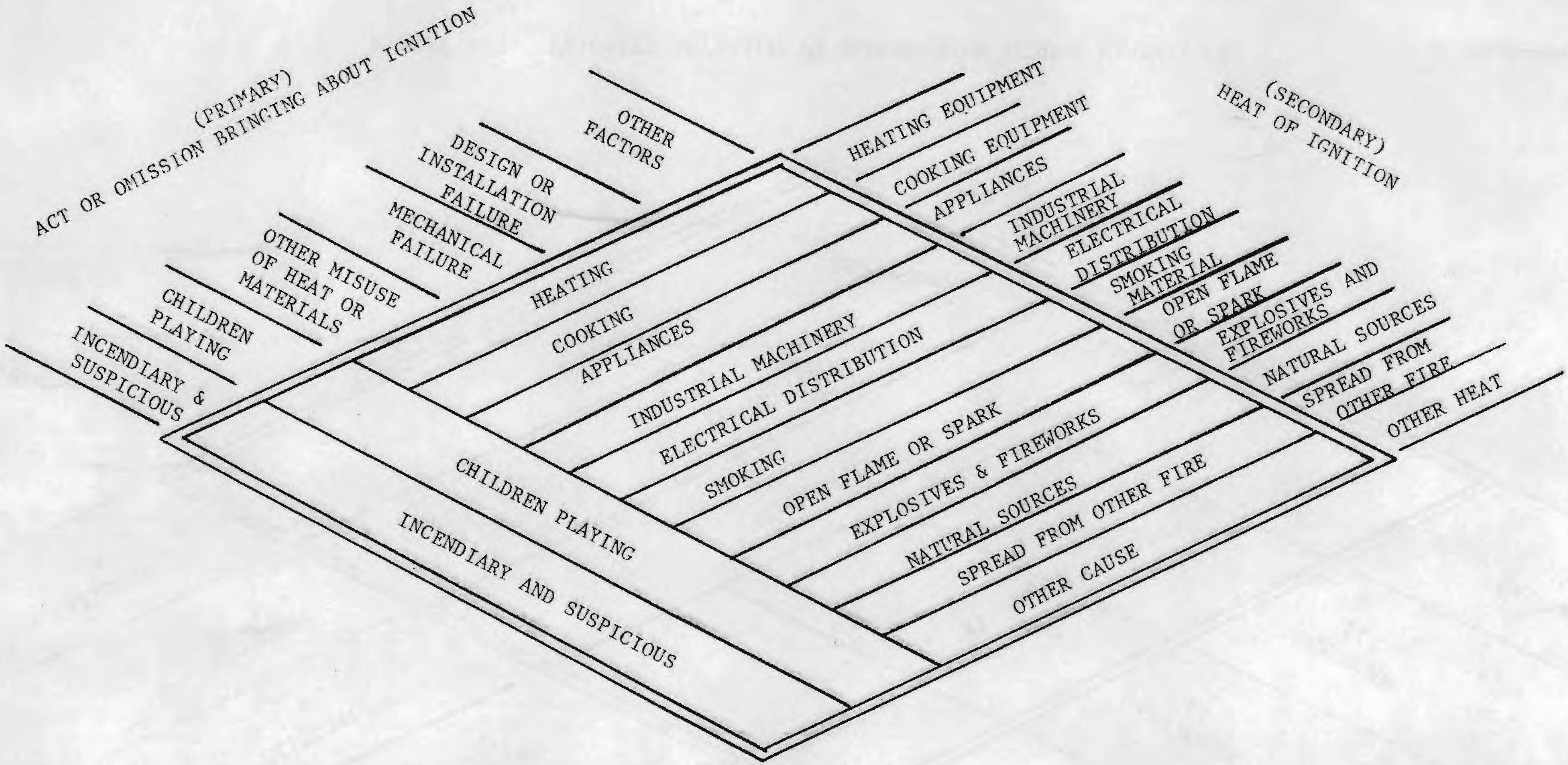


FIGURE 4-4: PRIORITY DERIVATION OF CAUSE DIMENSION FROM ACT OR OMISSION BRINGING ABOUT IGNITION AND HEAT OF IGNITION

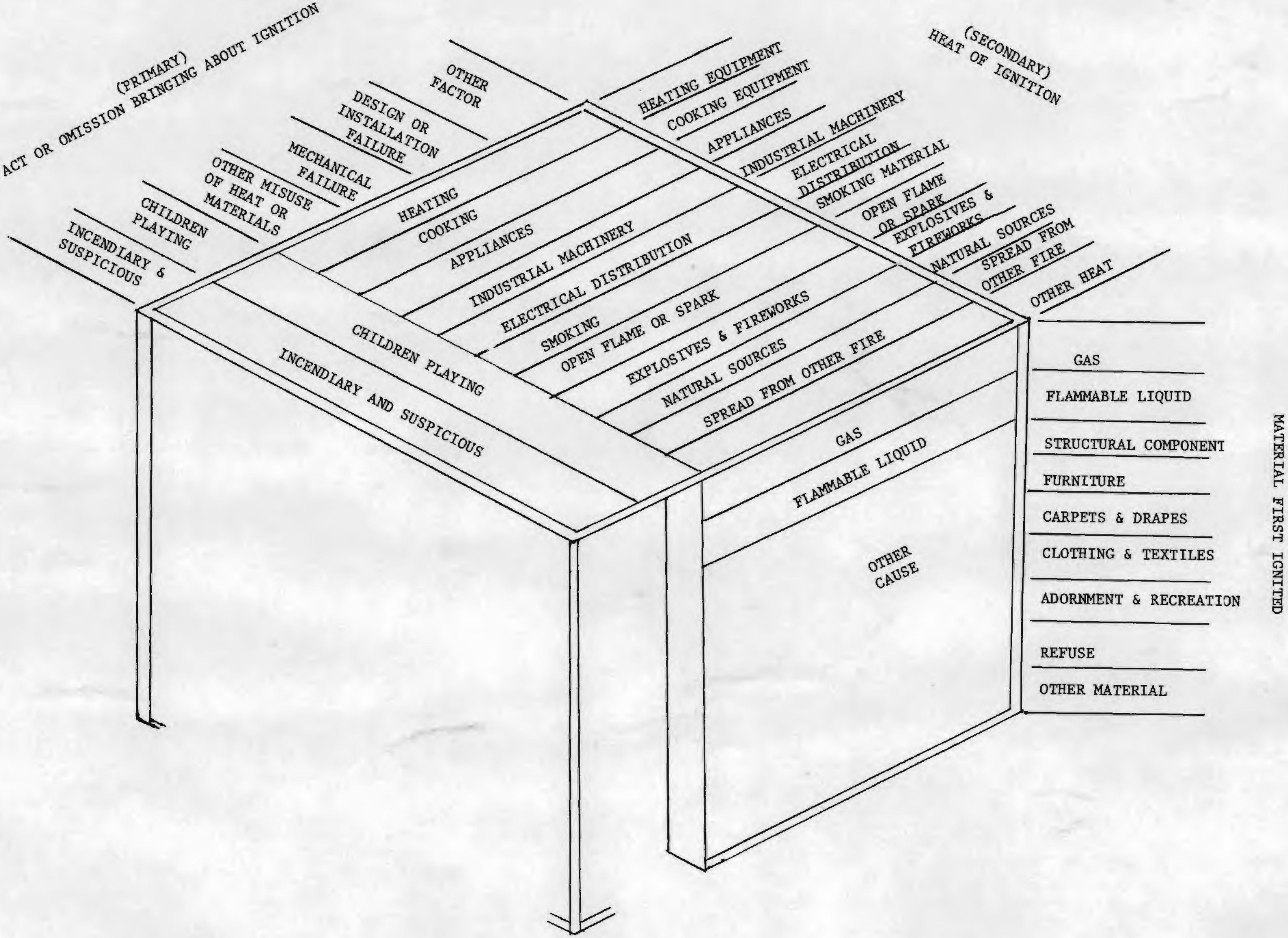


FIGURE 4-5: PRIORITY DERIVATION OF CAUSE DIMENSION FROM ACT OR OMISSION BRINGING ABOUT IGNITION AND HEAT OF IGNITION AND MATERIAL FIRST IGNITED

5. OUTLOOK

This document has presented a plan for a comparative international fire statistics report that would be of enormous value to policy makers in participating countries. There are many detail issues of category definition, rate calculation, etc. that remain to be resolved. However, there do not appear to be any serious barriers preventing the eventual production of such a report. Georgia Tech's earlier survey of data gathering systems [6] showed that many developed nations already have data collection systems capable of supporting most of the needs of the international report outlined above. Regular production of such a report awaits mainly further initiatives to actually implement an agreed system.

REFERENCES

1. British Fire Protection Association (1976), "U.K. Fire Damage Compared with Those of Other Countries 1970-1974," Fire Prevention, No. 113, p. 39.

2. International Monetary Fund, "International Financial Statistics," published monthly with annual data in May issue.

3. Motor Vehicle Manufacturers Association of the United States, Inc., "Motor Vehicle Facts and Figures," published annually.

4. Rardin, R. L., and Jerry Banks, "Selected International Comparisons of Fire Loss: 1975-78," Georgia Institute of Technology, December, 1980.

5. Rardin, R. L. and Morris Mitzner, "Final Technical Report," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, Georgia Institute of Technology, June 1977.

6. Rardin, R. L. and Morris Mitzner, "Report on Fire Data Collection and Presentation," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, Georgia Institute of Technology, June 1978.

7. Rardin, R. L. and Morris Mitzner, "Selected International Comparisons of Fire Losses," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, Georgia Institute of Technology, June 1978.

8. Tokyo Fire Department, "Statistics on Fire Services in the World," published annually.

9. Tovey, Henry, Memorandum, subject: Draft ISO Standard Fire Data System, July 3, 1979. (copies available from United States Fire Administration)

10. UN Statistics Office, "Monthly Bulletin," U.N. Publishing Service, published monthly.

11. United Nations Statistical Office, Statistical Yearbook, U.N. Publishing Service, published annually.

12. United Nations Statistical Office, Demographic Yearbook, U.N. Publishing Service, published annually.

13. United States Central Intelligence Agency, National Basic Intelligence Factbook, U.S. Government Printing Office, published semi-annually.

SELECTED INTERNATIONAL COMPARISONS OF FIRE LOSS

1975–1978

Prepared for the
United States Fire Administration
National Fire Data Center

GEORGIA INSTITUTE OF TECHNOLOGY

December 1980

The fire mark illustrated on the cover of this report and on the title page is an important part of the history of fire fighting. Such insignias were first issued by British fire insurance companies after the disastrous London fire of 1666 to serve as a guide to the insurance company's fire fighting brigade. If a burning home displayed the fire mark, paid firefighters fought to extinguish the blaze. If it did not, the firefighters would not lift a hand to help the unfortunate owner.

In early America, volunteer fire departments received financial rewards from the fire insurance companies for extinguishment effort. To identify their insured properties, the fire insurance companies each adopted an insignia made of lead or cast iron and placed it on the front of the building. This fire mark indicated that the building was insured and by what company. Volunteer firefighters, seeing such a mark on a burning house, knew that they would be paid and, presumably, were inspired to fight the fire with extra effort.

This is a replica of one such fire mark.

SELECTED INTERNATIONAL COMPARISONS OF FIRE LOSS 1975–1978

By

Jerry Banks

Ronald L. Rardin

GEORGIA INSTITUTE OF TECHNOLOGY

Atlanta, Georgia 30332

With The Support Of The
United States Fire Administration
National Fire Data Center
Grant No. USFA–79065

DECEMBER 1980

EXECUTIVE SUMMARY

The consistent finding of comparative estimates of fire loss experience in various developed nations has been that the United States has one of the highest rates of per capita fire incidence and fire fatality. These comparative estimates have been published intermittently for a number of years. This report presents an analysis of the United States' relative standing for the 1975-78 time period. Statistics from Canada, Australia, Japan and several countries in western Europe are compared to those of the United States for the time period of interest.

Any comparison between reported fire losses of different countries is beset by major incomparabilities in the data and the procedures by which the statistics are calculated. When, as in the case of this report, published results from individual countries are interpolated to conform to a standard format, additional opportunities for confusion are introduced. Thus, a reader should treat all conclusions from the data presented only as indications of possible phenomena. Within these limitations, however, some conclusions do seem appropriate.

- Building Fire Incidence. The incidence of building fires per 1,000 persons was estimated for thirteen nations including the United States. Although slightly down from earlier time periods, the per capita rate of reported building fires in the United States was the second highest of the countries reported, Ireland being the highest. The United States rate is one and one half times that of our neighbor, Canada.
- Building Fire Loss. The United States compares somewhat more evenly with other developed countries for which data is available when the

rate of monetary building fire loss is computed. Either on the basis of monetary loss per capita or monetary loss as a percent of Gross National Product, the United States ranks at the middle of the countries considered in this report.

- Fatalities. Per capita death rates among the seventeen developed countries, for which information can be obtained from the World Health Organization, are greater in the very young, the very old, and in males. However, in all age and sex categories, the United States rate is greater than any other country considered except Canada and Ireland.
- Occupancy. When fire loss experience is subdivided by the occupancy of the property in which the fire occurs, residential fires seem to be a more important component of the United States' fire problem than they are for other countries.
- Cause. The United States experience with the cause of fires mirrors, in many ways, that of the Netherlands, the United Kingdom, and the New South Wales state of Australia (the jurisdictions for which comparable information is available). However, there are some exceptions. The most important appears to be a greater contribution of incendiary and suspicious fires in the United States.
- City Data. When available city fire incidence and fire fatality rates are compared for United States cities and world cities, the relatively poor standing of the United States is confirmed. Both per capita fire incidence and per capita fire fatalities in the United States cities average significantly higher than those of comparable foreign cities. Rates in the largest United States cities

(over 1,000,000) are several times those of world cities. Relatively greater fire incidence in the United States is apparently reflected in the comparatively larger numbers of fire personnel employed by American cities.

TABLE OF CONTENTS

Executive Summary iii

Table of Contents vii

List of Tables ix

List of Figures xi

1. Introduction 1

1.1 Sources of Information 3

2. Comparisons of Aggregate Fire Indices 7

2.1 Economic and Technological Determinants 15

2.2 The Uniqueness of Japan 19

3. Comparisons by Occupancy and Cause 21

3.1 Comparison by Broad Occupancy Classifications . . . 21

3.2 Residential Fires 24

3.3 Non-residential Structure Fires 27

3.4 Mobile and Outside Fires 31

4. Fatality Patterns 35

5. Comparisons of City Data 43

References 49

Appendix A: Supporting Tables 51

Appendix B: Details of Calculations 57

B.1 Derivation of Values in Table 2-1 58

B.1.1 Australia 60

B.1.2 Austria 60

B.1.3 Belgium 63

B.1.4 Canada 64

B.1.5 Denmark 65

B.1.6 France 66

B.1.7 Germany (F.R.) 71

B.1.8 Ireland 72

B.1.9 Japan 73

B.1.10 Netherlands 74

B.1.11 Norway 74

B.1.12 United Kingdom 75

B.1.13 United States 76

B.2 Computation of Technological Index in Table 2-2 . . 77

B.3 Derivation of Values in Table 3-1 78

B.3.1 Canada 78

B.3.2 Japan 78

B.3.3 Netherlands 79

B.3.4 New South Wales 79

B.3.5 United Kingdom 79

B.3.6 United States 80

B.4 Derivation of Values in Table 3-2 through 3-5 . . . 81

B.4.1 Netherlands 81

B.4.2 New South Wales 83

B.4.3 United Kingdom 83

Appendix C: Sources of International Fire Statistical Information 91

LIST OF TABLES

1-1 Sources of National Fire Statistics 4

2-1 Comparison of Fire Loss Indices for 1976-78 10

2-2 Indices of Economic and Technological Development . . . 16

3-1 Fire Loss by Major Property Type 22

3-2 Residential Fires by Occupancy and Cause 25

3-3 Non-Residential Fires by Cause and Occupancy Class . . 28

3-4 Mobile Fires by Occupancy Class 32

3-5 Outside Fires by Occupancy Class 33

4-1 Death Rates by Age and Sex, 1975-77 36

5-1 World City Fire Losses 44

A-1 Comparison of Fire Loss Indices for 1965-67 52

A-2 Comparison of Fire Loss Indices for 1972-74 53

A-3 Death Rates by Age and Sex, 1972-74 54

A-4 U.S. Cities Fire Losses 55

B-1 Classification Codes 82

B-2 Netherlands Classifications 84

B-3 New South Wales Classifications 86

B-4 United Kingdom Classifications 88

LIST OF FIGURES

2-1 Comparison of National and World Health Organization Fire Death Rates 8

2-2 Comparisons of Fire Loss Indices 11

2-3 Relationship Between Monetary Building Fire Loss and GNP Per Capita 17

2-4 Relationship Between Per Capita Fire Deaths and Technological Index 18

4-1 Comparison of 1972-74 and 1975-77 Fire Death Rates (Per Million Population) by Sex 37

4-2 Comparison of 1972-74 and 1975-77 Fire Death Rates (Per Million Population) by Age 38

5-1 World Cities Fire Rate Per 10,000 Persons vs. United States Cities 45

5-2 World Cities Fire Death Rate Per 1,000,000 Persons vs. United States Cities 45

5-3 Population vs. Total Fire Personnel for World Cities 46

5-4 Total Fires vs. Total Fire Personnel for World Cities . . . 48

1. INTRODUCTION

The consistent finding of international comparisons has been that the United States has one of the highest rates for per capita fire incidence and fire fatalities among the developed nations of the Western World [4, 20]. As a first systematic effort to obtain some understanding of what causes such differences in reported fire loss the United States Fire Administration sponsored the Georgia Institute of Technology in a grant project entitled, Determinants of International Differences in Reported Fire Loss. The object of the project was to systematically enumerate and screen the various hypotheses and theories which have been advanced to explain fire loss differences among nations - including social, economic, cultural, technological and fire policy variations, as well as differences in statistical reporting procedures. The principal results of this Georgia Tech project are a Final Technical Report [23] and a Final Summary Report [22] published in 1977.

As an extension of the earlier work, the Georgia Tech research team undertook in 1978 to produce two more detailed reports. The first of these, entitled Report on Fire Data Collection and Presentation [24], more thoroughly analyzed the collection and analysis systems used to prepare fire data in different countries. The second supplemental report, Selected International Comparisons of Fire Losses [25], provided more detailed analyses of fire loss in a more limited set of countries.

Georgia Tech's earlier work was based on fire statistics for 1973-75. This report extends the earlier analyses through the 1975-78 time period. The analyses of Selected International Comparisons of Fire Losses are updated to the later time, and results for the two time periods are compared for trends or changes in the relative position of the United States.

Several specific analyses are included. In Section 2, aggregate indices of fire loss are compared for the United States, Australia, Canada, Japan and nine western European nations. The incidence of building fires, losses resulting from building fires, and rates of fire fatalities are related to national populations, economic and technical activity. Section 3 contains more detailed comparisons by the occupancy of the fire site and the cause of the fire. The United States, the United Kingdom, the Netherlands and Australia are represented. Rates of fire incidence are calculated for particular classes of residential, non-residential, mobile and outside occupancy; residential and non-residential are further subdivided by cause. Section 4 focuses on fire fatalities. Drawing on World Health Organization reports of deaths due to fire and flame accidents [33], age and sex differences in fire fatalities are analyzed for seventeen developed nations including the United States. A final section presents fire loss data from major cities of the world. Using reports collected by the Tokyo Fire Department [26] from 48 cities, populations, numbers of fires, fire deaths, and number of fire personnel are correlated.

Any major comparison between reported fire losses of different countries is beset by major incomparabilities in the data on which statistics are based and the procedures by which the statistics are calculated. When published results must be manipulated and interpolated to conform to a standard format, additional opportunities for confusion are introduced. Still, useful insights and directions for future research do arise from souch rough investigations. Thus, the reader should accept none of the results to follow as irrefutable, but instead, should view them as indications of underlying phenomena.

1.1 Sources of Information

As detailed in Appendix C, the Georgia Tech research team has undertaken a rather thorough effort to contact and obtain reports from agencies known to be producing fire loss statistics in various industrialized nations. Although only a few sources were discovered that analyze fire loss in as much detail as USFA's National Estimates, information that could be used in one or more of the tables and figures in this document was obtained for a variety of countries. Specific sources of national data are detailed in Table 1-1.

In addition to the sources listed in Table 1-1, information for individual cities was obtained from a report by the Tokyo Fire Department [26]. This report is based on 1976-78 data which was collected by the Tokyo Fire Department through surveys of numerous fire departments throughout the world.

In preparing the values presented in the exhibits which follow, it was often necessary to perform various calculations on the data directly available from the above sources. The purpose of such calculations was to reconcile subdivisions by cause and occupancy, to convert foreign losses to United States dollars for a base year, etc., in order to have all data correspond more directly with each other and with USFA's national estimates. Although values were not presented unless a reasonable basis for such calculations could be developed, some decisions were necessarily arbitrary.

TABLE 1-1

SOURCES OF NATIONAL FIRE STATISTICS

COUNTRY	SOURCE OF INFORMATION
AUSTRALIA	Fire Statistics, New South Wales, 1977 [3], which contains statistics of service calls made by the New South Wales Fire Brigade to fires and other hazards. "As New South Wales is fairly representative of Australia generally, it is reasonable to use the population ratio as a factor to obtain a national picture." [17]
AUSTRIA	Reports for 1977 and 1978 of The Austrian Fire Prevention Agency [9]. The report is derived from a combination of official fire reports and insurance sources.
BELGIUM	Summary of 1978 Belgian Fire Brigade operations [2] produced by the Belgian Ministry of the Interior.
CANADA	Report for 1977 of the Dominion Fire Commissioner [10] which is compiled from data provided by the provincial fire marshals and fire commissioners, the fire marshals of the Territories, the Canadian Forces Fire Marshal and Statistics Canada.
DENMARK	Reports of fire losses for 1976-78 were prepared by Danmarks Statistik [7], based on information from insurance companies.
FRANCE	Monthly reviews [13] and general report [12] for 1976-77 on fire brigade operations. The reports are prepared by the French Ministry of the Interior. Monetary loss values came from the insurance industry figures of the Assemblee Pleniere [1].
GERMANY (F.R.)	Values on insurance for 1977 and 1978 published by the Germany Casualty Insurance Association [8]. Reports reflect fire insurance claims paid.
IRELAND	Values for 1978 compiled by the Irish Department of the Environment [15]. Statistics are based on local authority reports.
JAPAN	White Book on Fire Service in Japan for 1976 and 1978 [16], by the Japanese Fire Defense Agency, which is derived from reports of responses by Japanese fire brigades.
NETHERLANDS	Reports for 1976 and 1977 of the Centraal Bureau voor de Statistek in the Dutch government [11], which is derived primarily from reports on responses of Dutch fire brigades.
NORWAY	Publications for 1976 and 1977 [21] describing the distribution of fires by sources and causes, based on reports from all fire insurance companies underwriting in Norway.
UNITED KINGDOM	Reports of the British Home Office for 1976 and 1977 [5], the statistics presented are of fires attended by local fire brigades. Monetary loss values come from the British Insurance Association [6].
UNITED STATES	USFA's Fire in the United States for 1977 and 1978 [19], which is derived from the surveys conducted by the National Fire Protection Association, data from the National Center for Health Statistics, and from reports on fire department responses entered in the NFIRS information system.

Furthermore, all decisions were based on the very limited information available within reports on the definitions of categories for which national statistics were reported. Details of calculations performed are provided in Appendix B.

2. COMPARISONS OF AGGREGATE FIRE INDICES

Fire statistics published by various national agencies provide numbers of fire incidents, numbers of injuries due to fires, numbers of fire fatalities, and estimates of direct monetary loss from fires. Specific reports may contain one or more of these measures. Prior Georgia Tech analysis in the Final Technical Report [23], showed that the number of fatalities and the amount of monetary loss attributed to non-building fires is small, and that there is high variability among nations in the degree to which non-building fires are included in reports. For that reason, in preparing aggregate fire loss comparisons, only building fires are included in incidence and monetary loss analyses. Some nations do report injuries, but the definition and comparability of these reports is very doubtful. For this reason, injuries are not compared in this report.

The single instance in which fire data is systematically collected by an international agency is the fire fatality information published by the World Health Organization (WHO). Figure 2-1 compares death rates available from individual national reports to those WHO statistics. As seen in the figure, the WHO values are usually smaller. WHO statistics are derived from cause of death data on death certificates. Disparities between them and fire service reports derive from differences in handling of incidents that might or might not be called a fire death. For example, WHO classifies deaths due to fires connected with motor vehicle collisions as automobile accident deaths, not as fire deaths. Since our interest in this report lies with the relative position of the various countries; the WHO values appear to present the most consistent basis for comparison among a wide group of nations. For this reason, all national death statistics to follow are derived from WHO values.

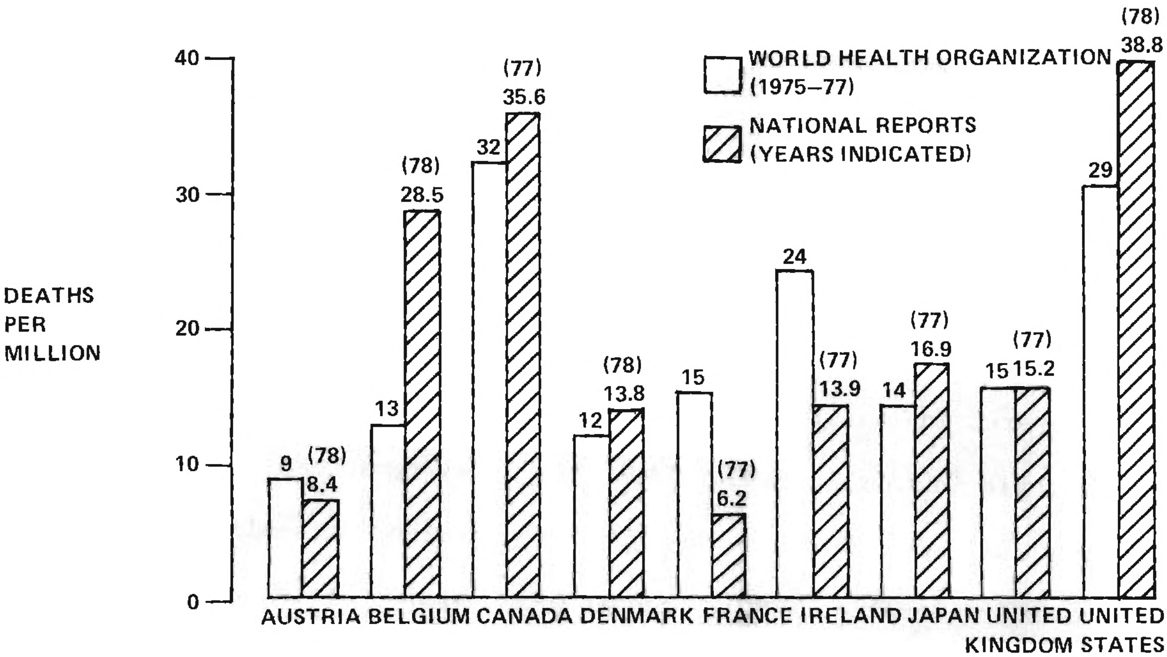


FIGURE 2-1. COMPARISON OF WORLD HEALTH ORGANIZATION AND NATIONAL REPORT FIRE DEATH RATES

Like fire incidents, monetary fire loss estimates in this report are adjusted to reflect only building fires. However, additional adjustments are necessary to convert monetary values into a single currency for a single year. As detailed more completely in Appendix B, monetary loss estimates for this report were obtained by adjusting to a standard year (1977) through consumer price indices of the United Nations Statistical Office [29] and the prevailing exchange rates published by the International Monetary Fund [14].

By whatever method fire loss is measured, it is not possible to make meaningful comparisons among nations unless loss values are standardized into indices. The most widespread approach for producing loss indices from monetary loss estimates, fire counts, and numbers of fire deaths is the calculation of per capita rates. However, per capita rates are not the only reasonable choice. Other possibilities are comparison to the size of economies as measured by the Gross National Product comparison, the level of technological development in the various nations and computation of losses per fire incident.

Table 2-1 presents all such indices for Australia, Canada, Japan, the United States and nine western European nations. Figure 2-2 compares results in Table 2-1 to similar ones for 1965-67 and 1972-74. (See appendices Tables A-1 and A-2 for details of the earlier time periods.) Major highlights of Table 2-1 and Figure 2-2 are the following:

- <u>Building Fires Per 1,000 Persons</u>. The United States rate of 4.8 building fires per 1,000 persons is the second highest of the thirteen nations considered, Ireland having a rate of 6.5. In fact, the United States rate in each of the three time periods is first or second highest for building fires per capita. The lowest relative rate of building fires in all

TABLE 2-1

COMPARISON OF FIRE LOSS INDICES FOR 1976-78

COUNTRIES	BUILDING FIRES/1,000 PERSONS	$ BUILDING FIRE LOSS PER CAPITA	BUILDING FIRE LOSS AS % OF GNP	FIRE DEATHS/ 1,000,000 PERSONS	BUILDING FIRE LOSS/ FIRE ($1,000'S)	FIRE DEATHS/ 1,000 BUILDING FIRES
Australia	1.2	-	-	11.6	-	9.6
1977	25%	-	-	34%	-	133%
Austria	2.4	9.6	.15	9.2	4.0	3.9
1977, 78	50%	49%	65%	27%	95%	54%
Belgium	1.2	-	-	12.6	-	7.9
1977	25%	-	-	37%	-	110%
Canada	3.2	23.6	.27	32.1	7.3	9.9
1977	67%	120%	117%	94%	174%	138%
Denmark	3.3	25.6	.26	11.6	7.6	3.5
1976, 77, 78	69%	131%	113%	34%	181%	49%
France	1.5	22.2	.26	14.9	14.6	10.0
1976, 77	31%	113%	113%	44%	348%	139%
Germany	-	13.3	.16	8.9	-	-
1977, 78	-	68%	70%	26%	-	-
Ireland	6.5	9.8	.16	24.0	1.5	3.7
1976, 77, 78	135%	50%	70%	70%	36%	51%
Japan	0.3	4.0	.07	14.1	11.6	40.6
1977	6%	20%	30%	41%	276%	564%
Netherlands	1.0	13.3	.16	5.3	12.9	5.2
1976, 77	21%	68%	70%	15%	307%	72%
Norway	3.9	36.4	.42	14.6	9.5	3.8
1976, 77	82%	186%	183%	43%	226%	53%
United Kingdom	1.7	8.9	.20	15.4	5.2	9.0
1976, 77	35%	45%	87%	45%	124%	125%
United States	4.8	19.6	.23	34.2	4.2	7.2
1977, 78	100%	100%	100%	100%	100%	100%

Notes: Losses are expressed in 1977 U.S. dollars.

Death values are from WHO Statistics Annual: Vital Statistics and Causes of Death [33] and reflect an average for 1975-77.

Percentages reflect the ratio formed by comparing the fire loss index value for the country under consideration to the same fire loss index value for the United States.

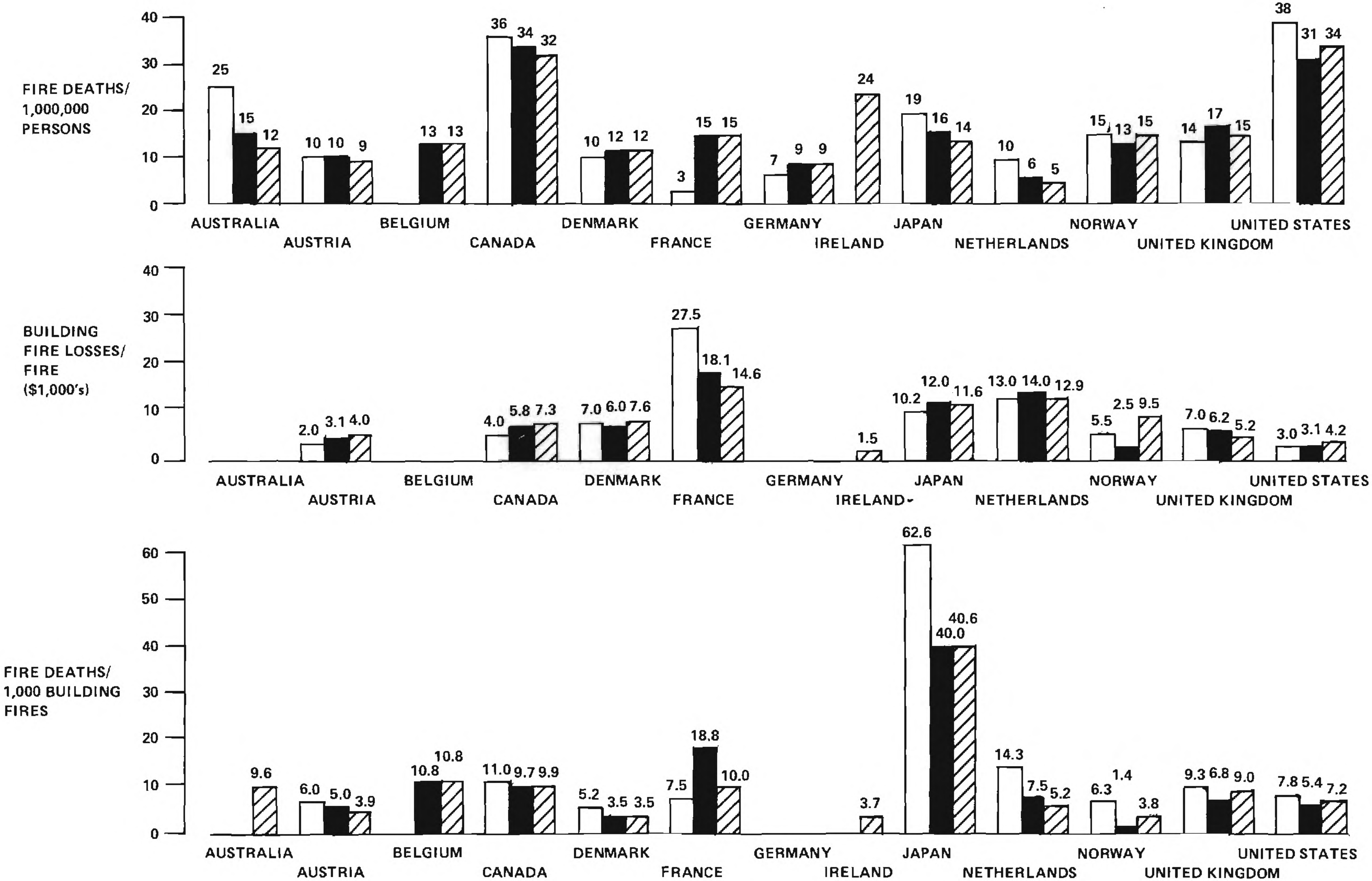


FIGURE 2-2: COMPARISONS OF FIRE LOSS INDICES

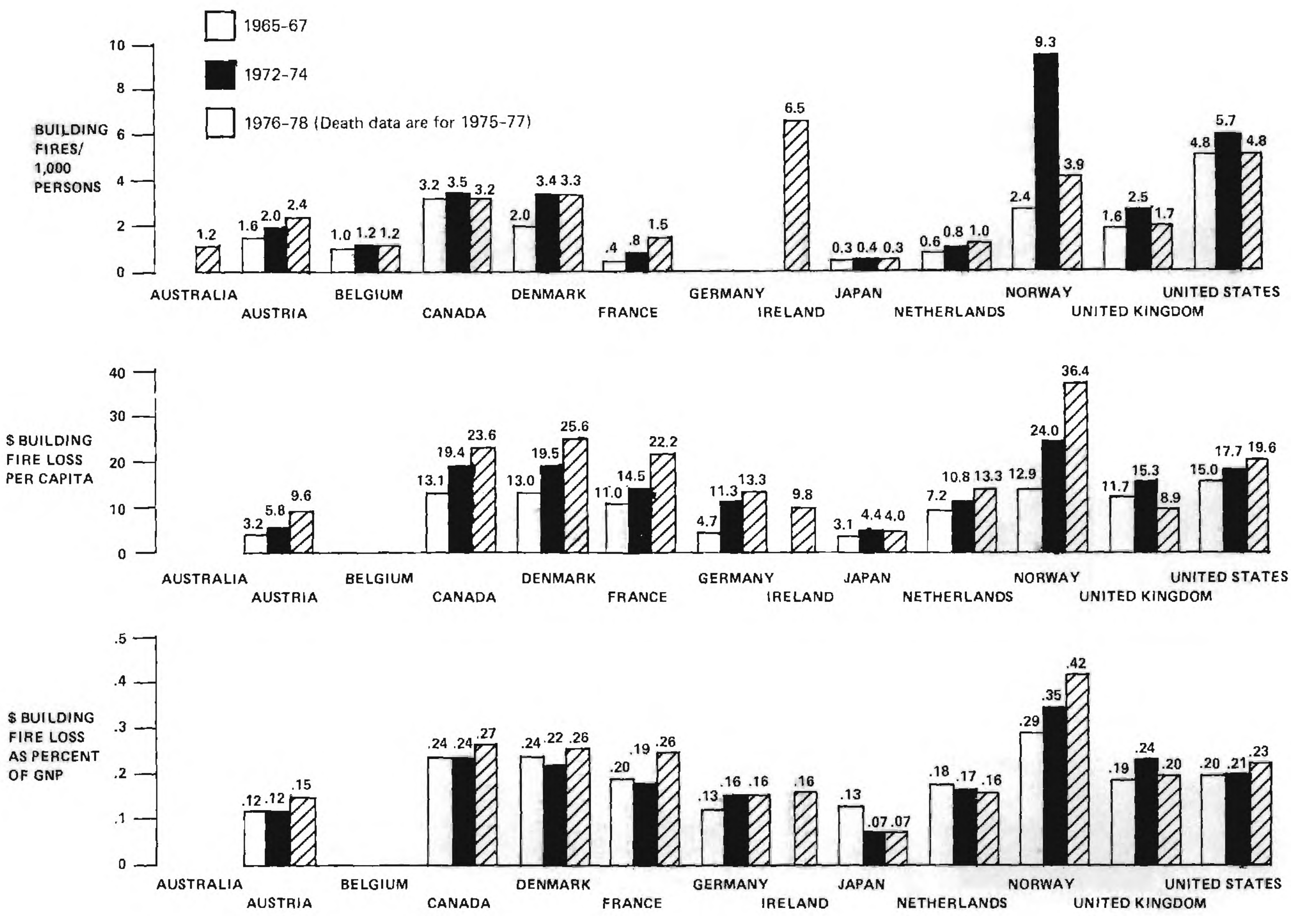


FIGURE 2-2 (CONTINUED)

Notes: Values for the current time period are taken from Table 2-1 of the document. Values for earlier time periods, other than death data, are taken from an earlier Georgia Tech report [23].

Death values are from WHO Statistics Annual: Vital Statistics and Causes of Death [33] and reflect an average for the time period indicated.

three time periods is Japan. The United States building fire incidence rate is approximately 15 times that of Japan. It is over one and one half times that of our neighbor, Canada.

- Building Fire Loss Per Capita. Even after adjustment to 1977 dollars, Figure 2-2 shows that building fire losses per capita are increasing in most countries for which data is available. The United States is no exception. In contrast to results for numbers of fires per capita, the United States ranks in the middle of the countries considered on monetary fire loss per capita. Table 2-1 shows Canada, Denmark, France and Norway with higher rates than the United States; Austria, Germany, Ireland, Japan, the Netherlands and the United Kingdom are lower. As with fire incidents, reported monetary fire loss per capita in Japan is extraordinarily low - one fifth of the United States' value.
- Building Fire Loss as a Percent of Gross National Product. When fire losses are measured as a fraction of Gross National Product, they reflect the economic burden of monetary fire losses on the various nations. By this standard, the burden of fire losses has remained consistent over the past several years in most of the countries reported in Figure 2-2. There are two significant exceptions. Norway's fire losses are growing dramatically as a percent of Gross National Product; Japan's have decreased by nearly 50%. Since this index is a function of two measures, large changes in the denominator (GNP) may be causing such perturbations. The United States is one of the countries that has experienced a fairly consistent fraction of its Gross National Product lost to fires. As with the case of building fire losses per capita, the United States ranks in the lower middle of the reported countries on monetary losses per GNP.

- Fire Deaths Per 1,000,000 Persons. The WHO fire death rates reflected in Figure 2-2 show for most countries a decreasing fire fatality rate over the past decade. The United States, however, has shown little improvement and has the highest fire death rate per million persons among the thirteen nations. The United States' rate is comparable only to the slightly lower one of Canada and is almost twice that of all other countries reported.
- Building Fire Loss Per Fire ($1,000's). When fire losses are calculated per fire, they reflect the magnitude of the fire incidents included in published statistics. By this measure Table 2-1 shows the United States to have one of the lower monetary fire loss per fire rates. The lower United States value may reflect the fact that more inconsequential fire incidents are included in the United States data, or the possibility that fires are better controlled in the United States after ignition.
- Fire Deaths Per 1,000 Building Fires. Although WHO values in Table 2-2 include a limited number of nonbuilding fires, the ratio of fire deaths to building fires reflects the seriousness of building fire incidents. When fire deaths are calculated per building fire, the United States stands in the middle of the countries reported. Six countries have more deaths per fire and five have fewer. The deaths per fire rate in Japan is extraordinarily higher than any of the other values, although it has improved slightly over the past decade.

2.1 Economic and Technological Determinants

In the earlier Final Technical Report [23] and Final Summary Report [22] Georgia Tech's analyses considered many hypotheses that might explain differences in fire losses. Among those which seemed plausibly related to fire loss were the levels of economic and technological development.

Table 2-2 shows the indicators of economic and technological development available from multinational organizations. Gross National Products per capita are obtained from estimates of the International Monetary Fund [14] and the United Nations Statistical Office [29]. Numbers of televisions, radios and telephones per capita are estimated by the United Nations [30]. To obtain a single measure of technological development, the latter three were combined into a Georgia Tech technological index as detailed in Appendix B-2.

Figures 2-3 and 2-4 plot relationships between the values in Table 2-2. The first of these figures demonstrates the tendency of monetary fire losses to increase with the Gross National Product of the various nations. Among the possibilities to explain this relationship are the notions that increasing GNP creates more opportunities for fires and that greater economic activity indicates greater burnable wealth.

Figure 2-4 shows the relationship between fire death rates and the technological index. Statistically, the implied relation is a relatively strong one. However, the fire death rates and technological index rates for all countries except the United States, Canada and Ireland are almost indistinguishable. The substantial disparity between the United States and Canada versus the other countries suggest that the fire ignition risk presented by wider permeation of technology may be one cause of the relatively high United States and Canadian fire death rates.

TABLE 2-2

INDICES OF ECONOMIC AND TECHNOLOGICAL DEVELOPMENT

COUNTRIES	$ BUILDING FIRE LOSS PER CAPITA	FIRE DEATHS/ 1,000,000 PERSONS	GNP PER CAPITA ($1,000'S)	TV'S PER 1,000 POP.	TELEPHONES PER 1,000 POP.	RADIOS PER 1,000 POP.	GEORGIA TECH TECHNOLOGICAL INDEX
Australia	-	11.6	6.8	274	395	211	2.66
Austria	9.6	9.2	6.3	247	304	342	2.71
Belgium	-	12.6	8.2	255	300	384	2.85
Canada	23.6	32.1	8.7	411	596	959	5.90
Denmark	25.6	11.6	9.0	308	494	331	3.39
France	22.2	14.9	7.4	268	293	346	2.77
Germany	13.3	8.9	8.4	306	344	338	3.02
Ireland	9.8	24.0	5.6	192	150	287	1.95
Japan	4.0	14.1	6.1	235	426	465	3.34
Netherlands	13.3	5.3	7.7	259	391	284	2.81
Norway	36.4	14.6	8.7	255	366	319	2.83
United Kingdom	8.9	15.4	4.4	320	394	750	4.42
United States	19.6	34.2	8.7	571	721	1,882	9.54

Notes: GNP per capita are obtained from 1977 estimates of the International Monetary Fund [14] and the United Nations Statistical Office [29].

Numbers of televisions, telephones and radios per capita are estimated by the United Nations [30].

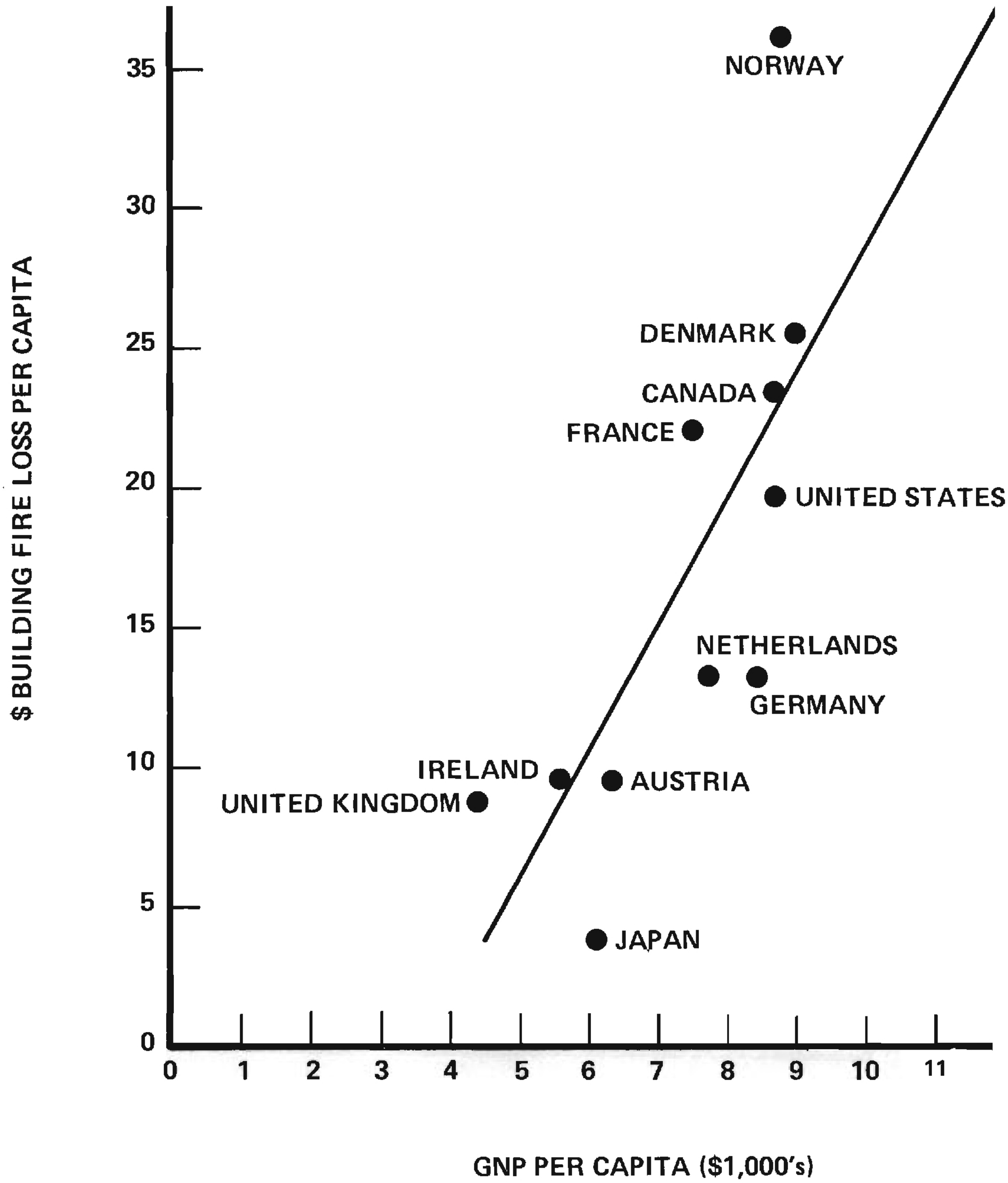


FIGURE 2-3. RELATIONSHIP BETWEEN MONETARY BUILDING FIRE LOSS & GNP PER CAPITA

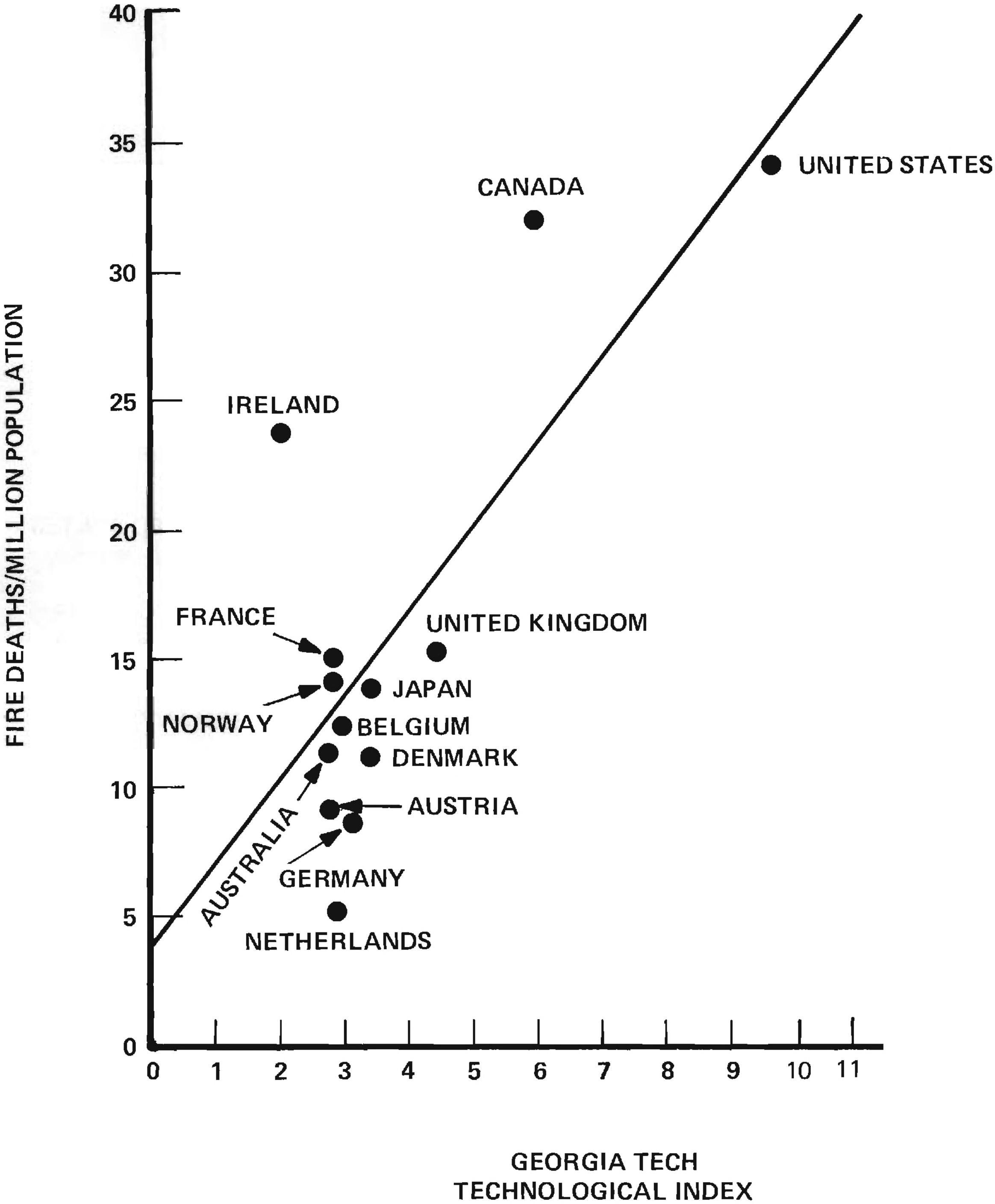


FIGURE 2-4. RELATIONSHIP BETWEEN PER CAPITA FIRE DEATHS AND TECHNOLOGICAL INDEX

2.2 The Uniqueness of Japan

Some researchers have suggested that the attitudes and opinions of society effect fire incidence within a nation. The unique standing of Japan in the comparisons of Table 2-1 and Figure 2-2 may reflect such a cultural element. Reported values for numbers of fires and monetary loss in Japan are extraordinarily low. On the other hand, loss per fire and especially deaths per fire are exceptionally large. Japanese fire professionals [28] suggest that the traditional burnability of the Japanese living environment is closely connected with both these unusual standings. The high risk associated with a fire is reflected in the large losses per fire. A long history of large fires--especially ones connected with earthquakes and war--has produced a strong cultural concern about fire that is expressed in low fire incidence. It is reported that great shame and embarrassment falls on any family responsible for a fire in a neighborhood.

3. COMPARISON BY OCCUPANCY AND CAUSE

Any set of fire statistics for an entire nation reflects a host of fire problems presented by different structure types (or occupancies) where fires arise and by different causal factors leading to the fires. Most agencies producing fire statistics recognize this fact by subdividing statistics according to occupancy and/or cause. An effort is under way to develop a standard international fire data system, and a draft proposal for such a system is now being circulated in a committee of the International Standards Organization [27]. However, unfortunately, a standard that would provide for uniform reporting of fire incidents on an international scale has not yet been adopted; consequently, reporting schemes vary significantly from nation to nation. Still, insight can be gained if these classification schemes can be brought into approximate harmony. The analyses of this section are based on the recategorization and interpolation of national fire reports to achieve such harmony. Appendix B details the calculations performed.

3.1 Comparison by Broad Occupancy Classifications

The United States Fire Administration (USFA) fire experience statistics [19] classify structure type or occupancy into four broad categories: residential structure, non-residential structures, mobile structures (not used as a residence), and outside structures. Table 3-1 shows 1975-78 breakdowns of fire losses in six nations according to this occupancy classification. Numbers of fires, numbers of fire deaths, and monetary loss due to fire are estimated for each occupancy. Per capita rates are also computed. Dashes in the table reflect values not available from the indicated country.

Results in Table 3-1 can be evaluated from two general points of view. A first question is "What is the general role of each occupancy classification in the fire problems of the nations presented?" Observations about the various occupancy classes include the following:

TABLE 3-1

FIRE LOSS BY MAJOR OCCUPANCY CLASS

	CANADA			JAPAN			NETHERLANDS			NEW SOUTH WALES			UNITED KINGDOM			UNITED STATES		
	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent	Number	Rate	Percent
<u>RESIDENTIAL</u>																		
FIRES (1,000's)	36.5	1.6	-	20.2	.18	35%	7.1	.52	24%	3.5	.72	10%	53.9	.97	16%	706	3.3	25%
DEATHS	599	26.3	82%	993	8.8	62%	-	-	-	33	7.3	-	694	12.4	81%	5,058	23.4	82%
DOLLAR LOSS ($1,000,000's)	206.9	9.1	-	155.2	1.4	33%	27.2	2.0	14%	-	-	-	-	-	-	2,172	10.0	46%
<u>NON-RESIDENTIAL STRUCTURE</u>																		
FIRES (1,000's)	37.5	1.6	-	19.0	.17	32%	7.1	.52	24%	2.5	.52	8%	41.8	.75	12%	317	1.5	11%
DEATHS	79	3.5	11%	197	1.7	12%	-	-	-	3	0.7	-	77	1.4	9%	552	2.6	9%
DOLLAR LOSS ($1,000,000's)	330.7	14.5	-	299.3	2.6	65%	155.5	11.3	80%	-	-	-	-	-	-	2,084	9.6	44%
<u>MOBILE STRUCTURES</u>																		
FIRES (1,000's)	-	-	-	3.6	.03	6%	2.8	.20	10%	3.6	-	11%	28.1	.50	8%	500	2.3	18%
DEATHS	43	1.9	6%	114	1.0	7%	-	-	-	-	-	-	72	1.3	8%	464	2.1	7%
DOLLAR LOSS ($1,000,000's)	-	-	-	5.6	.05	1%	9.1	0.7	5%	-	-	-	-	-	-	351	1.6	7%
<u>OUTSIDE STRUCTURES</u>																		
FIRES (1,000's)	-	-	-	15.8	.14	27%	12.0	.87	42%	23.2	-	71%	222.4	4.0	64%	1,302	6.0	46%
DEATHS	10	0.4	1%	293	2.6	19%	-	-	-	-	-	-	19	0.3	2%	131	0.6	2%
DOLLAR LOSS ($1,000,000's)	-	-	-	3.6	.03	1%	2.9	0.2	1%	-	-	-	-	-	-	130	.6	3%
TOTAL																		
FIRES (1,000's)	-	-	-	58.6	.52	100%	29.0	2.11	100%	32.8	-	100%	346.2	6.2	100%	2,825	13.1	100%
DEATHS	731	32.1	100%	1,597	14.1	100%	73	5.3	100%	-	-	-	862	15.4	100%	6,205	28.7	100%
DOLLAR LOSS ($1,000,000's)	-	-	-	463.7	4.1	100%	194.7	14.2	100%	-	-	-	-	-	-	4,737	21.9	100%

Notes: Percentages shown are formed from the ratio of the number in occupancy class divided by number in total, multiplied by 100.

Monetary losses are in 1977 U.S. dollars.

Rates for fires, deaths and dollar losses are as follows: fires/thousand persons, deaths/million persons, dollar loss/person.

Death rates under total category reflect average World Health Organization values [33] for 1975-77. Deaths by occupancy class are scaled to match average WHO values for years available since 1976, then converted to the death rates in this table.

Fire deaths (used to determine death rates by occupancy class) and dollar loss data are based on the following years for the various nations: Canada (1977), Japan (1977), Netherlands (1976-77), New South Wales (1977), United Kingdom (1976-77) and United States (1977-78).

- Residential Fires. Residential fires contribute from 10% to 35% of the fire incidence in the countries reflected in Table 3-1. However, residential fires lead to approximately three quarters of all fire fatalities. Values in Table 3-1 vary widely in the fraction of monetary loss to residential fires.
- Non-residential Structures. The number of non-residential structure fires has two modes in Table 3-1. For three nations the value is approximately 10% of all fires, and for two nations the values are 24% and 32% of all fires. These fires account for a large part of the monetary loss. In the United States, residential and non-residential monetary losses are approximately equal, but in Japan and the Netherlands non-residential losses are much greater than residential monetary losses. In contrast, non-residential structures account for relatively small numbers of fire fatalities--approximately 10% in the countries considered.
- Mobile and Outside Structures. As already noted above, reporting of vehicle and outdoor fires varies substantially from country to country. However, results in Table 3-1 show a consistent pattern of more than half of all fire incidence taking place in vehicles or out of doors. Much smaller proportions of the numbers of fire fatalities and monetary fire loss are attributed to such fires.

A second way of analyzing the results in Table 3-1 is to ask "How does the mix of fire loss in different occupancies for the United States differ from that of other countries?" As with the earlier analyses in Selected International Comparisons of Fire Losses [25], the most important observation of this type apparent in Table 3-1 is that residential fires seem to be a more important component of the United States' fire problem than they are for other countries.

- Fire Incidence. The fraction of fire incidence in the United States in residential structures is more than twice that in non-residential structures. For Japan, the Netherlands, the United Kingdom and Australia's New South Wales, numbers of residential and non-residential fires are much more equal.
- Deaths. The ratio of residential to non-residential fire deaths varies from 5.0 up to 11.0 for the six countries reported in Table 3-1. However, fire deaths are heavily concentrated in residential fires for all countries, and (as noted in Section 2) the United States rate of fire deaths per capita is much higher than for the other nation's except Canada.
- Monetary Loss. In the United States, the fractions of monetary fire loss due to residential and non-residential fires are nearly equal. In Japan, the non-residential loss is approximately twice the residential loss, and in the Netherlands non-residential loss is almost six times the residential loss.

3.2 Residential Fires

From the discussion of the previous section, it appears that residential fires are a particular interest in explaining the relationship between the United States' fire problem and that of other developed countries. Comparable detail on such fires is available for the Netherlands, the United Kingdom, the United States, and New South Wales in Australia.

Table 3-2 presents numbers of fires and per capita rates for these countries. For all countries except the Netherlands, values are subdivided by the type of residential occupancy. Except for the United Kingdom, the information is also classified by the principal cause of the fire.

TABLE 3-2

RESIDENTIAL FIRES BY CAUSE AND OCCUPANCY CLASS

			COOKING	SMOKING	HEATING	INCENDIARY/ SUSPICIOUS	ELECTRICAL DISTRIBUTION	APPLIANCES	CHILDREN PLAYING	OPEN FLAMES, TORCHES	EXPOSURE	NATURAL	OTHER	TOTAL	PERCENT OF ALL RESIDENTIAL STRUCTURES
ONE AND TWO FAMILY	UNITED STATES	-No.	91886	42442	128439	54803	49498	43609	34219	24192	15385	8276	37773	530522	75.2%
		-Rate	42.5	19.6	59.4	25.3	22.9	20.2	15.8	11.2	7.1	3.8	17.5	245.2	
	NEW SOUTH WALES	-No.	786	209	413	102	325	312	94	150	17	12	137	2557	73.4%
		-Rate	16.0	4.3	8.5	2.1	6.7	6.4	1.9	3.1	0.4	0.2	2.8	52.7	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	35444	65.7%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	63.5	
APARTMENTS, TENEMENTS AND FLATS	UNITED STATES	-No.	33685	25509	8444	18985	6511	7617	7617	5112	4145	697	8850	127162	18.0%
		-Rate	15.6	11.8	3.9	8.8	3.0	3.5	3.5	2.4	1.9	0.3	4.0	58.8	
	NEW SOUTH WALES	-No.	331	140	77	24	72	72	24	9	3	-	16	768	22.0%
		-Rate	6.8	2.9	1.6	0.5	1.8	1.3	0.5	0.2	0.1	-	0.3	15.8	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	14705	27.3%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	26.3	
MOBILE HOMES	UNITED STATES	-No.	3640	1848	5769	1958	4370	2043	783	949	1006	221	1201	23788	3.4%
		-Rate	1.7	0.9	2.7	0.9	2.0	0.9	0.4	0.4	0.5	0.1	0.6	11.0	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	107	123	237	50	-	84	240	-	5	302	1148	2.1%
		-Rate	-	0.2	0.2	0.4	0.1	-	0.2	0.4	-	0.1	0.5	2.1	
HOTELS, MOTELS, & INNS	UNITED STATES	-No.	1066	5110	954	3114	909	701	141	407	155	100	856	12613	1.8%
		-Rate	0.5	2.4	0.4	1.5	0.4	0.3	0.1	0.2	0.1	0.1	0.4	5.8	
	NEW SOUTH WALES	-No.	22	62	16	1	20	17	2	8	-	-	12	160	4.6%
		-Rate	0.5	1.3	0.3	0.1	0.4	0.4	0.1	0.2	-	-	0.3	3.3	
	UNITED KINGDOM	-No.	408	378	206	213	184	49	38	94	-	8	119	1697	3.1%
		-Rate	0.7	0.7	0.4	0.4	0.3	0.1	0.1	0.2	-	0.1	0.2	3.0	
OTHER RESIDENTIAL	UNITED STATES	-No.	1641	1314	2778	2179	805	730	610	760	177	102	548	11644	1.6%
		-Rate	0.8	0.6	1.3	1.0	0.4	0.3	0.3	0.4	0.1	0.1	0.3	5.4	
	NEW SOUTH WALES	-No.	-	-	-	-	-	-	-	-	-	-	-	-	-
		-Rate	-	-	-	-	-	-	-	-	-	-	-	-	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	931	1.7%
		-Rate	-	-	-	-	-	-	-	-	-	-	-	1.7	
TOTAL RESIDENTIAL	UNITED STATES	-No.	131918	76223	146384	80139	62093	54700	43370	31420	20868	9386	49228	705729	
		-Rate	61.0	35.2	67.7	37.0	28.7	25.3	20.0	14.5	9.6	4.3	22.8	326.2	
		-Percent	18.7%	10.8%	20.7%	11.4%	8.8%	7.8%	6.1%	4.5%	3.0%	1.3%	7.0%	100%	
	NEW SOUTH WALES	-No.	1139	411	506	127	417	401	120	167	20	12	165	3485	
		-Rate	23.5	8.5	10.4	2.6	8.6	8.3	2.5	3.4	0.4	0.2	3.4	71.8	
		-Percent	32.7%	11.8%	14.5%	3.6%	12.0%	11.5%	3.4%	4.8%	0.5%	0.3%	4.7%	100%	
	UNITED KINGDOM	-No.	-	-	-	-	-	-	-	-	-	-	-	53925	
		-Rate	-	-	-	-	-	-	-	-	-	-	-	96.5	
		-Percent	-	-	-	-	-	-	-	-	-	-	-	100%	
	NETHERLANDS	-No.	1478	315	1255	432	372	227	1682	765	8	36	489	7059	
		-Rate	10.7	2.3	9.1	3.1	2.7	1.6	12.2	5.6	0.1	0.3	3.5	51.2	
		-Percent	20.9%	4.5%	17.8%	6.1%	5.3%	3.2%	23.8%	10.8%	0.1%	0.6%	6.9%	100%	

Notes: Incidents of fire are based on the following years of data for the various nations: United States (1977-78), New South Wales (1977), United Kingdom (1976-77), and the Netherlands (1976-77).

Rates of fire are per 100,000 persons in the population base.

Percent of all Residential Structures along the right hand column are obtained by dividing the fire incidents for the occupancy class by total fire incidents, then multiplying the result by 100.

Percents appearing for each nation in the row entitled Total Residential represent the distribution of residential fires by cause.

Turning first to the cause classifications, the following points are indicated:

- Cooking Fires. Cooking fires are the first or second most important known cause of residential fires in the three countries for which data is available. However, the United States' per capita rate is nearly three times that of New South Wales and six times that of the Netherlands.
- Smoking Fires. Smoking fires cause approximately the same fraction of residential fires in the United States and New South Wales, but two and one half times that of the Netherlands.
- Heating Fires. Heating fires are ranked as the most important cause of residential fires in the United States, the second highest in New South Wales, and the third highest in the Netherlands.
- Incendiary/Suspicious Fires. Incendiary and suspicious fires are a significant cause of residential fires only in the United States.
- Children Playing Fires. Children playing fires form only 6.1% of the cause for the United States fires and 3.4% for New South Wales, but 23.8% for the Netherlands. In fact, such fires are the leading reported cause of residential fires in the Netherlands. However, it is possible that the high Dutch value merely reflects the use of the children playing category as a substitute for unknown cause. Such misclassification is known to occur in some data.

Notwithstanding the differences between categories noted above, the most important observation that can be drawn from Table 3-2 is that in almost every category the per capita rate of residential fire incidence in the United States is significantly higher than the other countries reported. This disparity suggests that the difference between the United States and other developed countries in per capita fire incidence will only be reduced if the elements of residential fire can be restricted. These might be remedied by more rigorous home construction codes and greater public awareness of the need for home fire safety.

3.3 Non-residential Structure Fires

Table 3-3 presents a detailed cause versus occupancy analysis of fires in non-residential structures in the United States, New South Wales, the United Kingdom and the Netherlands. As with Table 3-2, results in Table 3-3 should be treated with some caution because of numerous problems in defining categories. However, the results do offer some useful insights:

- Data for all four countries show that stores and offices and manufacturing occupancies are the sites of many non-residential fires. Stores and offices account for approximately 20% to 30% of non-residential fires in each of the four countries; manufacturing properties account for an additional 10% to 20%.
- Results for public assembly occupancies (theatres, restaurants, auditoriums, etc.) show some variation among the countries. Nine to ten percent of non-residential fires in the United States and the United Kingdom are classified in this category, but 15.7% of New South Wales fires and 30.2% of the Netherlands fires occur in public assembly occupancies.
- Storage fires in the United States and vacant/construction fires in New South Wales represent unusually high percentages of the total for non-residential fires. However, it is quite possible that these apparent disparities are a consequence of data gathering

TABLE 3-3

NON-RESIDENTIAL FIRES BY CAUSE AND OCCUPANCY CLASS

			COOKING	SMOKING	HEATING	INCENDIARY/ SUSPICIOUS	ELECTRICAL DISTRIBUTION
PUBLIC ASSEMBLY	UNITED STATES	-No.	9136	2330	2401	6725	3507
		-Rate	4.2	1.1	1.1	3.1	1.6
	NEW SOUTH WALES	-No.	159	34	11	40	57
		-Rate	3.3	0.7	0.2	0.8	1.2
	UNITED KINGDOM	-No.	1275	471	274	562	480
		-Rate	2.3	0.8	0.5	1.0	0.9
	NETHERLANDS	-No.	211	111	83	158	92
		-Rate	1.6	0.8	0.6	1.1	0.7
EDUCATION	UNITED STATES	-No.	630	912	912	11314	1326
		-Rate	0.3	0.4	0.4	5.2	0.6
	NEW SOUTH WALES	-No.	7	8	11	33	8
		-Rate	0.1	0.2	0.2	0.7	0.2
	UNITED KINGDOM	-No.	120	128	166	729	129
		-Rate	0.2	0.2	0.3	1.3	0.2
	NETHERLANDS	-No.	19	53	19	83	16
		-Rate	0.1	0.4	0.1	0.6	0.1
INSTITUTIONS	UNITED STATES	-No.	1944	7330	912	7514	2506
		-Rate	0.9	3.4	0.4	3.5	1.2
	NEW SOUTH WALES	-No.	18	39	8	7	18
		-Rate	0.4	0.8	0.2	0.2	0.4
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	NETHERLANDS	-No.	24	37	18	48	19
		-Rate	0.2	0.3	0.1	0.3	0.1
STORES AND OFFICES	UNITED STATES	-No.	2036	5745	6031	12943	14396
		-Rate	0.9	2.7	2.8	6.0	6.7
	NEW SOUTH WALES	-No.	28	90	23	49	127
		-Rate	0.6	1.9	0.5	1.0	2.6
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	NETHERLANDS	-No.	54	58	75	115	151
		-Rate	0.4	0.4	0.5	0.8	1.1
BASIC INDUSTRY	UNITED STATES	-No.	137	228	1007	835	3103
		-Rate	0.1	0.1	0.5	0.4	1.4
	NEW SOUTH WALES	-No.	3	8	13	8	41
		-Rate	0.1	0.2	0.3	0.2	0.9
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	NETHERLANDS	-No.	12	9	72	49	57
		-Rate	0.1	0.1	0.5	0.4	0.4
MANUFACTURING	UNITED STATES	-No.	1292	1881	3758	3658	4251
		-Rate	0.6	0.9	1.7	1.7	2.0
	NEW SOUTH WALES	-No.	17	22	24	21	58
		-Rate	0.4	0.5	0.5	0.4	1.2
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	NETHERLANDS	-No.	14	25	33	29	46
		-Rate	0.1	0.2	0.2	.2	0.3
STORAGE	UNITED STATES	-No.	391	2701	3697	16873	4643
		-Rate	0.2	1.2	1.7	7.6	2.1
	NEW SOUTH WALES	-No.	1	23	8	15	28
		-Rate	0.2	0.5	0.2	0.3	0.6
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	NETHERLANDS	-No.	2	6	6	31	8
		-Rate	0.01	0.04	0.04	0.22	0.06
VACANT/ CONSTRUCTION	UNITED STATES	-No.	49	661	458	15132	433
		-Rate	0.1	0.3	0.2	7.0	0.2
	NEW SOUTH WALES	-No.	5	110	13	50	40
		-Rate	0.1	2.3	0.3	1.0	0.8
	UNITED KINGDOM	-No.	100	157	152	374	64
		-Rate	0.2	0.3	0.3	0.7	0.1
	NETHERLANDS	-No.	-	6	9	5	3
		-Rate	-	0.05	0.07	0.03	0.02
OTHER	UNITED STATES	-No.	2532	2822	4683	9382	3018
		-Rate	1.2	1.3	2.2	4.4	1.4
	NEW SOUTH WALES	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
	NETHERLANDS	-No.	5	71	5	100	45
		-Rate	0.1	0.5	0.1	0.7	0.3
TOTAL NON-RESIDENTIAL	UNITED STATES	-No.	18147	24610	23861	84576	37183
		-Rate	8.4	11.4	11.0	39.1	17.2
		-Percent	5.7%	7.8%	7.3%	26.7%	11.7%
	NEW SOUTH WALES	-No.	256	329	114	219	395
		-Rate	5.3	6.8	2.3	4.5	8.1
		-Percent	10.2%	13.2%	4.6%	8.8%	15.8%
	UNITED KINGDOM	-No.	-	-	-	-	-
		-Rate	-	-	-	-	-
		-Percent	-	-	-	-	-
	NETHERLANDS	-No.	336	388	317	629	438
		-Rate	2.4	2.8	2.3	4.6	3.2
		-Percent	4.7%	5.5%	4.5%	5.9%	6.2%

TABLE 3-3 (continued)

APPLIANCES	CHILDREN PLAYING	OPEN FLAMES, TORCHES	EXPOSURE	NATURAL	OTHER	TOTAL	PERCENT OF ALL NON-RESIDENTIAL STRUCTURES
1545 0.7	321 0.1	861 0.4	656 0.3	371 0.2	2303 1.1	30156 13.9	9.5%
10 0.2	16 0.3	10 .2	6 0.1	2 0.1	46 0.9	391 8.1	15.7%
60 0.1	258 0.5	196 0.3	- -	54 0.1	215 0.4	3845 6.9	9.2%
14 0.1	1101 8.0	200 1.5	3 0.1	12 0.1	158 1.1	2143 15.6	30.2%
630 0.3	737 0.3	606 0.3	237 0.1	282 0.1	1979 0.9	19564 9.0	6.2%
3 0.1	12 0.2	8 0.2	- -	1 0.1	18 0.4	109 2.2	4.4%
7 0.1	238 0.4	113 0.2	- -	24 0.1	116 0.3	1770 3.2	4.2%
2 0.1	113 0.8	32 0.2	2 0.1	6 0.1	28 0.2	372 2.7	5.2%
3476 1.6	252 0.1	2352 1.1	98 0.1	160 0.1	2134 1.0	28678 13.3	9.0%
14 0.3	4 0.1	11 0.2	- -	- -	20 0.4	139 2.9	5.6%
- -	- -	- -	- -	- -	- -	2747 4.9	6.6%
18 0.1	35 0.3	25 0.2	- -	3 0.1	27 0.2	254 1.8	3.6%
7781 3.6	798 0.4	3566 1.6	3268 1.5	1161 0.5	7120 3.3	64845 29.9	20.5%
29 0.6	10 0.2	55 1.1	6 0.1	1 0.1	86 1.8	504 10.4	20.2%
- -	- -	- -	- -	- -	- -	8725 15.6	20.9%
24 0.2	1001 7.3	312 2.3	3 0.1	12 0.1	243 1.8	2048 14.9	28.8%
423 0.2	148 0.1	846 0.4	331 0.2	617 0.3	2199 1.0	9873 4.6	3.1%
7 0.1	2 0.1	24 0.5	3 0.1	13 0.3	62 1.3	186 3.8	7.4%
- -	- -	- -	- -	- -	- -	4818 8.6	11.5%
14 0.1	84 0.6	117 0.9	5 0.1	54 0.4	43 0.3	516 3.7	7.3%
2715 1.3	602 0.3	4195 1.9	1488 0.7	2623 1.2	17185 7.9	43648 20.2	13.8%
7 0.2	2 0.1	94 1.9	6 0.1	11 0.2	- -	448 9.3	17.9%
- -	- -	- -	- -	- -	- -	7363 13.2	17.6%
60 0.4	24 0.2	263 1.9	8 0.1	35 0.3	198 1.4	735 5.3	10.6%
997 0.5	6465 3.0	5404 2.5	5880 2.7	2580 1.2	7373 3.4	57014 26.4	18.0%
3 0.1	4 0.1	10 .2	4 0.1	4 0.1	23 0.5	123 2.5	4.9%
- -	- -	- -	- -	- -	- -	- -	-
4 0.03	82 0.60	6 0.04	- -	4 0.03	16 0.12	164 1.20	2.3%
76 0.1	1755 0.8	1907 .9	688 0.3	127 0.1	1043 0.5	22329 10.3	7.0%
17 0.3	135 2.8	27 0.5	132 2.7	27 0.5	44 0.9	398 12.3	23.9%
4 0.1	234 0.4	286 0.5	- -	3 0.1	73 0.1	1447 2.6	3.5%
3 0.02	8 0.06	17 0.12	- -	2 0.01	12 0.1	65 0.47	0.9%
1748 0.8	3116 1.4	3121 1.4	3313 1.5	768 0.4	6139 2.8	40844 18.9	12.9%
- -	- -	- -	- -	- -	- -	- -	- -
- -	- -	- -	- -	- -	- -	11085 19.8	26.5%
4 0.1	356 2.6	84 0.6	15 0.1	77 0.6	43 0.3	805 5.8	11.3%
19391 9.0 6.1%	14194 6.6 4.5%	22858 10.6 7.2%	15959 7.4 5.0%	8689 4.0 2.7%	47483 21.9 15.0%	316951 146.5 100%	
92 1.9 3.7%	158 3.3 6.3%	248 5.1 9.9%	129 2.7 5.2%	56 1.1 2.2%	502 10.3 20.1%	2498 51.5 100%	
- - -	- - -	- - -	- - -	- - -	- - -	41801 74.7 100%	
147 1.1 2.0%	2761 20.0 38.9%	1068 7.8 15.0%	37 0.3 0.5%	208 1.5 2.9%	772 5.6 10.9%	7101 51.6 100%	

Notes: Incidents of fire are based on the following years of data for the various nations: United States (1977-78), New South Wales (1977), United Kingdom (1976-77) and the Netherlands (1976-77).

Rates of fire are per 100,000 persons in the population.

Percent of all Non-residential Structures along the right hand column are obtained by dividing the fire incidents for the occupancy class by total fire incidents, then multiplying the result by 100.

Percents appearing for each nation in the row entitled Total Non-residential represent the distribution of non-residential fires by cause.

and classification procedures. Storage facility fires are sometimes classified as building fires and at other times designated as outside fires. Fires in vacant buildings and buildings under construction are often reported on short data forms [24]. This relatively smaller paper workload on fire officials sometimes biases data toward the vacant/construction category.

Some useful insights can also be obtained by comparing the cause summary at the end of Table 3-3:

- Incendiary and suspicious fires appear to contribute a greater fraction of non-residential fires in the United States than in the other two countries for which data is available. Values in Table 3-3 show that 26.7% of United States' non-residential fires are attributed to this cause while only 8% to 9% of those in New South Wales and the Netherlands are classified incendiary and suspicious. This fact supports the theory that arson is a significant factor in the relatively greater fire incidence in the United States.
- For New South Wales, the most significant cause of non-residential fires is apparently electrical distribution systems. The fraction attributed to this cause in the United States is slightly lower, although the per capita rate of such fires in the United States is still approximately twice that of New South Wales.
- A large percentage, 38.9%, of the Netherlands' non-residential fires are attributed to children playing. Again, it is possible that this fact reflects variations in classification systems. Under some reporting procedures, children playing becomes a miscellaneous category when a specific cause cannot be determined.

With the exceptions of the unusual items noted above, the detailed analysis of Table 3-3 fairly closely follows the more aggregate behavior of earlier tables. Reported fire incidence in the United States is two to three times that of the other three countries reported.

3.4 Mobile and Outside Fires

Tables 3-4 and 3-5 report the breakdowns that are available for fires in mobile property and in outside structures. The pattern presented for mobile fires parallels that of earlier tables. The per capita United States rate is four and one half to eleven times that of the United Kingdom and the Netherlands. However, the per capita number of vehicles is also higher in the United States. Using world vehicle registration counts available from the Motor Vehicle Manufacturers Association of the United States [18], the mobile United States fires of Table 3-4 represent 3.61 fires per thousand registered vehicles. The comparable values for the United Kingdom and the Netherlands are 1.73 and 0.69 respectively. Thus, if the greater number of vehicles in the United States is taken into account, the number of vehicle fires in this country may be more typical than implied by per capita values.

Outside fires are unquestionably the most erratically reported of all fires accounted for in published reports. For example, United States values in Table 3-5 are known to exclude forest fires in federally owned forests. Data for the United Kingdom reflects the fact that only a brief report is collected on incidents of grass or brush fires. Thus, no conclusions could appropriately be drawn from the very limited data in Table 3-5.

TABLE 3-4

MOBILE FIRES

BY OCCUPANCY CLASS

		Automobile	Other Motor Vehicles	Rail, Water, Air Trans.	Other Mobile	Total Mobile
United States	-No.	337449	92986	16998	52492	499925
	-Rate	156.0	43.0	7.9	24.3	231.1
	-Percent	67.5%	18.6%	3.4%	10.5%	100%
United Kingdom	-No.	16730	7936	917	2549	28132
	-Rate	30	14.2	1.6	4.6	50.4
	-Percent	59.5%	28.2%	3.3%	9.1%	100%
Netherlands	-No.	2531	-	280	30	2841
	-Rate	18.4	-	2	0.2	20.6
	-Percent	89.1%	-	9.9%	1.1%	100%

Notes: Incidents of fire are based on the following years of data for the various nations: United States (1977-78), United Kingdom (1976-77), and the Netherlands (1976-77).

Rates shown are per 100,000 population.

All motor vehicle fires are grouped in the Netherlands statistics.

TABLE 3-5

OUTSIDE FIRES

BY OCCUPANCY CLASS

		Refuse	Trees, Grass, Brush	Forest	Crops	Other Outside	Total Outside
United States	-No.	441227	570080	-	71585	218662	1301554
	-Rate	203.9	263.5	-	33.1	101.1	601.6
	-Percent	33.9%	43.8%	-	5.5%	16.8%	100%
United Kingdom	-No.	76299	105271	1399	1902	37536	222407
	-Rate	136.6	188.5	2.5	3.4	67.2	398.2
	-Percent	34.3%	47.3%	0.6%	0.9%	16.9%	100%
Netherlands	-No.	667	863	1125	81	9275	12011
	-Rate	4.8	6.3	8.2	0.6	67.4	87.2
	-Percent	5.5%	7.2%	9.4%	0.7%	77.2%	100%

Notes: Rates shown are per 100,000 population.

Incidents of fire are based on the following years of data for the various nations: United States (1977-78), United Kingdom (1976-77), and the Netherlands (1976-77).

Forest fires in the United States is blank because such incidents are not regularly reported to fire departments, from which incident data is obtained.

4. FATALITY PATTERNS

The statistics on deaths due to "Fire and Flames" accidents available from the World Health Organization (WHO) make it possible to compare fire fatality patterns in many developed countries. Table 4-1 shows the rates per million population of WHO fire fatalities by sex and by age grouping of the victim. Figures 4-1 and 4-2 plot the 1975-77 values of Table 4-1 versus the 1972-74 data of Appendix Table A-3.

Turning first to the sex classification of Figure 4-1, it is apparent that the rate of fire fatalities is greater for males than for females in most nations. Of the seventeen countries considered, only Ireland and the United Kingdom were exceptions in the 1975-77 time period.

Figure 4-2 confirms the widely held view that fire fatalities fall heavily on the very young and the very old. For 1975-77 the United States per million fire fatality rate for infants 0 to 4 years old was 1.6 times the overall rate, and that of persons over 65 was 2.7 times the average. Similar concentrations were observed in many other countries. However, several of the countries (Austria, Denmark, Finland and Switzerland) have apparently escaped extraordinary fire death rates for infants.

As with other results of this report, the clearest observation in Figures 4-1 and 4-2 is the consistently poor ranking of the United States. Per million fatality rates are often higher in Canada than in the United States, and values are also high for Ireland. However, the United States has a higher reported fire fatality rate than any of the other fourteen countries in each of the age and sex categories shown in the figures. The one exception is the over 65 age group in Japan. That concentration of

TABLE 4-1

DEATH RATES BY AGE AND SEX, 1975-77

		0-4	5-14	15-24	25-44	45-64	65+	TOTAL
AUSTRALIA	MALE	44	14	22	20	30	50	26
	FEMALE	26	5	4	4	10	30	9
	TOTAL	35	10	13	12	20	38	18
AUSTRIA	MALE	7	1	3	6	12	37	10
	FEMALE	6	1	1	3	5	33	8
	TOTAL	6	1	2	4	8	36	9
BELGIUM	MALE	53	9	12	8	11	26	15
	FEMALE	16	3	8	6	11	24	11
	TOTAL	35	6	10	7	11	25	13
CANADA	MALE	44	19	24	34	52	125	40
	FEMALE	48	17	15	14	26	60	24
	TOTAL	46	18	19	24	39	87	32
DENMARK	MALE	9	5	14	12	12	37	14
	FEMALE	2	1	3	5	9	34	9
	TOTAL	6	3	8	8	11	35	12
FINLAND	MALE	6	3	10	25	59	71	28
	FEMALE	0	3	5	2	9	32	8
	TOTAL	3	3	7	14	32	46	17
FRANCE	MALE	22	4	10	13	19	48	17
	FEMALE	20	4	3	6	8	42	13
	TOTAL	21	4	7	9	13	44	15
GERMANY (F.R.)	MALE	16	3	6	9	12	31	12
	FEMALE	10	2	3	3	8	18	7
	TOTAL	13	3	4	6	10	23	9
IRELAND	MALE	53	3	7	5	17	103	22
	FEMALE	25	3	4	9	6	167	27
	TOTAL	39	3	6	7	11	133	24
JAPAN	MALE	18	6	6	8	18	115	17
	FEMALE	14	4	4	4	6	66	11
	TOTAL	16	5	5	5	12	87	14
NETHERLANDS	MALE	13	2	3	4	6	27	7
	FEMALE	8	2	1	3	4	10	4
	TOTAL	11	2	2	3	5	17	5
NEW ZEALAND	MALE	10	2	5	6	26	55	13
	FEMALE	17	11	0	6	10	38	13
	TOTAL	13	7	3	6	18	57	13
NORWAY	MALE	26	0	7	16	29	62	22
	FEMALE	9	3	3	2	7	28	9
	TOTAL	18	1	6	10	18	43	15
SWEDEN	MALE	19	5	13	17	32	49	21
	FEMALE	9	3	4	5	10	25	9
	TOTAL	14	5	8	11	21	31	15
SWITZERLAND	MALE	1	5	1	4	6	25	7
	FEMALE	3	5	3	1	6	14	5
	TOTAL	2	5	2	3	6	19	6
UNITED KINGDOM	MALE	21	6	5	7	14	55	15
	FEMALE	23	5	5	5	11	57	16
	TOTAL	22	6	5	6	12	56	15
UNITED STATES	MALE	53	18	18	26	45	104	36
	FEMALE	42	14	9	10	23	59	22
	TOTAL	45	16	14	17	36	78	29

Notes: Death rates are per million population in the age category indicated.

Death data are from WHO Statistics Annual: Vital Statistics and Causes of Death [33] and reflect an average for the time period.

Population data are from the Statistical Yearbook published by the United Nations [30].

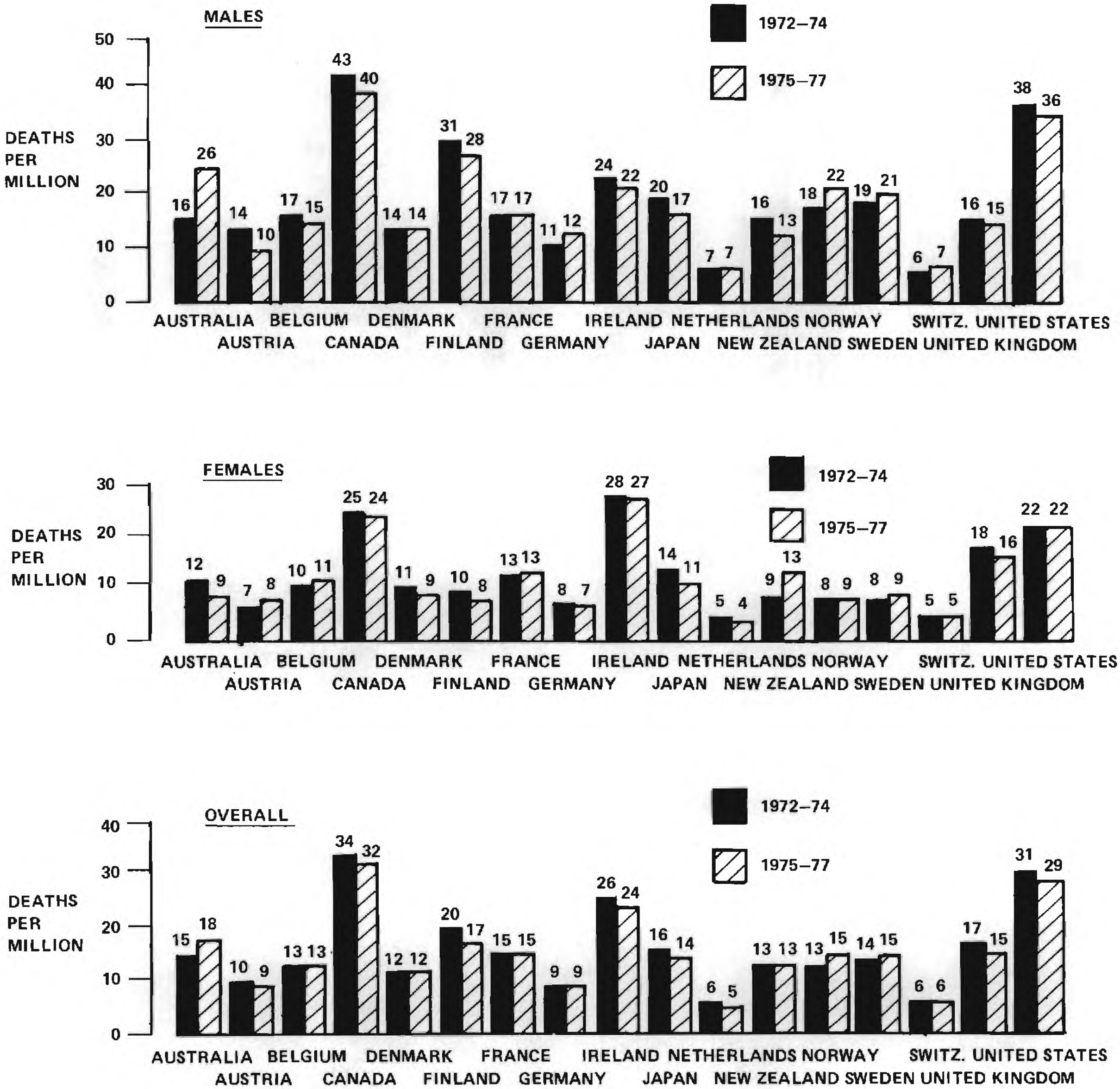


FIGURE 4-1. COMPARISON OF 1972-74 AND 1975-77 FIRE DEATH RATES (PER MILLION POPULATION) BY SEX

Notes: Death data are from WHO Statistics Annual: Vital Statistics and Causes of Death [33] and reflect an average for the time period indicated.

Population data are from the Statistical Yearbook published by the United Nations [30].

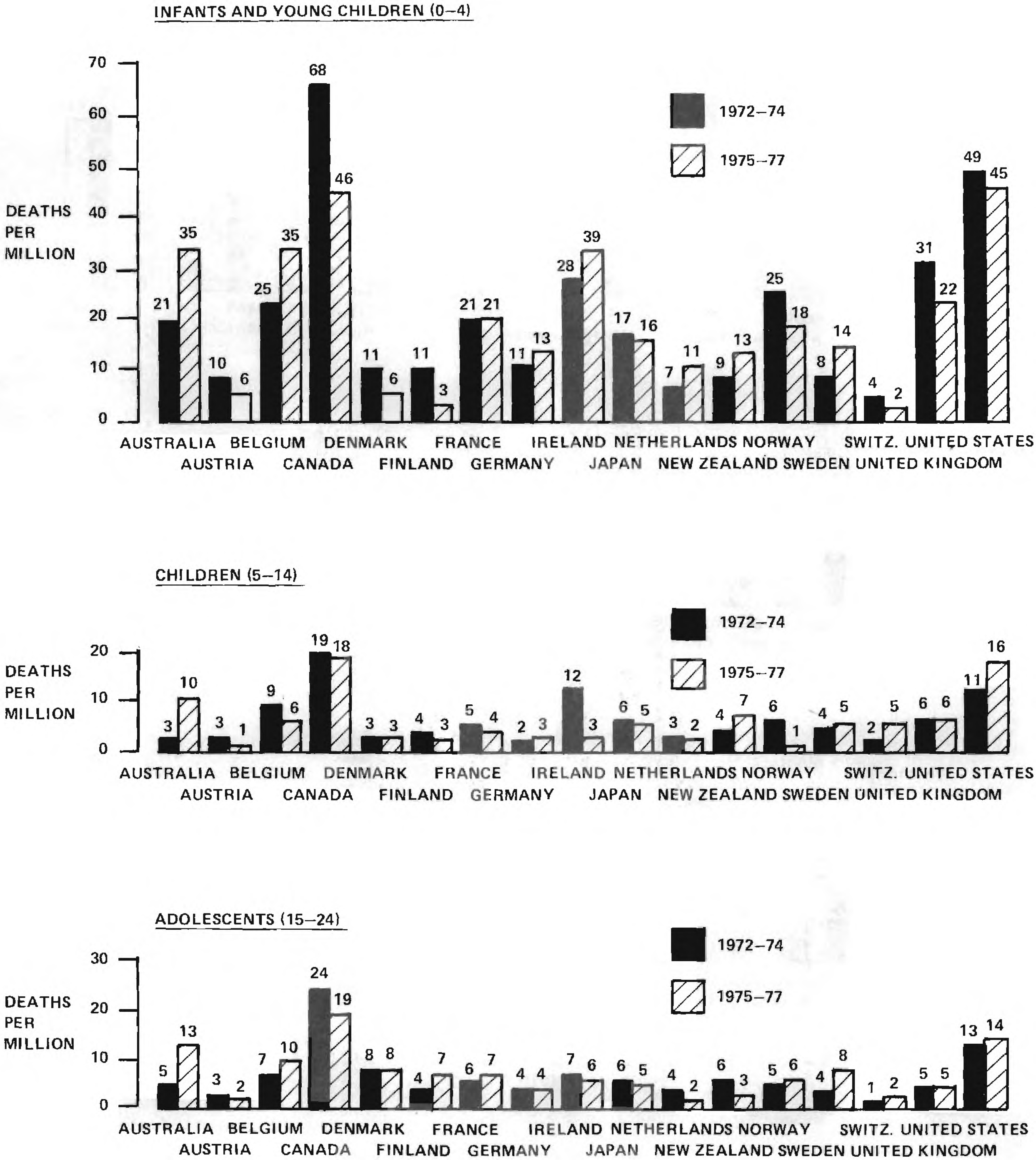
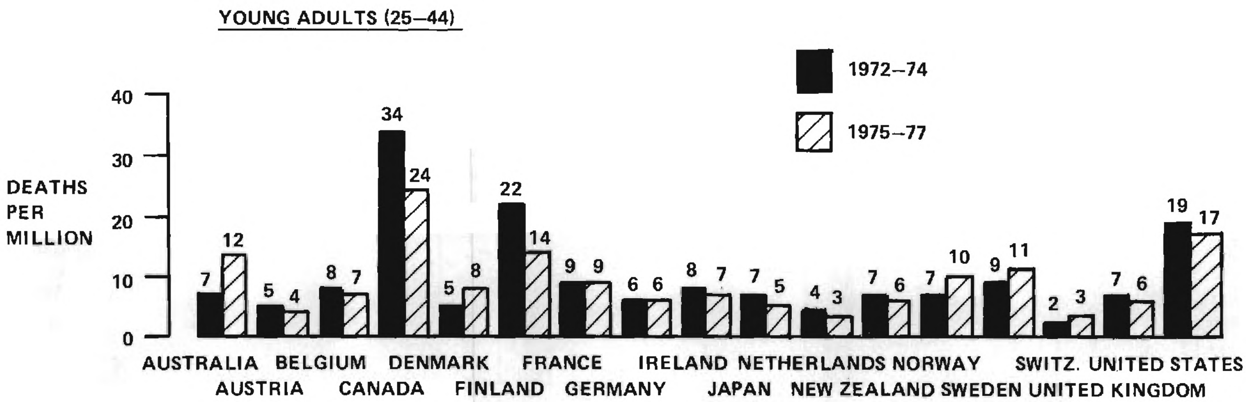


FIGURE 4-2. COMPARISON OF 1972-74 AND 1975-77 FIRE DEATH RATES (PER MILLION POPULATION) BY AGE



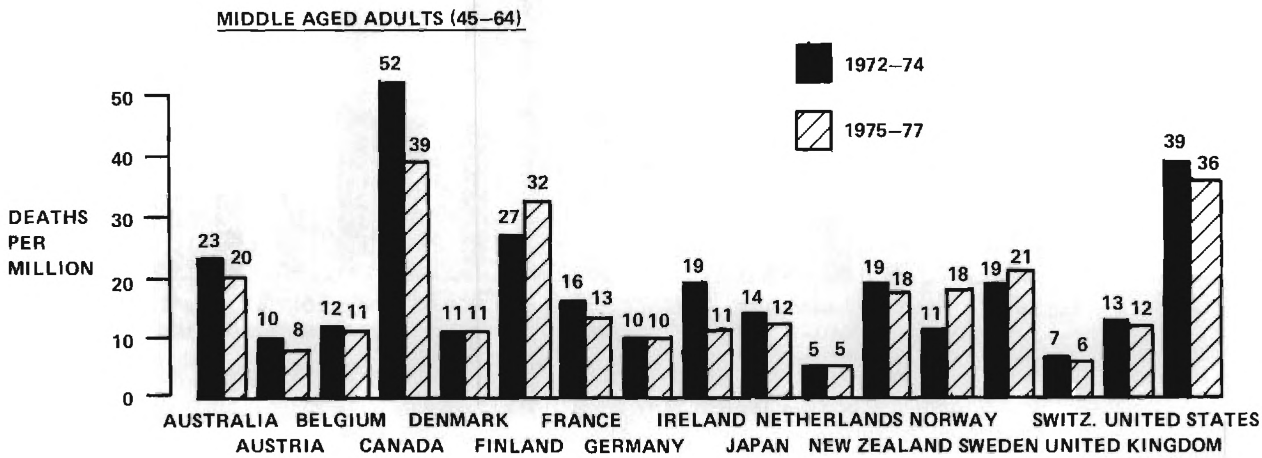


FIGURE 4-2. (CONTINUED)

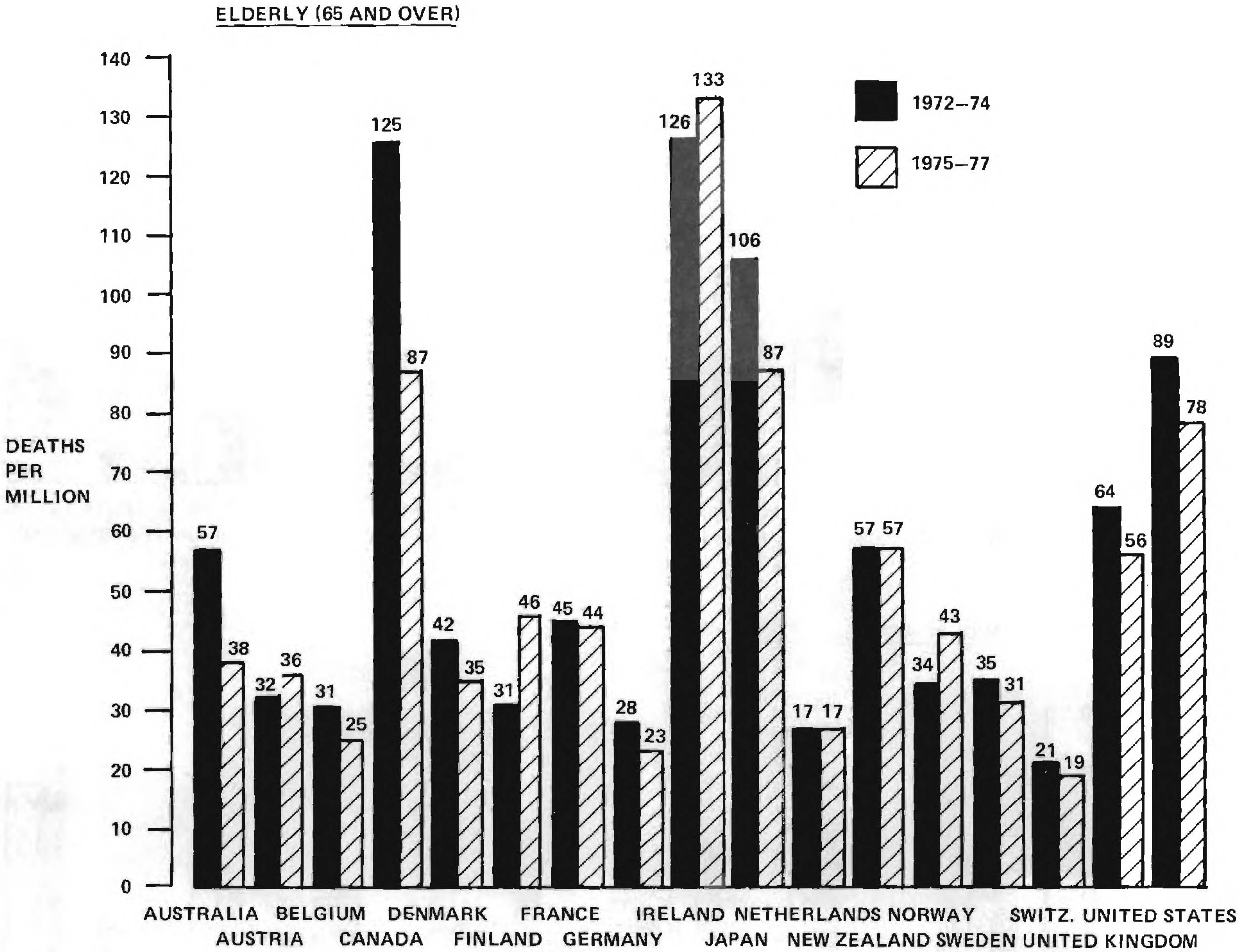


FIGURE 4-2. (CONTINUED)

Notes: Death data are from WHO Statistics Annual: Vital Statistics and Causes of Death [33] and reflect an average for the time period indicated.

Population data are from the Statistical Yearbook published by the United Nations [30].

fire fatalities is attributed in Japanese fire reports [16] to suicides by fire.

5. COMPARISONS OF CITY DATA

For a number of years, the Tokyo Fire Department [26] has collected information on the numbers of fire personnel, the number of reported fires, and the number of reported fire deaths in major cities of the world. A 1976-78 compilation of this fire loss data for foreign cities is presented in Table 5-1. Tokyo Fire Department data for United States cities are shown in Appendix Table A-4.

There is no way of knowing from the brief reports received by the Tokyo Fire Department how comparable the reported data may be. However, the average rates of fires per 10,000 population and fire deaths per million population shown in Table 5-1 mirror national experience presented in earlier sections. Figures 5-1 and 5-2 plot the average rates for non-United States cities in the Tokyo survey versus estimated average rates for all United States cities of comparable size prepared by the United States Fire Administration [19]. Separate averages are provided for cities of over 1,000,000 persons, 500,000 to 1,000,000 persons, and 250,000 to 500,000 persons. For all three sizes of cities, and both fire incidence and fire deaths, the values in Figures 5-1 and 5-2 confirm the relatively poor standing of the United States. Particularly in the largest cities, the reported per capita fire incidence and fire fatality rate is several times that of the world cities considered.

Earlier Georgia Tech research [23] has shown a tendency for United States cities to have larger professional fire services than world cities of comparable population. Figure 5-3 confirms this experience. That figure graphs population versus the number of fire personnel shown in Table 5-1. Separate trend lines are calculated for the United States and

TABLE 5-1

WORLD CITY FIRE LOSSES

CITY	PROTECTED POPULATION IN (1,000'S)	FIRE FIGHTING PERSONNEL	NUMBER OF REPORTED FIRES	NUMBER OF REPORTED FIRE DEATHS	FIRES PER 10,000 POPULATION	DEATHS PER MILLION POPULATION
Over 1,000,000 People						
Tokyo	11,247	16,117	7,759	146	7	13
London	7,083	7,310	42,077	111	59	16
New Delhi (1978)	6,500	874	3,234	63	5	10
Hong Kong	4,567	4,068	10,434	40	23	9
Istanbul (1976)	3,418	1,266	2,907	37	9	11
West Midlands (1977-78)	2,727	2,022	12,866	27	47	10
Greater Manchester	2,711	2,631	23,375	62	56	23
Melbourne (1976-77)	2,649	1,741	8,475	15	32	6
Manila	2,459	781	7,887	34	12	14
Singapore	2,317	821	4,048	37	17	16
Johannesburg	2,283	508	1,432	13	6	6
Berlin	2,047	3,120	6,377	29	31	14
Hamburg	1,697	2,048	4,988	10	29	6
Merseyside (1978)	1,576	176	1,887	21	12	13
Kent	1,465	1,170	5,378	22	38	15
Essex (1977-78)	1,456	1,323	6,392	17	44	12
Lancashire (1977-78)	1,348	1,689	7,819	26	58	19
Brussels (1977-78)	1,175	815	2,250	16	20	13
Montreal (1976, 1978)	1,060	2,434	6,193	43	58	39
					29.6	13.9
Comparable United States Average Rate					141.1	39.6
500,000 to 1,000,000 People						
Hertfordshire (1976-77)	938	876	5,336	11	57	12
Lothian & Borders (1978)	930	1,031	6,396	26	69	28
Avon (1976, 1978)	918	836	4,678	10	51	11
Capetown	892	330	2,036	30	23	34
Amsterdam	727	784	2,637	17	36	24
Brisbane	709	724	3,488	7	50	10
Stockholm (1977-78)	656	605	5,628	29	86	44
Frankfurt (1976, 1978)	635	1,892	2,632	7	41	11
Rotterdam	600	651	2,867	7	48	12
					51.2	20.7
Comparable United States Average Rate					130.7	37.5
250,000 to 500,000 People						
Helsinki (1977-78)	490	446	1,570	9	32	18
Edmonton	474	816	2,586	12	5	25
Oslo	460	473	1,366	7	30	15
Vancouver (1977-78)	410	815	2,866	13	70	32
Hamilton	312	435	2,363	14	76	45
Ottowa	306	517	3,793	8	124	26
Bonn (1976, 1978)	284	303	681	4	24	18
					51.6	25.6
Comparable United States Average Rate					136.3	35.7

Notes: The row entitled Comparable United States Average Rate is the United States Fire Administration [19] estimated average for all U.S. cities in that population class, not just those in Appendix A-4.

Other data are as reported in a compilation prepared annually by the Tokyo Fire Department [26].

Columns headed Fire Fighting Personnel, Number of Reported Fires and Number of Reported Fire Deaths are average for 1976-78 unless otherwise indicated.

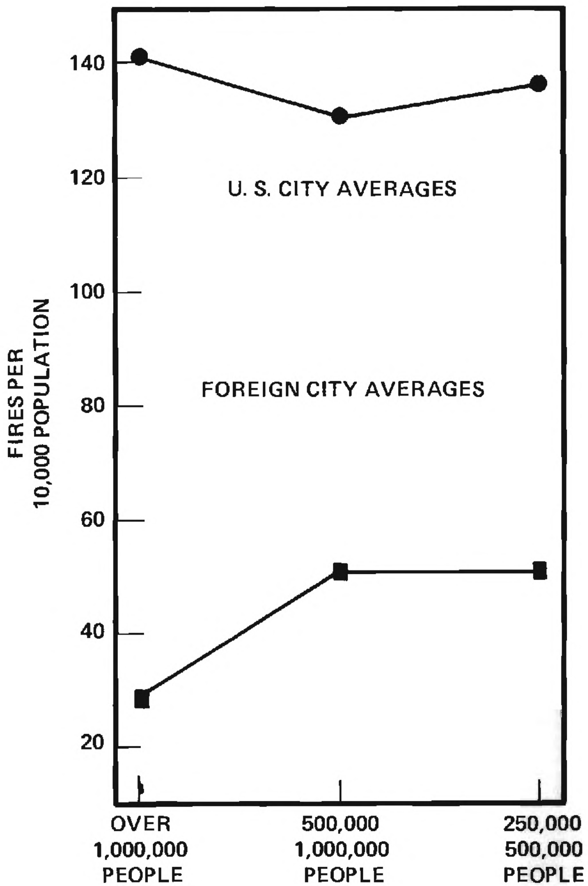


FIGURE 5-1: WORLD CITIES FIRE RATE PER 10,000 PERSONS VS. UNITED STATES CITIES

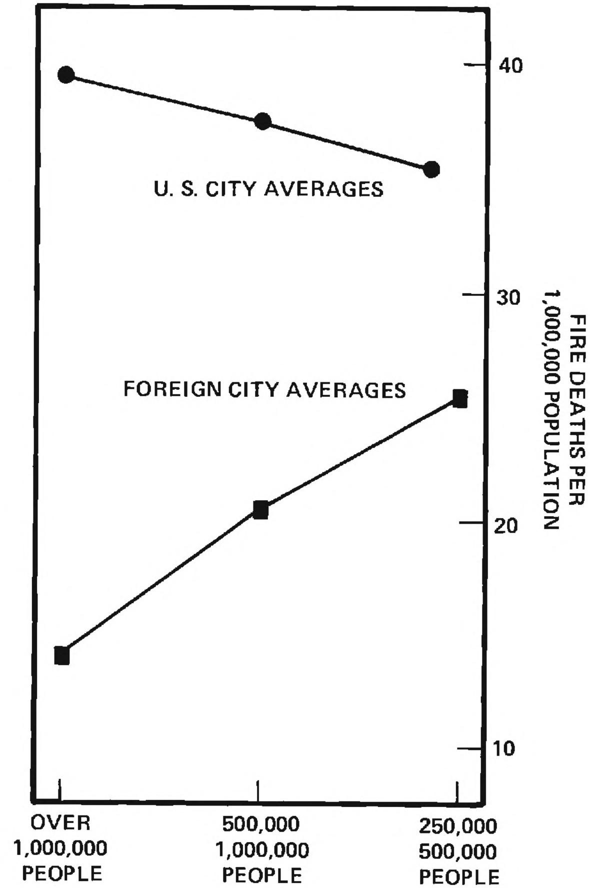


FIGURE 5-2: WORLD CITIES FIRE DEATH RATE PER 1,000,000 PERSONS VS. UNITED STATES CITIES

Notes: U.S. City Averages are from United States Fire Administration estimates [19].

Other data are as reported in a compilation prepared annually by the Tokyo Fire Department [26].

Number of Reported Fires and Number of Reported Fire Deaths are for 1976-78 unless indicated otherwise as shown in Table 5-1.

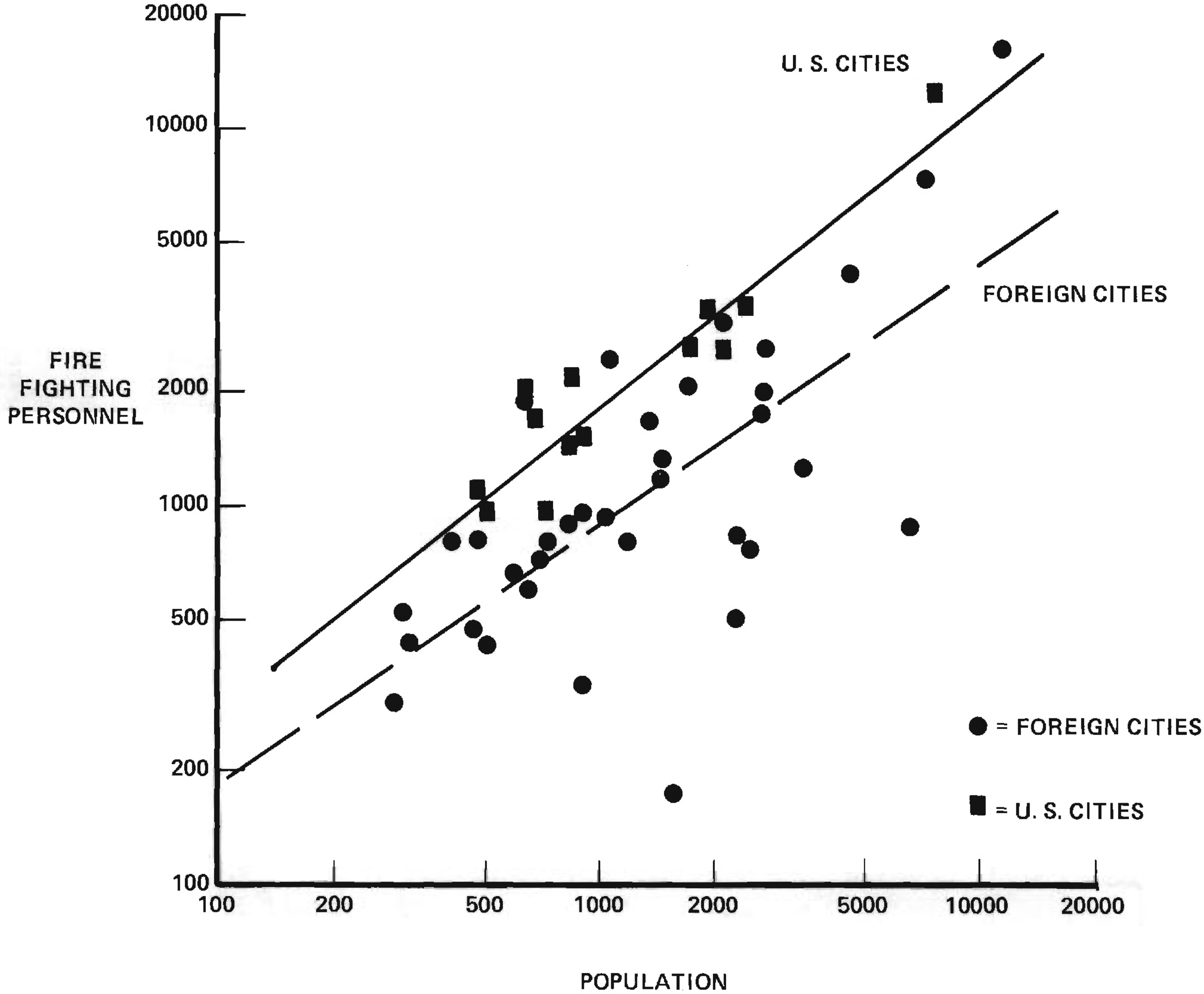


FIGURE 5-3. POPULATION VS. TOTAL FIRE PERSONNEL FOR WORLD CITIES

Notes: Data are as reported in a compilation prepared annually by the Tokyo Fire Department [26]. Trend lines are computed by Georgia Tech.

Fire Fighting Personnel are for 1976-78 unless indicated otherwise as shown in Table 5-1.

foreign cities. The trend line for the United States represents more than twice as many fire personnel as that for the world cities of comparable population.

Figure 5-4 presents a similar analysis. Numbers of fire personnel in Table 5-1 are plotted versus the total numbers of reported fires. As with the earlier figure, separate trend lines are computed for the United States cities and foreign cities.

The latter trend lines show that fire personnel per fire in foreign cities is approximately 10% higher than the comparable value for the United States. Thus, much of the variation in per capita fire personnel shown in Figure 5-3 is apparently connected with variations in fire incidence. In the light of general findings throughout this report of relatively high fire incidence in the United States, these results suggest that the greater number of fire personnel in the United States is primarily a reflection of the greater fire problem. However, it is possible to argue for a reverse association. Greater availability of fire service in the United States cities may lead to more frequent calling of the fire service for small fire incidence and thus greater reporting of such minor incidents.

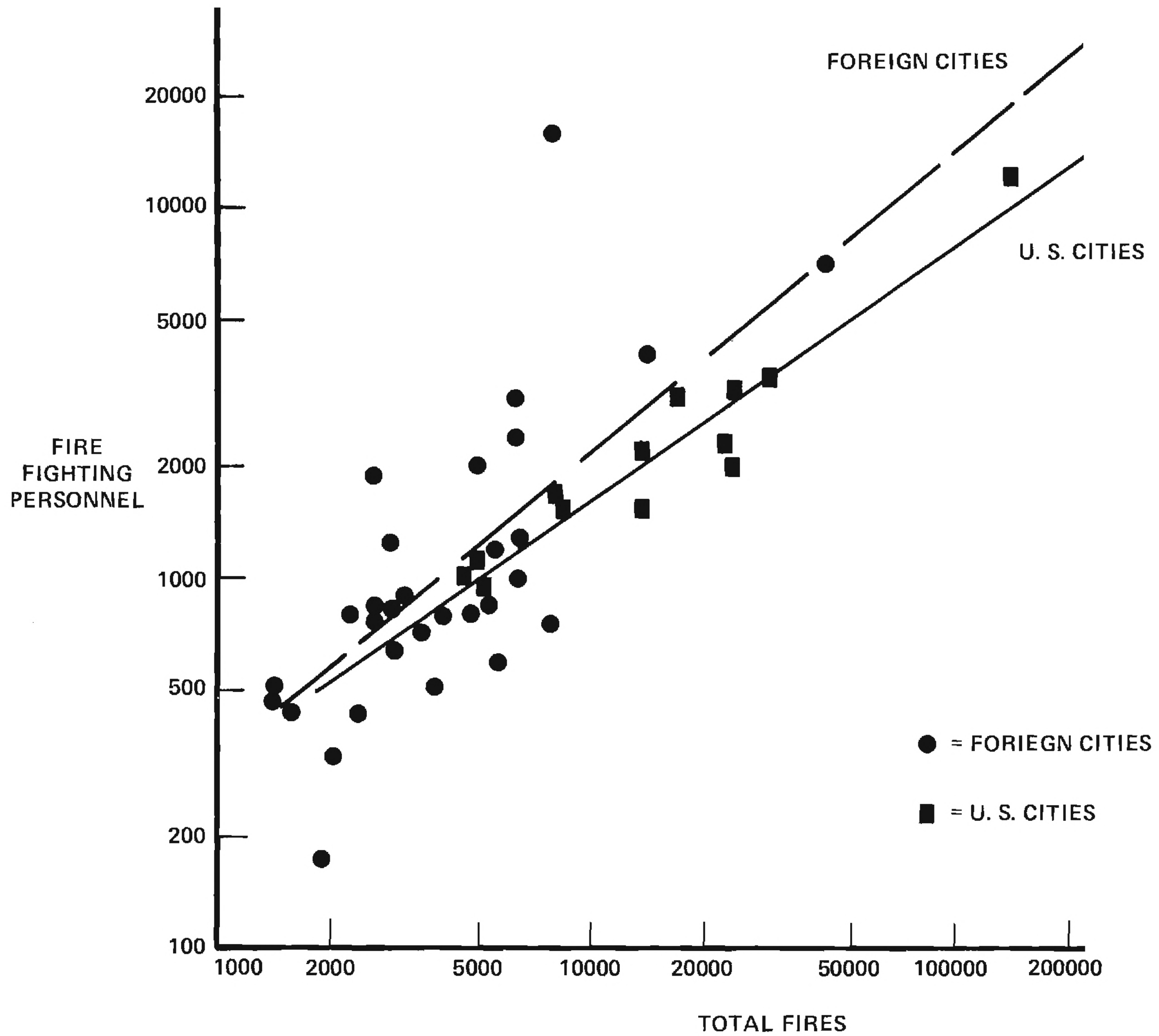


FIGURE 5-4. TOTAL FIRES VS. TOTAL FIRE PERSONNEL FOR WORLD CITIES

Notes: Data are as reported in a compilation prepared annually by the Tokyo Fire Department [26]. Trend lines are computed by Georgia Tech.

Fire Fighting Personnel and Total Fires are for 1976-78 unless indicated otherwise as shown in Table 5-1.

REFERENCES

1. Assemblee Pleniere, Correspondence to Jerry Banks, dated April, 1969.

2. Belgium Ministere de L'Interieur, "Interventions des Services de Secours," published annually.

3. The Board of Fire Commissioners of New South Wales, "Fire Statistics: New South Wales," published annually.

4. British Fire Protection Association (1976), "U.K. Fire Damage Compared with Those of Other Countries 1970-1974," Fire Prevention, No. 113, p. 39.

5. British Home Office, "United Kingdom Fire Statistics," published annually.

6. British Insurance Association, "Insurance Facts and Figures," published annually.

7. Danmarks Statistik, "Brandskader (year)," published annually.

8. Deutschland Bundesaufsichtames fur vas Versicherungswesin, "Schaden - und Unfallversicherung," published bi-annually.

9. Die Osterreichischen Brandverhutungsstellen, "Die Brandschaden in Osterreich," published annually.

10. Dominion Fire Commission, "Fire Losses in Canada," published annually.

11. Dutch Central Bureau voor de Statistiek, "Statistiek der Branden," published annually.

12. French Ministere de L'Interieur, "Statistiques des Interventions des Sapeurs - Pompiers contre L'Incendie: Rapports Generaux D'Incendies," published bi-annually.

13. French Ministere de L'Interieur, "Statistiques des Interventions des Sapeurs - Pompiers: releves mensuels des centres de secours," published bi-annually.

14. International Monetary Fund, "International Financial Statistics," published monthly with annual data in May issue.

15. Ireland Department of the Environment, "Fire Statistics," published annually.

16. Japan Fire Protection Association, "White Book on Fire Services in Japan," published bi-annually.

17. Keough, J. J., Correspondence to Jerry Banks, dated November 28, 1979.

18. Motor Vehicle Manufacturers Association of the United States, Inc., "Motor Vehicle Facts and Figures," published annually.

19. National Fire Data Center, "Fire in the United States," National Fire Prevention and Control Administration, published annually.

20. National Fire Protection Association (serial-b), "International Fire Statistics," Fire Journal (NFPA Quarterly), published annually.

21. Norges Brannkasse, Skadeforsikringsselskapenes Forening, "Branner i Norge," published annually.

22. Rardin, R. L. and Morris Mitzner, "Final Summary Report," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, June 1977.

23. Rardin, R. L. and Morris Mitzner, "Final Technical Report," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, June 1977.

24. Rardin, R. L. and Morris Mitzner, "Report on Fire Data Collection and Presentation," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, June 1978.

25. Rardin, R. L. and Morris Mitzner, "Selected International Comparisons of Fire Losses," Determinants of International Differences in Reported Fire Loss: Preliminary Investigation, June 1978.

26. Tokyo Fire Department, "Statistics on Fire Services in the World," published annually.

27. Tovey, Henry, Memorandum, subject: Draft ISO Standard Fire Data System, July 3, 1979.

28. Toyoshima, Riemon (1971), "Condition of Fire Losses in Japan," paper presented to the National Fire Protection Association.

29. UN Statistics Office, "Monthly Bulletin," published monthly.

30. United Nations Statistical Office (serial-g), Statistical Yearbook, U.N. Publishing Service, published annually.

31. U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the U.S., published annually.

32. Wilmot, R.T.D., "European Fire Cost: The Wasteful Statistical Gap," (2nd Edition), Association de Geneve, April 1979.

33. World Health Organization (serial), WHO Statistics Annual: Vital Statistics and Causes of Death, World Health Organization, Geneva, published annually.

APPENDIX A

SUPPORTING TABLES

TABLE A-1

COMPARISON OF FIRE LOSS INDICES FOR 1965-67

COUNTRIES	BUILDING FIRES/1,000 PERSONS	$ BUILDING FIRE LOSS PER CAPITA	BUILDING FIRE LOSS AS % OF GNP	FIRE DEATHS/ 1,000,000 PERSONS	$ BUILDING FIRE LOSS/ FIRE (1,000'S)	FIRE DEATHS/ 1,000 BUILDING FIRE
AUSTRALIA	-	-	-	25 66%	-	-
AUSTRIA	1.6 33%	3.2 21%	.12 60%	10 26%	2.0 67%	6.0 77%
BELGIUM	1.0 21%	-	-	-	-	-
CANADA	3.2 67%	13.1 87%	.24 120%	36 95%	4.0 133%	11.0 141%
DENMARK	2.0 42%	13.6 91%	.24 120%	10 26%	7.0 233%	5.2 67%
FRANCE	0.4 8%	11.0 73%	.20 100%	3 8%	27.5 917%	7.5 96%
GERMANY (F.R.)	-	4.7 31%	.13 65%	7 18%	-	-
JAPAN	0.3 6%	3.1 21%	.13 65%	19 50%	10.2 340%	62.6 803%
NETHERLANDS	0.6 12%	7.2 48%	.18 90%	8 21%	13.0 433%	14.3 183%
NORWAY	2.4 50%	12.9 86%	.29 145%	15 39%	5.5 183%	6.3 81%
UNITED KINGDOM	1.6 33%	11.7 78%	.19 95%	14 37%	7.0 233%	9.3 119%
UNITED STATES	4.8 100%	15.0 100%	.20 100%	38 100%	3.0 100%	7.8 100%

Note: Data are adjusted from Georgia Tech report Determinants of International Differences in Reported Fire Loss dated June, 1977 [22]. All monetary data are expressed in 1977 U.S. dollars.

TABLE A-2

COMPARISON OF FIRE LOSS INDICES FOR 1972-74

COUNTRIES	BUILDING FIRES/1,000 PERSONS	$ BUILDING FIRE LOSS PER CAPITA	BUILDING FIRE LOSS AS % OF GNP	FIRE DEATHS/ 1,000,000 PERSONS	$ BUILDING FIRE LOSS/ FIRE (1,000'S)	FIRE DEATHS/ 1,000 BUILDING FIRE
AUSTRALIA	-	-	-	15 48%	-	-
AUSTRIA	2.0 35%	5.8 33%	.12 57%	10 32%	3.1 100%	5.0 93%
BELGIUM	1.2 21%	-	-	13 42%	-	10.8 200%
CANADA	3.5 61%	19.4 110%	.24 114%	34 110%	5.8 187%	9.7 180%
DENMARK	3.4 60%	18.5 105%	.22 105%	12 39%	6.0 194%	3.5 65%
FRANCE	0.8 14%	14.5 82%	.19 90%	15 48%	18.1 580%	18.8 348%
GERMANY (F.R.)	-	11.3 64%	.16 76%	9 29%	-	-
JAPAN	0.4 7%	4.4 25%	.07 33%	16 52%	12.0 387%	40.0 741%
NETHERLANDS	0.8 14%	10.8 61%	.17 81%	6 19%	14.0 452%	7.5 139%
NORWAY	9.3 163%	24.0 136%	.35 167%	13 42%	2.5 81%	1.4 26%
UNITED KINGDOM	2.5 43%	15.3 86%	.24 114%	17 55%	6.2 200%	6.8 126%
UNITED STATES	5.7 100%	17.7 100%	.21 100%	31 100%	3.1 100%	5.4 100%

Note: Data are adjusted from Georgia Tech report Determinants of International Differences in Reported Fire Loss, dated June, 1977 [22]. All monetary data are expressed in 1977 U.S. dollars.

TABLE A-3

DEATH RATES BY AGE AND SEX, 1972-74

		0-4	5-14	15-24	25-44	45-64	65+	TOTAL
AUSTRALIA	MALE	22	5	7	9	29	74	18
	FEMALE	19	2	3	5	17	44	12
	TOTAL	21	3	5	7	23	57	15
AUSTRIA	MALE	13	1	6	10	14	52	14
	FEMALE	9	5	1	1	7	26	7
	TOTAL	10	3	3	5	10	32	10
BELGIUM	MALE	33	14	10	13	11	36	16
	FEMALE	17	4	4	4	12	28	13
	TOTAL	25	9	7	8	12	31	13
CANADA	MALE	78	21	23	27	58	131	43
	FEMALE	58	17	12	13	33	60	26
	TOTAL	68	19	24	34	52	125	34
DENMARK	MALE	13	0	12	6	13	52	14
	FEMALE	8	6	4	4	9	41	11
	TOTAL	11	3	8	5	11	42	12
FINLAND	MALE	6	6	25	36	34	67	31
	FEMALE	16	2	1	9	12	20	10
	TOTAL	11	4	4	22	27	31	20
FRANCE	MALE	15	6	9	14	20	51	17
	FEMALE	21	4	3	5	8	42	13
	TOTAL	21	5	6	9	16	45	15
GERMANY (F.R.)	MALE	12	3	8	8	12	35	11
	FEMALE	10	2	2	3	8	24	8
	TOTAL	11	2	4	6	10	28	9
IRELAND	MALE	24	10	5	9	17	131	24
	FEMALE	31	13	10	8	22	122	28
	TOTAL	28	12	7	8	19	126	26
JAPAN	MALE	18	6	7	9	20	136	20
	FEMALE	16	5	5	6	8	84	14
	TOTAL	17	6	6	7	14	106	16
NETHERLANDS	MALE	9	4	6	5	5	26	7
	FEMALE	5	2	3	2	4	10	5
	TOTAL	7	3	4	4	5	17	6
NEW ZEALAND	MALE	6	4	10	12	27	67	16
	FEMALE	11	3	3	2	11	51	9
	TOTAL	9	4	6	7	19	57	13
NORWAY	MALE	37	3	8	11	17	44	18
	FEMALE	13	9	2	2	4	26	8
	TOTAL	25	6	5	7	11	34	13
SWEDEN	MALE	12	4	6	13	30	50	19
	FEMALE	4	4	2	4	9	23	8
	TOTAL	8	4	4	9	19	35	14
SWITZERLAND	MALE	6	3	3	4	8	28	6
	FEMALE	3	1	0	1	7	16	5
	TOTAL	4	2	1	2	7	21	6
UNITED KINGDOM	MALE	31	6	6	9	13	59	17
	FEMALE	30	5	4	5	9	67	18
	TOTAL	31	6	5	7	13	64	17
UNITED STATES	MALE	55	15	18	27	42	117	38
	FEMALE	44	15	8	11	27	69	22
	TOTAL	49	11	13	19	39	89	31

Notes: Data are as reported in a compilation prepared annually by the Tokyo Fire Department [26].

Columns headed Fire Fighting Personnel, Number of Reported Fires and Number of Reported Fire Deaths are averages for 1976-78.

TABLE A-4

U.S. CITIES FIRE LOSSES

	POPULATION IN 000'S	FIRE FIGHTING PERSONNEL	NUMBER OF REPORTED FIRES	NUMBER OF REPORTED FIRE DEATHS	FIRES PER 10,000 POPULATION	DEATHS PER MILLION POPULATION
Over 1,000,000 People						
New York City	7,569	12,390	131,570	159	174	21
Los Angeles City	2,827	3,474	29,962	45	28	10
Los Angeles County	2,158	2,575	17,316	40	80	19
Philadelphia	1,950	3,195	24,653	110	126	57
Houston	1,700	2,681	22,760	65	134	38
500,000 to 1,000,000 People						
Dallas	881	1,561	13,376	40	152	45
Baltimore	858	2,238	13,445	41	157	48
Washington, D.C.	835	1,508	8,521	40	103	48
Honolulu	716	980	5,095	4	71	6
San Francisco	673	1,711	7,968	27	118	40
Boston	641	1,988	23,433	28	366	44
Seattle	502	1,005	4,630	13	92	26
250,000 to 500,000 People						
Pittsburgh	479	1,095	4,942	12	103	24

Notes: Data are as reported in a compilation prepared annually by the Tokyo Fire Department [26].

Columns headed Fire Fighting Personnel, Number of Reported Fires and Number of Reported Fire Deaths are averages for 1976-78.

APPENDIX B

DETAILS OF CALCULATIONS

In preparing the various tables of this report, numerous regrouping and interpolations were necessary to make results for other countries conform to United States reports [19]. This appendix provides details omitted in the main text on the calculations which were undertaken in preparing each table.

B.1 Derivation of Values in Table 2-1

Table 2-1, Comparison of Fire Loss Indices for 1975-78, requires the following data elements, if available, for all countries:

- Building Fires
- Population
- Building Fire Loss (converted to 1977 US $)
- GNP
- Fire Deaths

Of the above elements, GNP and death data come from a constant source for all countries. Population data are from the Statistical Yearbook: 1977, of the United Nations [30]. Specifically, Table 7 was used since it gives population values by sex, a statistic useful elsewhere in this updated fire report. Most of the estimates in the UN publication were for 1976.

GNP data obtained, mainly, from International Financial Statistics, for June, 1979, published by the International Monetary Fund [14]. In several cases, a more current publication, "UN Statistics," Monthly Bulletin, December, 1979 [29] was used. Death data came from WHO [33] under the category, "Accidents due to Fires and Flames." These data were averaged for the years available since 1975.

Building fire losses for the various nations, from which such data were obtained, were converted to constant 1977 US dollars. Such conversions may have required several pieces of international monetary data and several operations. The data elements are the exchange rates for 1976, 1977 and 1978 as well as consumer price indexes for that time period. The exchange rates are from International Financial Statistics, mentioned above [14]. Consumer price information is from Statistical Abstract of the US: 1978, a Department of Commerce Publication [31]. The CPI's in this last document are on a 1967 base of 100. Late CPI's for several nations were obtained from "UN Statistics," Monthly Bulletin for December, 1979 [29], also mentioned above. These latter CPI's are on a 1970 base of 100. Hence, upward scaling was required to convert the 1970 based CPI to a 1967 based CPI.

The first example requiring all of these conversions is Austria. That example appears in Section B.1.2 of this appendix. The conversions are only shown for Austria, other nations follow that, or, a simpler model.

The data elements mentioned above are used to compute the columnar values in Table 2-1 in a straightforward manner. In those instances which have two or more years of fire loss data, the annual value is computed, then an average is formed of the annual values. This method applies to the columns indicated as follows:

- $ Building Fire Loss Per Capita
- Building Fire Loss (U.S. % of GNP)
- Building Fire Loss/Fire ($1,000's).

For example, if monetary fire loss data are available for 1977 and 1978, the loss data were first converted to U.S. dollars (1977). Then, the dollar building fire loss per capita is computed for each year. These two values are then averaged for the two years, and the resultant enters Table 2-1.

In the paragraphs which follow, the calculations for a) building fires and b) building fire loss, are presented. If the data is unavailable, that letter is skipped.

B.1.1 Australia

Fire statistics for New South Wales were obtained from the Experimental Building Station [3]. As New South Wales (NSW) is fairly representative of Australia generally, it is reasonable to use the population ratio as a factor to obtain a national picture. In 1977, the population of NSW was 4,955,000 and that of Australia was 14,074,000. Therefore, the multiple was 2.84.

a) Building Fires. Entries in Table 15, Fires in Buildings ... for NSW, were multiplied by factors of 2.84.

B.1.2 Austria

Data was obtained from the document translated as "The Fire Damage in Austria in 1978," prepared by the Austrian Fire Prevention Agency [9]. As mentioned above, calculations for the fire losses for Austria in 1977 U.S. dollars will be fully depicted as a model for other conversions that were made.

a) Building Fires. Table 3 (untitled) contains incident measures for 1974-1978. An average of the values for 1977-78 was determined as follows:

$$\text{Average Building Fires (Preliminary)} = \frac{20{,}105 + 20{,}750}{2} = 20{,}427.5 \ .$$

These losses include a category called "Landwirtschaft." This item was not in the standard German language dictionary. The German Consulate, Atlanta, was called to translate this term. It was defined as "agriculture and agri-business." It was estimated that one-half of such fires were in buildings and the remainder in open space. The average was as follows:

$$\text{Average Landwirtschaft} = \frac{2,305 + 2,355}{2} = 2,330.$$

One-half of Landwirtschaft was then determined as 1,165. The incidents in Table 3 were broken down into major fires with significant losses, and those which were not significant. The average of total fires with significant loss was calculated as follows:

$$\text{Average Significant} = \frac{10,263 + 9,790}{2} = 10,026\ .$$

The proportion of these fires which were Landwirtschaft was then determined as follows:

$$\text{Proportion Landwirtschaft} = \frac{1,165}{10,026} = .116\ .$$

This proportion was increased to 0.125 since it agreed with perceptions of the researchers concerning the measure based on prior studies at Georgia Tech. The complement of this last proportion, or 0.875, was applied to the building fire average to obtain the estimate as follows:

$$\text{Average Building Fires Estimate} = .875 \text{ X } 20,427.5 = 17,874.$$

b) Fire Loss. Damage estimates were also given in Table 3. The 0.875 factor described above was verified for losses (all in 1,000's of schillings) in the following manner:

$$\text{Average Landwirtschaft Loss} = \frac{364,745 + 367,113}{2} = 365,929.$$

One-half of this loss is attributed to building, or

$$\frac{1}{2} \text{ of Average Landwirtschaft Loss} = \frac{365,929}{2} = 182,964$$

The average significant losses for the two years was calculated as follows:

$$\text{Average Total Significant Fire Loss} = \frac{1,236,411 + 1,562,005}{2} = 1,399,208.$$

The complement of 0.13 is 0.87 which verifies the use of 0.875 (described in (a) above) as a factor. Losses for 1977 and 1978 were then calculated as follows:

Loss for 1977 = .875 X 1,243,135 = 1,087,743

Loss for 1978 = .875 X 1,567,978 = 1,371,980.

Now, these losses must be converted to 1977 U.S. dollars. The conversion of the 1977 Austrian losses is the easiest. The exchange rate was 16.527 schillings per U.S. dollar in 1977. Converting to exponential notation, the losses were 1.088×10^9 schillings. This converts to a fire loss in U.S. dollars as follows:

$$\text{Fire Loss} = \frac{108.8 \times 10^7}{16.527} = \$6.583 \times 10^7.$$

The 1978 fire losses must be "stepped down" to 1977 values. The step down is accomplished by the ratio of the consumer price indexes (CPI's) as follows:

$$\text{Step Down} = \frac{CPI_{1977}}{CPI_{1978}} = \frac{178.0}{184.4} = 0.945.$$

The loss in 1978 was 1.372×10^9 schillings. This is stepped down to 1977 schillings as follows:

$$\text{Fire Loss} = .945 \times 1,372 \times 10^9 = 1.2965 \times 10^9 \text{ (in 1977 schillings).}$$

This value must now be converted to 1977 U.S. dollars as follows:

$$\text{Fire Loss} = \frac{12.965 \times 10^8}{1.6527 \times 10^1} = \$7.847 \times 10^7 \text{ (1977 dollars).}$$

B.1.3 Belgium

Data was obtained from the 1978 fire service statistics prepared by the Minister of the Interior [2]. These data provided information on the number of building fires, but the monetary fire losses could not be determined.

a) Building Fires. Table 1 of the referenced document contains general statistics by nature of the fire. The number of building fires was determined by summing the number of fires (incendies), 12,904, and the number of chimney fires, 2,606, to obtain 15,510.

B.1.4 Canada

Data for 1977 was obtained from the Report of the Dominion Fire Commissioner [10]. Information on both fires and monetary losses was available.

a) Building Fires. The number of building fires was determined by summing the components of Table 3 of the referenced source document. These components and their contributions were as follows:

Residential	36,513
Institutional and Assembly	3,018
Farm Properties	2,085
Manufacturing Properties	1,821
Mercantile Properties	2,525
Miscellaneous Properties	28,081
TOTAL	74,043

To insure that the entries in Table 3 represented building fires, a call was placed to the statistician who was responsible for the report (Mr. John Johnson).

b) Fire Loss. Table 3, discussed above, also contains data on losses in Canadian dollars. The components and their contributions were as follows:

Residential	\$220,005,245
Institutional and Assembly	72,842,790
Farm Properties	26,885,338
Manufacturing Properties	69,149,692
Mercantile Properties	59,493,002
Miscellaneous Properties	123,288,689
TOTAL	\$571,664,757 (1977 Canadian dollars)

The exchange rate during 1977 was 1.0637 which yields a fire loss in U.S. dollars of $\$537.57 \times 10^6$.

B.1.5 Denmark

Data were obtained from the Danish Fire Protection Association in two formats [7]. From these data, both the number of building fires and the monetary fire loss was estimated. The statistics were compiled by "Danmarks Statistik" and are based on information from insurance companies.

a) Building Fires. The estimated "calls for the fire brigade" is 17,000 per year for 1976-78. The source of this data is the Danish Fire Inspection.

b) Fire Loss. Two issues of "Branskader (Fire Loss)" were used to determine monetary losses. The first issue used gave data for 1976. The second issue used gave data for 1978 and 1979. In Table 1 of both issues, the total fire loss is given. To determine building fires, the following equation (first in Danish, then in English) was used:

$$\text{Building Fire Loss} = \begin{cases} \text{Brandskader i alt} - (\text{Skove} + \text{Skihe} + \text{Driftstab) brandskader} \\ \text{Total fire loss} - (\text{forests} + \text{ships/vessels} + \text{business interruption) fire losses} \end{cases}$$

For 1976,

$$\underset{(\times 10^6 \text{kr})}{\text{Building Fire Loss}} = 744.8 - 0.2 - 11.6 - 39.4 = 693.6.$$

For 1977,

$$\underset{(\times 10^6 \text{kr})}{\text{Building Fire Loss}} = 734.6 - 1.5 - 4.4 - 25.9 = 702.8.$$

For 1978,

$$\underset{(x10^6 kr)}{\text{Building Fire Loss}} = 1033.5 - 0.0 - 9.4 - 62.7 = 961.4.$$

These values were then converted to equivalent U.S. (1977) dollars using the method described for Austria above.

B.1.6 France

Data concerning building fires were obtained from documents prepared by the Direction de la Sécurité Civile for the years 1976 and 1977 [12, 13]. Data for fire loss for 1976 and 1977 were obtained through Sociétés D'Assurances Contre L'Incendie [1]. The source listed for the data was Ministére de l'Economie, Direction des Assurances. Many adjustments were needed to determine the number of building fires and the amount of fire loss. The results and method of determination are given below.

a) Building Fires. Data for the number of building fires were obtained from two documents. The first of these is a general report of fires [12]. This will be called document A. Document A describes the occurences of fires by class, or use, and further breaks down each class in considerable detail. Document B [13] is a summary of monthly statistics. However, the total fires in document B is about 50% higher than that in document A. It should be noted that document B is not as detailed as document A. Two reasons, one certain and the other conjectured, for the low count in document A are that chimney fires are not included and minor fires have been excluded. To bring document A up to the level of document B, two steps are required:

Step 1. Take all relevant fire numbers in document A and scale them up to equal the total number of fires in document B.

Step 2. Apportion chimney fires from document B over the building fire categories produced in Step 1.

The calculations to get the "A" numbers are shown below. The data comes from the eight classes of fires and have been rearranged into the four classes used in this research.

	1976	1977
Residential Fires		
Real Property	28,735	28,903
Hotels	494	460
Total	29,229	29,363
Non-Residential Fires		
Public Establishments	5,362	4,910
Public Places/Hotels	- 494	- 460
Agriculture/Cattle Farming	442	333
Agriculture/Other Activities	113	85
Industry	4,934	3,826
General Commerce	1,274	840
Road Transport/Buildings	621	632
Railway Stations	135	84
Maritime Transport Installations	7	4
Internal Navigation Installations	11	5
Air Transport Installations	30	17
Total	12,435	10,276

	1976	1977
Mobile Fires		
Vehicles and Transports	13,693	13,322
Agriculture/Tractors, etc.	824	499
Transport/Pipe Lines	- 4	- 3
Road Transport/Buildings	- 621	- 632
Railway Stations	- 135	- 84
Maritime Transport Installations	- 7	- 4
Internal Navigation Installations	- 11	- 5
Air Transport Installations	- 30	- 17
Total	13,709	13,076
Outside Fires		
Outside Risks	18,673	9,977
Transport/Pipe Lines	4	3
Agriculture/Sea Farming	9	13
Agriculture/Forests	1,244	224
Agriculture/Brush	36,218	5,375
Agriculture/Farming	8,266	3,897
Total	64,414	19,489
Total of All A Fires	119,787	72,204

The B numbers for 1976 and 1977 are shown below. These values are obtained from a table of fires, asphyxiations, etc., by reporting district.

	1976	1977
Incendies (Fires)	156,505	89,776
Fue de Chemenie (Chimney fires)	26,184	25,193
Total	182,689	114,969

Scale factors to raise A numbers to B numbers (Fires only) are as follows:

1976	1977
156,505/119,787 = 1.307	89,776/72,204 = 1.243

Applying these scale factors to A numbers gives

Category	1976	1977
Residential	38,188	36,509
Non-residential	16,247	12,777
Mobile	17,911	16,258
Outside	84,159	24,232
TOTAL	156,505	89,776

Now, compute the proportion of A building fires which are residential and those which are nonresidential:

	1976	1977
Residential	29,229/41,664 = .702	29,363/39,639 = .741
Non-Residential	12,435/41,664 = .298	10,276/39,639 = .259
Total	41,664/41,664 = 1.000	39,639/39,639 = 1.000

Proceeding with Step 2, apportion the chimney fires to residential and non-residential classes as follows:

	1976	1977
Residential	26,184 X .702 = 18,381	25,193 X .741 = 18,668
Non-Residential	26,184 X .298 = 7,803	25,193 X .259 = 6,525
Total	26,184	25,193

And finally, compute new values for residential and non-residential fires as follows:

	1976	1977
Revised Residential	38,188 + 18,381 = 56,569	36,509 + 18,668 = 55,177
Revised Non-Residential	16,247 + 7,803 = 24,050	12,777 + 6,525 = 19,302

In summary,

Category	1976	1977	Average
Building Fires	80,619	74,479	77,549
Residential	56,569	55,177	
Non-Residential	24,050	19,302	
Mobile	84,159	24,232	
Outside	17,911	16,258	
Total	182,689	114,969	

b) Fire Loss. Losses are classified as Domestic, Industrial, and Agricultural. The Agricultural losses were estimated as 50% Building Fires and 50% Outside Fires. Thus, 50% of Agricultural Fires are to be redistributed. The fire loss estimate must be augmented for:

i) losses not insured (add 3%)

ii) losses underinsured (add 7 1/2%).

These percentage additions are in accordance with the work of Wilmot [32]. Thus, in 1976 the total losses shown (4486 X 10^6 francs) become 4957.03 X 10^6 francs. Similarly, in 1978, the loss estimate becomes 5964.79 X 10^6 francs, after adding the 10 1/2%.

Now, the building fire loss is estimated using the following equation which redistributes the agricultural losses as discussed previously:

$$\text{Building Fire Loss} = \frac{\text{Original Total} - 1/2 \text{ Original Agricultural}}{\text{Original Total}} \text{ X Modified Total.}$$

For 1976 the result is as follows:

$$\underset{(10^6 \text{ francs})}{\text{Building Fire Loss}} = \frac{4486 - 1/2(902)}{4486} \text{ X } 4957.03 = 4458.675$$

Similar computations give results of 4802.33 X 10^6 francs in 1977 and 5488.535 X 10^6 francs in 1978. These values were then converted to equivalent U.S. (1977) dollars using the method described previously for Austria.

B.1.7. Germany (F.R.)

Data concerning fire losses were obtained from Bundesaufsichtames für vas Veisicherungswesen, Berlin [8]. Specifically, the data for 1977 and 1978 were found in Table 4 on page 195 of the document. The years 1977 and 1978 were obtained from the referenced table. The data on fire losses are based on insurance claims.

b) Fire Losses. Table 4, referenced above, contains values of insurance claims for fire losses for 1977 and 1978. These values contain building and non-building fire losses. In other instances, the precedent has been set in this research to apply 87 1/2% of the fire claims as building fire losses. This results in an estimate of 1.741 X 10^9 dm for 1977 and 1.998 X 10^9 dm for 1978. With these values, the method applied to Austria can now be used.

B.1.8. Ireland

Data concerning fire incidents and losses were obtained from a compilation of fire brigade statistics for 1978. These statistics are based on local authority returns submitted to the Department of the Environment, Fire Services Section [15]. In the letter of transmittal, the chief fire officer of Cork Corporation Fire Department indicated that a major problem in computing Irish fire statistics is the lack of a uniform reporting system.

a) Building Fires. On the last page of the report discussed above, is a table entitled "Statistics Relating to Fire Services in the Period April, 1966 - December, 1978." One of the columns is entitled "Total Number of Fires Attended." The figures for 1976 - 1978 are entered by year. An asterisk by the 1978 entry indicates that the figures are partial from several reporting stations.

Beginning on page 13 is a table entitled "Classification and Location of Fires." The columns were assigned to Residential, Non-Residential, Mobile and Outside in the following fashion:

Residential

- Private Houses
- Caravans/Mobile Homes
- Hotels
- Guest Houses, Flats, etc.

Non-Residential

- Institutions
- Industrial
- Commercial
- Places of Public Entertainment
- Public Houses
- Petrol Service Stations and Oil Risks
- Public and Service Garages

Mobile

Hazardous Substances in Transport

Motor Vehicles

Ships

Outside

Forest

Farms, Hay, Straw

Fog, Grass

The fires in each category were counted and 73.03% were Residential while 6.46% were Non-Residential. These percentages were applied to the 1976 and 1977 data to approximate the location of those fires.

b) Fire Losses. The table on the last page mentioned previously contains a column headed "Estimated Material Fire Loss" for the years through 1978. Fire losses for 1976, 1977 and 1978 were used. Since these losses included mobile and outside losses, a factor of 5% was subtracted from each entry. This will give an approximation for the number of building fire losses. Then the method discussed previously for Austria was applied to the data to convert it to 1977 U.S. dollars.

B.1.9 Japan

Extensive data on fire damages in Japan are reported in the White Book [16]. The Fire Defense Agency of Japan prepares the White Book every two years. Data for this report were taken from the 1978 White Book with information about fires that occurred in 1977.

a) Building Fires. Exhibit 29 contains losses from building fires by type of structure. The total number of building fires for 1977 was 39,302.

b) Fire Loss. Exhibit 29 also contains the amount of fire loss for each type of building structure. The total monetary fire loss from building fires is indicated as 122,064 million yen. These losses are converted to 1977 dollars using the method previously described for Austria.

B.1.10 Netherlands

Data for 1976 and 1977 come from the document "Statistek der Branden" for the subject years [11]. These documents provide detailed information about fires by occupancy type, by cause of fire, and by heat source. Sufficient data is available to fully determine the number of building fires and monetary fire losses.

a) Building Fires. The number of building fires was determined from Tables 19a, 19b and 21 in the 1977 document, and their counterparts in the 1976 document. The method by which these tables were used is described later in Appendix B in association with a discussion of Tables 3-2 and 3-3.

b) Fire Loss. Building fire loss was obtained from Staat 11 in the 1977 document and its counterpart in 1976. In the source table, the designation "Gebouwen," is given. This term relates to buildings. All losses in this category are included in the monetary fire loss data. In addition, "woongelegenheden" (mobile homes) from "Geen Gebouwen" (not buildings) was included. This method of analysis gives building losses of 396,079,000 guilders in 1976 and 474,089,000 guilders in 1977. These losses are converted to 1977 dollars using the method previously described for Austria.

B.1.11 Norway

Data for Norway were obtained from "Branner i Norge," (Fires in Norway) for 1976 and for 1977 [21]. These documents are based on reports from all fire insurance companies underwriting in Norway. Sufficient data are available for the determination of building fires and monetary fire losses.

a) Building Fires. The number of building fires is obtained using Table 1 under the column heading Tilsammen, (Total) and further sub-heading Antall Branner (All Fires). The numbers in Table 1 for 1976 and 1977 are 16,157 and 16,576 respectively. Analysis of further tables in the documents indicates that some of the fires included in Table 1 are non-building fires. Nearly 2% of these could be readily identified. However, it is estimated that the percentage found was low and should be raised to 5%. Thus, 95% of the average building fires in 1976 and 1977 results in a value of 15,548 [.95 X 1/2(16,157+16,576)].

b) Fire Loss. Table 1 contains monetary fire loss estimates (Tillsomen-Erstatring). For 1976 the value is 793,398,952 kroner, and for 1977 the value is 767,384,184 kroner. As above, 95% of these losses are estimated to be in building fires. The results are 7.537 X 10^8 kroner in 1976 and 7.290 X 10^8 kroner in 1977. These values are then converted to 1977 U.S. dollars using the method described previously for Austria.

B.1.12 United Kingdom

Data on building fires for 1976 and 1977 were obtained from "United Kingdom Fire Statistics," for each year, prepared by the Home Office [5]. Data concerning losses were obtained from "Insurance Facts and Figures: 1977," prepared by the British Insurance Association [6].

a) Building Fires. In numerous places in the pamphlets of statistics, the fires in occupied buildings are given. For example, in the 1976 document, the location of fires in occupied buildings is given. In the United Kingdom, there were 95,795 building fires in 1976. To this value is added 1,190 fires in "caravans" (mobile homes) obtained from Table 17, Outdoor Fires and Fires in Derelict Buildings to obtain a total of 96,985 building fires in 1976. A similar analysis yields a value of 94,465 in 1977. The average of these is 95,725, the value used in computations.

b) Fire Losses. The source of data on fire losses is a pamphlet published annually by the British Insurance Association. The 1978 edition of "Insurance Facts and Figures" contains data about 1977. On page 10, there is a set of bar graphs of estimated annual fire damage. For 1976, 231.7 X 10^6 pounds sterling of damage is estimated for Great Britain. To this total is added 44.8 X 10^6 pounds sterling which is the estimate for Northern Ireland. From this total of 276.5 X 10^6 pounds sterling, a value of 7 1/2% is subtracted since it is known that some outside losses are included. From Wilmot's prior study, it is known that mobile fire loss is not in the total so no adjustments are required to remove this class of fires. The estimated fire loss for 1976 is then 255.8 X 10^6 (.95 X 276.5 X 10^6) pounds sterling. A similar analysis for 1977 yields an estimate of 271.8 X 10^6 pounds sterling. The values are then converted to 1977 U.S. dollars using the method previously explained for Austria.

B.1.13 United States

Information for building fires and monetary fire losses was provided by the USFA. These values are preliminary estimates which, when finalized, will become a portion of "Fire in the United States," [19].

a) Building Fires. Three categories from the National Estimates are added to form building fires. These are residential (705,728), public/mercantile (143,243), and industry/etc. (173,708) for a total of 1,022,679 building fires.

b) Fire Losses. The National Estimates are for 1977-78. The average monetary fire loss for these two years was estimated to be \$4,106,180 X 10^3. To bring these values back to 1977, one-half of the 1977-1978 inflation rate (1/2 of 7.29%, or 3.645%) was subtracted. This yields an estimate of \$3,956,510 X 10^3 in 1977 U.S. dollars.

B.2 Computation of Technological Index in Table 2-2

Table 2-2 contains indices of economic and technological development, culminating in a "Technological Index." This index has been formed to determine if fire deaths are related to technology in developed societies. The technological index is a weighted sum of TV's per 1,000 population, telephones per 1,000 population, and radios per 1,000 population. The equation for the index is as follows:

$$\text{Technological Index} = \frac{\text{TV's per 1,000 pop.}}{\text{median of all entries}} + \frac{\text{Telephones per 1,000 pop.}}{\text{median of all entries}} + \frac{\text{Radios per 1,000 pop.}}{\text{median of all entries}} .$$

The median number of TV's per 1,000 population is 268. Corresponding numbers for telephones and radios are 391 and 338. Thus, the technological index for Belgium is computed as follows:

$$\text{Technological Index (Belgium)} = \frac{225}{268} + \frac{300}{391} + \frac{384}{338}$$

$$= .95 + .77 + 1.14 = 2.85$$

The technological indices range from a low of 1.95 to a high of 9.54. A large cluster of indices exists from a value of 2.6 to a value of about 3.0.

B.3 Derivation of Values in Table 3-1

Table 3-1 shows fire incidents, fire deaths, and monetary fire loss by major occupancy grouping--residential, non-residential, mobile and outside. In many cases, complete information was not available, and some Table 3-1 values had to be omitted. Derivation of these that were included is detailed in the subsections below.

As with Table 2-1, monetary values and fire death information were modified to effect some standardization. Monetary values were adjusted for inflation and converted to U.S. dollars. Breakdowns of fire deaths in national reports were scaled to match the more standardized World Health Organization fatality rates. Details of both these adjustments are as detailed in Section B.1 above.

B.3.1 Canada

Canadian information in Table 3-1 was computed from Tables 3(A) and 7a of the fire loss report of the Dominion Fire Commissioner [10]. Fire incidents and monetary losses shown as "Residential Properties" in Table 3(A) were classified residential; all other values in Table 3(A) were treated as nonresidential. Canadian Table 7a provided fire death information. Deaths classified "Transportation" were treated as Mobile, those identified as "Outside Area" were classified Outside, and deaths marked "Buildings" and "Miscellaneous Other" yielded building fire deaths. The latter were subdivided with "Dwellings," "Apartment, hotels, lodgings, tenements, etc." being treated as residential and all other categories forming non-residential.

B.3.2 Japan

Japanese figures in Table 3-1 were derived primarily from Exhibits 1 and 14 of the White Book on Fire Service in Japan [16]. Fires shown as

"Vehicle Fires," "Vessel Fires," and "Aircraft Fires" were treated as Mobile; "Forest Fires" and "Other Fires" were classified outside. "Building Fires" data of Exhibit 1 were subdivided into residential and nonresidential using Exhibit 29 of the Japanese report. Values in that exhibit for "Dwelling Houses" and "Hotels and Inns" were treated as residential; all others were non-residential. Residential fire deaths were taken from the text on page 32 of the Japanese report. Non-residential fire deaths were computed by subtracting residential ones from the building fire total of Exhibit 14.

B.3.3 Netherlands

Table 3-1 fire incident information for the Netherlands was derived from totals of the more detailed Tables 3-2 through 3-5. The latter were, in turn, calculated as described in Section B.4.1 below. Monetary loss information in Table 3-1 was computed from Staat 11 of Dutch reports [11] using the classification scheme of Table B-2 and the adjustments of Section B.1.

B.3.4 New South Wales

Table 3-1 fire incident information for Australia's New South Wales was obtained from totals in Tables 3-2 through 3-5. The latter tables, in turn, were prepared as outlined in Section B.4.2 below. Fire death information for New South Wales is derived from Table 27 of their report. The occupancy classification of Table B-3 was employed to divide incidents into residential and non-residential.

B.3.5 United Kingdom

As with the Netherlands and New South Wales, United Kingdom information in Table 3-1 follows from more detailed computations of Tables 3-2 through 3-5. Fire incident information of Table 3-1 was taken directly from subtotals

TABLE B-1. CLASSIFICATION CODES

Residential Property:

R1 = One and Two Family Dwellings

R2 = Apartments, Tenements, and Flats

R3 = Mobile Homes

R4 = Hotels, Motels, Inns, and Lodges

R5 = Other Residential

R* = Total Residential

Non-Residential Structures:

N1 = Public Assembly

N2 = Education

N3 = Institutions

N4 = Stores and Offices

N5 = Basic Industry

N6 = Manufacturing

N7 = Storage

N8 = Vacant, Construction

N9 = Other

N* = Total Non-Residential Structure

Mobile Property:

M1 = Automobiles

M2 = Other Motor Vehicles

M3 = Rail, Water, and Air Transportation

M4 = Other Mobile

M* = Total Mobile

Outside Property:

01 = Refuse

02 = Trees, Grass and Brush

03 = Forests

04 = Crops

05 = Other Outside

0* = Total Outside

Causes:

C1 = Cooking

C2 = Smoking

C3 = Heating

C4 = Incendiary/Suspicious

C5 = Electrical Distribution

C6 = Appliances

C7 = Children Playing

C8 = Open Flame, Spark

C9 = Exposure

C10 = Natural

C11 = Other

C12 = Unknown

information (by occupancy) from Table 21, and dividing any residual in each occupancy category evenly among C8 and C15. Table B-2 shows details of the reclassifications.

B.4.2 New South Wales

Building fire incidents in Australia's New South Wales report [3] are listed in Table 15 by cause and occupancy. Values in Tables 3-2 and 3-3 of this report reflect reclassification of that Table 15 information as indicated below in Table B-3.

B.4.3 United Kingdom

Building fire incidents in United Kingdom reports [5] are listed for 1977 in Table 24 (Table 12 in 1976 report) by cause and occupancy, and in Table 27 (Table 15 for 1976) by occupancy. Non-building fires are classified in Table 29 (Table 17 for 1976). The occupancy classification of Table 27 is somewhat more detailed than that of Table 24. Thus, in some cases, marginal subtotals were developed for occupancy classifications of Tables 3-2 and 3-3 in this report, even though a cause breakdown was impossible. Similarly, when some, but not all incidents of an occupancy group were classified by cause, others were distributed proportionately. Details of all reclassifications are provided in Table B-4 below.

TABLE B-2. NETHERLANDS CLASSIFICATIONS

(a) Occupancy

	TOTAAL
GEBOUWEN	Remainder N9 1/
w.v. Woonhuizen	R*
w.v. bewoond	
onbewoond	
Land-, tuin-, bosbouw en visserij	N5
w.v. landbouw en veeteelt	
tuinbouw	
Nijverheid (excl. bouwnijverheid)	N6
w.v. voedings- en genotmiddelen	
textiel en textielwaren, leer, bont e.d.	
hout en meubelen	
papier enz.	
chemische	
bouwmaterialen e.d.	
metaal	
elektro-technische	
transportmiddelen	
Bouwnijverheid en aanverwante bedrijven	N8
Handel, bank- en verzekeringswezen	N4
w.v. winkels, warenhuizen e.d.	
Vervoer- en communicatiebedrijven	Remainder N9
w.v. vemen, pakhuizen, opslaggebouwen	N7
Dienstverlening	
w.v. scholen, kerken e.d.	N2
zieken- en bejaardenhuizen, gestichten, kazernes e.d.	N3
gebouwen voor cultuur en ontspanning	N1
horecabedrijven	N1
Kantoren e.d. (z.n.a.)	N4
GEEN GEBOUWEN	Remainder O5
w.v. Woonwagens, -schepen, caravans e.d.	R*
Land-, tuin-, bosbouw	
w.v. landbouwprodukten, bossen e.d.	
w.v. staande gewassen	O4
gestapelde gewassen	O4
tuinen, plantsoenen	O5
staande bomen	O3
heide-, duin- en veenterreinen	O2
Wegen, straten en terreinen	O5
Transportmiddelen	
w.v. straatmotorvoertuigen	M1
Nederlandse schepen	M3
rollend spoorwegmateriaal	M3
spoorweginstallaties	O5
Openluchtopslagplaatsen	
w.v. hout	O5
afval (vuilnisbelt, slakken)	O1
Openluchtinstallaties	Remainder N9
w.v. landbouwmachines e.d.	M4
Openluchtvoorwerpen	2/
w.v. kraampjes, stalletjes langs de weg	
openluchtmarkt, kermis, circus e.d.	

(b) Heat Source (Building Fires)

	TOTAAL
Elektrische toestellen	Remainder C11
w.v. kooktoestellen	C1
ruimteverwarming	C3
verlichting	C5
motor e.d.	C6
waterverwarmer	C3
warmtestraler	C3
radio, t.v., platenspeler	C6
deken, kussen e.d.	C6
droogapparatuur	C6
draden, leidingen, schakelaars	C5
las-, snij- en soldeerapparaat	C8
Gastoestellen	Remainder C11
w.v. kooktoestellen	C1
centrale verwarming	C3
andere ruimteverwarming	C3
waterverwarmer	C3
Vaste brandstoftoestellen	Remainder C11
w.v. centrale verwarming	C3
andere ruimteverwarming	C3
Vloeibare brandstoftoestellen	Remainder C8
w.v. kooktoestellen	C1
centrale verwarming	C3
andere ruimteverwarming	C3
motor	
las-, snij- en soldeerapparaat	
verfafbrander	
Niet gespecificeerde brandstof	C11
Diversen	
w.v. lucifer	
aansteker	
kaars, waxinelicht	
open vuur (z.n.a.)	
brandende stofdelen:	
vuurwerk, explosieven	C11
gloeiende tabak	
vliegvuur	
gloeiend metaal	
brandend, gloeiend afval	
gloeiende brandstofdelen	
mechanische hitte, vonken	
natuurgebeuren:	
bliksem	
andere ontlading v. stat.elektr.	
zelfontbranding, broeiing	
zonnestralen	
Onbekend	

1/ "v.v." in these tables means approximately "subtotals as follows". When all subtotals are not provided, the unallocated remainder of each total was also classified.

2/ Divided 50% N1 and 50% N4

(c) Heat Source (Non-Building Fire)

TOTAAL	
Elektrische toestellen	Remainder C11
w.v. verlichting	C5
draden, leidingen, schakelaars	C5
Gastoestellen	Remainder C11
w.v. kooktoestellen	C1
Vaste brandstoftoestellen	Remainder C11
w.v. ruimteverwarming	C3
Vloeibare brandstoftoestellen	Remainder C8
w.v. kooktoestellen	C1
ruimteverwarming	C3
motor	
las-, snij- en soldeerapparaat	
Niet gespecificeerde brandstof	Remainder C11
Diversen	
w.v. lucifer, aansteker	
kaars, waxinelicht	
open vuur e.d.	
brandende stofdelen:	
vuurwerk, explosieven e.d.	C11
gloeiende tabak	
vliegvuur	
brandend, gloeiend afval	
mechanische hitte, vonken	
natuurgebeuren:	
zelfontbranding, broeiing	
zonnestralen	
Onbekend	

(d) Ignition Factor

Totaal		
Brandstichting		C4
Spelen met vuur, baldadigheid		C7
Onvoorzichtigheid bij roken		C2
Vliegvuur		C9
Blikseminslag	Natuurgebeuren	C10
Zelfontbranding, broeiing	Natuurgebeuren	C10
Afbranden van terreinen, bermen e.d.		C9
Onbekend		C12

TABLE B-3. NEW SOUTH WALES CLASSIFICATIONS

(a) Cause

C4	Incendiarism/Suspicious Circumstances
C11	Fireworks
C2	Smoking in Bed, etc.
C7	Matches/Cigarettes (under 16 yrs)
C2	Matches/Cigarettes (Other)
C11	Re-ignition of Fire
C8	Campfire, barbecue in the open
"	Burning rubbish, waste
"	Burning bush, scrub, grass
"	Burning on demolition site
"	Incinerator
"	Other controlled fire in open
"	Fixed Open Fireplace
"	Portable Open Fireplace
C3	Fixed Electric Radiator, Defective
"	Portable " " , "
"	" " " , Upset
"	Fixed " " , Other
"	Portable " " , "
"	Fixed Gas Fire, Defective
"	Portable Gas Fire, "
"	" " " , Upset
"	Fixed " " , Other
"	Portable " " , "
"	Fixed Kero, Radiator, Defective
"	Portable Kero " , "
"	" " " , Upset
"	Fixed " " , Filling
"	Portable " " , "
"	Fixed " " , Other
"	Portable " " , "
"	Oil Heater, Fixed, Defective
"	" " , Portable, "
"	" " , Upset, Portable
"	" " , Other, Fixed
"	" " , " , Portable
"	Other Room and Space Heating, Fixed
"	" " " " " , Portable
C1	Electric Oven/Stove, Defective
"	" " " , Overheating
"	Foodstuff
"	Electric Oven/Stove, Other
"	Gas Oven/Stove, Defective
"	" " " , Overheating Foodstuff
"	Gas Oven/Stove, Other
"	Other Cooking Appliance, Defective
"	" " " , Overheating
"	Foodstuff
"	Other Cooking Appliance, Other

(b) Occupancy

Dwelling House	R1
Flat, Home Unit, etc.	R2
Group Accommodation	R4
Office	N4
Cafe, Restaurant	N1
Other Retailing	N4
Metal Manufacture	N6
Food and Drink Manufacture	N6
Brickworks, Glass, Chemical, Rubber, and Plastic Manufacture	N5
Wood Products Manufacture	N6
Paper Products Manufacture	N6
Textile Manufacture	N6
Other Manufacture (incl. Power Station)	N5
Public Assembly Building (incl. Club)	N1
Educational Institution	N2
Other Institutional Building	N3
Wholesale and Bulk Storage; Other Miscellaneous Structure	N7
Minor Ancillary Building and Unclassifiable Unoccupied Building	N8

(a) Cause (Continued)

C3	Defective Hot Water Service, Gas
"	" " " " , Oil
"	" " " " , Electric
"	" " " " , Other
"	Hot Water Service, Other than Defective
C11	Industrial Heat Production System, Boiler, Electric
"	Industrial Heat Production System, Boiler, Oil
"	Industrial Heat Production System, Boiler, Other
"	Industrial Heat Production System, Furnace, Electric
"	Industrial Heat Production System, Furnace, Gas
"	Industrial Heat Production System, Furnace, Oil
"	Industrial Heat Production System, Furnace, Other
"	Industrial Heat Production System, Other, Electric
"	Industrial Heat Production System, Other, Gas
"	Industrial Heat Production System, Other, Oil
"	Other Appliance Designed for Heat Production
C8	Blow Lamp
"	Welding and cutting equipment
"	Other Hand Tool
C6	T.V. - black and white
"	T.V. - colour
"	Electric blanket
"	Refrigerator (incl. freezer)
"	Washing Machine, Electric
"	Clothes Dryer, Electric
"	Other domestic appliance, n.e.c.
C11	Electric lighting fixture
C6	Electric fan
C11	Electric Motor, n.e.c.
"	Other Motor, n.e.c.
C5	Conveyor and power transmission
C11	Other Industrial Appliance, n.e.c.
C11	Telephone Equipment
"	Electric photo-copy machine
"	Other, Tools, Equipment, n.e.c.
C5	Overloading Electrical Circuit
"	Wiring from outlet to appliance
"	Wiring of building
"	Switchboard/Switchgear
"	Other electrical supply equipment
C11	Transport, crash or collision
"	Transport, electrical fault
C8	Sparks from transport, including locomotive, tractor -
C11	Transport, filling fuel tank
"	Transport, Other
"	Ignition of flammable substance during manufacture, n.e.c.
"	Flammable substance, storage of, n.e.c.
"	Fuel supply line, n.e.c.
"	Fat, cooking oil, n.e.c.
"	Other hot substance, n.e.c.
C8	Chimney exhaust
"	Flue exhaust
"	Duct exhaust
"	Other exhaust system
C10	Spontaneous combustion
"	Lightning
"	Static Electricity
"	Other natural cause
C5	Naked light
C11	Explosion, n.e.c.
"	Other known cause
C12	Unknown cause
	Total, All Causes

TABLE B-4. UNITED KINGDOM CLASSIFICATIONS

(a) Occupancy - Buildings

Dwellings	
Residential houses	R1
Flats and maisonettes	R2
Living accommodation as part of another occupancy	R5
Private occupancies (non-residential)	N9
Agriculture, forestry, fishing	N5
Mining and quarrying	N5
Manufacturing industry	
Food, drink and tobacco	N6
Coal and petroleum products	N5
Chemicals and allied industries	N6
Metal manufacture	N6
Mechanical engineering	N4
Instrument engineering	N4
Electrical engineering	N4
Shipbuilding and marine engineering	N6
Vehicles	N6
Metal goods not elsewhere specified	N6
Unknown metal goods	N6
Textiles	N6
Leather, leather goods, fur	N6
Clothing and footwear	N6
Bricks, pottery, glass, cement etc.	N6
Timber, furniture etc.	N6
Paper, printing and publishing	N6
Other manufacturing industries	N6
Construction industry	N8
Gas, electricity and water	N5
Transport and communication	N5
Distributive trades	N4
Wholesale	N4
Dealers	N4
Retail	N4
Insurance, banking, finance, business services	N4
Professional and scientific services	
Schools	N2
Hospitals – psychiatric	N3
– non psychiatric	N3
Other professional and scientific services	N4
Miscellaneous services	
Places of public entertainment and ancillary services	N1
Hotels	R4
Hostels, boarding houses, holiday camps etc.	R4
Cafes, restaurants etc.	N1
Clubs, public houses etc.	N1
Elderly persons' homes	N3
Orphanages, homes for disabled or handicapped	N3
Other miscellaneous services	N9
Public administration and defence	N4
Occupancy not recorded	N9

(b) Cause

Children with fire	C7
Malicious or doubtful ignition	C4
Smokers' materials, matches	C2
Electric	
Cooking appliances	C1
Space heating	C3
Central heating	"
Water heating, washing machine	"
Wiring installation	C5
Lighting	"
Blanket and bedwarmer	C6
Radio and television	"
Refrigerator	"
Iron	"
Other	C11
Gas (town and natural)	
Cooking appliances	C1
Space heating	C3
Central heating	C3
Water heating, washing machine	C3
Other	C8
Liquefied petroleum gas	
Cooking appliances	C1
Welding and cutting equipment	C8
Other	C8
Solid fuel	
Cooking appliances	C1
Fire in grate	C3
Slow combustion stove	C3
Other space heating and central heating	C3
Other	C11
Oil and petroleum	
Space heating	C3
Central heating	C3
Engine	C11
Welding and cutting equipment	C11
Lighting	C11
Other	C11
Acetylene – Welding and cutting equipment etc	C8
Other and unspecified fuels	
Cooking appliances	C1
Space heating and central heating	C3
Welding and cutting equipment	C8
Other	C11
Ahses and spot	C8
Chimney, stove pipe, flue (not confined to)	C3
Explosives, fireworks	C11
Mechanical heat or sparks	C11
Naked light, taper, candle etc	C11
Natural occurrencies	C10
Rubbish burning	C8
Spontaneous combustion	C10
Other specified sources of ignition	C11
Unknown and unrecorded source	C12
Non-dwellings fires not reported in detail during the fire service strike(4)	

(c) Occupancy – Nonbuilding

Derelict buildings	N8
Outdoor storage	05
Outdoor machinery and equipment	
Electrical supply plant	N5
Gas works plant and mains	N5
Tar boilers, tar plant	M4
Agricultural machinery	M4
Roadmaking and earth moving machinery	M4
Other mobile equipment	M4
Other fixed equipment	05
Road vehicles	
Cars	M1
Vans, shooting brakes, land-rovers	M2
Motor cycles, motor scooters	M2
Tankers	M2
Other lorries	M2
Coaches, omnibuses, minibuses	M2
Other vehicles	M2
Caravans	R3
On site	
Other	
Ships and boats	M3
On inland waterways	
In port or dry dock or on dry land	
At sea	
Railway rolling stock	M3
Aircraft	M3
Letter boxes	05
Crops and agricultural	04
Woods, forests, plantations, orchards	03
Allotments, gardens, nurseries	02
Grassland	02
Refuse	01
Other outdoor locations	05
Location not recorded	05

APPENDIX C

SOURCES OF INTERNATIONAL FIRE STATISTICAL INFORMATION

A comprehensive survey of potential infr..ation providers was undertaken to develop the comparisons presen   ıis document. The survey was accomplished by letters to pote...   .ondents requesting data, followed by additional letters .. required. Some of the responses were negative, viz., they did not have the data for the time period or in the format requested. Some of the requests were returned as "addressee unknown at this location." Still, other requests went unanswered. Finally, those that provided statistics on fires are indicated in the listing which follows:

1. J. J. Keough, Manager
   Fire Research
   Experimental Building Station
   Department of Housing and Construction
   P.O. Box 30
   Chatswood, NSW 2067
   AUSTRALIA

2. G. C. Ramsey
   Division of Building Research
   Commonwealth Scientific and Industrial Research Organization
   P.O. Box 30
   Chatswood, NSW 2067
   AUSTRALIA

3. Ing. J. Kaiser, Director
   Central Office for Fire Prevention
   Mariahidferstrasse 133
   1150 Vienna
   AUSTRIA

4. Direction Générale de la Protection Civile
   Minister de l'Interieur
   Royaume de Belgique
   100 Bruxelles
   1, rue de Louvain
   BELGIUM

5. John N. Cardoulis
Fire Commissioner
Government of Newfoundland and Labrador
Pleasantville Fire Station
St. Johns, Newfoundland
A1C 5T7
CANADA

6. G. R. Elliott
Fire Marshal
Department of Labour and Manp
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1
CANADA

7. Charles E. Findlay
Fire Marshal
Department of Labour
P.O. Box 697
Halifax, Nova Scotia
CANADA

8. G. A. Hope
Dominion Fire Commissioner
Public Works
Ottawa
CANADA

9. A. M. Johnston
Office of the Fire Commissioner
Division of Fire Safety
2780 E. Broadway
Vancouver, British Columbia
V5M 1Y8
CANADA

10. Peter F. Marshall
Public Relations Supervisor
Ministry of the Solicitor General
Office of the Fire Marshal
Public Safety Commission
590 Keele Street
Toronto, Ontario
M6N 4X2
CANADA

11. Arthur [illegible]asaiux
Division des Statistiques
Direction générale de la Prévention des incendies
127[illegible] [illegible]st, boulevard Charest
Qu[illegible] Qué
G1[illegible]

12. Erik Heimann Olsen
Danish Insurance Information Office
Forsikringsoplysningen
10 Amaliegade
DK-1256 Copenhagen K
DENMARK

13. Erik Pedersen
Danish Fire Protection Association
Nygards Plads 9
2610 Kobenhavn
Rodovre
DENMARK

14. B. Butcher
Information Officer
British Insurance Association
Aldermary House
Queen Street
London EC4N 1TU
ENGLAND

15. Dr. E. J. Denney
Fire Protection Association
Aldermary House
Queen Street
London EC4N 1TU
ENGLAND

16. B. B. Pigott, Head
Operational Research and Statistics Division
Building Research Establishment
Fire Research Station
Borehamwood, Hertfordshire
WD6 2BL
ENGLAND

17. R. T. D. Wilmot
The University of Sussex
Centre for Contemporary European Studies
Brighton
ENGLAND

18. Le Delque General
Assemblée Plênière
Des Sociétés D'Assurances
Contre L'Incendie
11, Rue Pillet-Will, 11
Paris - IX
FRANCE

19. M. T. Cornillet
Ministere de l'Interieur
Service National de la Protection Civile
Sous-Direction des Etudes et de la Prevention
Bureau de la Documentation et de l'Informatique
18 Rue Ernest Cognacq
92 - LEBALOIS - PERRET
FRANCE

20. Nikolaus - Grob - Weg 2
D-1000
Berlin, 13
GERMANY (F.R.)

21. (UNKNOWN) Kanthak
Verband Der Sachversicherer e v
5000 Koln 1-Riehler Strabe 36
Post Fach 10 20 24
GERMANY (F.R.)

22. Captain C. I. Garvey
Chief Fire Officer
Cork Corporation - Fire Department
Anglesea Street
Cork
IRELAND

23. Dott. Ing. Sergio Urbani, Direttore
Concordato Italiano Incendio
Rischi Industrali
Fondato Nel 1883
20122 Milano
ITALY

24. Haruo Ohno, Chief
Liason Branch
Tokyo Fire Dep ment
3-5 Otemachi chome Chiyoda Ku
Tokyo 100
JAPAN

25. B. M. Van de Harst, Librarian
R. H. M. Smulders, Acting Head, Criminal and Judicial Statistiek
Centraal Bureau voor de Statistiek
Princes Beautrixlaan 428
Postbus 959
2270 AZ Voorburg
THE NETHERLANDS

26. Per Birkevold
Norwegian Fire Protection Association
Lorenfaret 1
Postboks 3 - Okern
Oslo 5
NORWAY

27. A. Rydning
Noges Brannkasse
Postboks 1045 Sentrum
Oslo 1
NORWAY

28. Hans Lagerhorn
Swedish Fire Protection Association
Kungsholms Hamnplan 3
112 20 Stockholm
SWEDEN

29. K. Celese
Vereinigung Kantondler
Feuerversicheiringen
Bundesgasse 20
3001 Bern, Postfach 4081
SWITZERLAND

30. Dr. W. Lindenmann
Fire Prevention Service for Industry and Trade
Dokumentation
Nuschelerstrasse 45
CH - 8001
Zurich
SWITZERLAND

31. S. R. (Initials only were given)
P.O. Box 172 CH-8022
Zurich,
SWITZERLAND

32. Henry Tovey
National Fire Data Center
U.S. Fire Administration
Washington, D.C. 20472
UNITED STATES