COST Action C17: ‘Built Heritage: Fire Loss to Historic Buildings’ Working Group 1

Short Term Scientific Mission: *‘Comparison of Data Categorisation of European Countries Fire Reporting Statistics’*

Scientific Report by Kalle Reivila, National Board of Antiquities, Finland: 3rd November 2004

1. Introduction

This report summarises The Short Term Scientific Mission carried out for COST Action C17 “Fire Loss to Historic Buildings” Working Group 1 (Data, Loss Statistics and Evaluating Risks) by Kalle Reivilä from Finland’s National Board of Antiquities during the period 5-13th of October 2004. The mission was performed at Historic Scotland’s premises in Edinburgh, Scotland complemented by two scientific visits, one to Grampian Fire and Rescue Service in Aberdeen and the other to the UK Government Office of the Deputy Prime Minister’s (ODPM) Fire Statistics & Research Division in London.

2. Purpose of the visit

The aim of the Short Term Scientific Mission was to set common criteria for facilitating direct comparison of data categorisation from each COST Action C17 participating country’s fire statistics.

Reporting to the Action Working Group 1, The Mission was to address the hypothesis that identifying and setting up eight levels of fire causes would be sufficient for European historic building managers to gain useful information.

By comparing the detail from each country’s reporting pro forma system, the STSM was also to address:

- How to include historic buildings data in the fire reporting processes
- How to ensure more effective links between the historic building authorities and those compiling fire statistics
- How to make data on historic buildings more accessible
- The possibility of agreeing a common format of categorising and analysing historic buildings data that could be included in the reporting pro-forma procedure

2. Work carried out during the visit

To support the actual data analysis and comparison, two scientific visits were made. These enabled idea exchange and demonstration of fire reporting systems and databases in the UK and Finland as well as collection of available data for the primary purpose of the visit; comparison of fire report statistics.

The Scottish Historic Buildings National Fire Database[1] demonstrated to Kalle Reivila at Grampian Fire and Rescue Service in Aberdeen is a good example of collaboration between cultural heritage professionals and rescue authorities. The outcome of this project, used together with relevant statistics on actual fires, presents a very effective means of increasing fire safety in historic buildings in the future.

The visit to ODPM's Statistics & Social Research Branch's Fire Statistics & Research Division in London was to enable demonstration of the Finnish electronic recording systems of accidents to officials responsible for developing the UK equivalent - as well as to collect UK data for the data comparison exercise. During the visit it was acknowledged that, whilst it would be possible to collect relevant UK fire statistics to enable analysis of fires from the historic building viewpoint, such specific information is unfortunately not readily available as it would be too difficult and burdensome to source from old paper based archive data. This emphasised the need for an up-to-date electronic system for recording fires. The general fire statistics obtained during the visit were however helpful for the comparison exercise.

Data categorisation of fire causes in European Countries fire reporting systems

In advance of the mission it was agreed that WG1 members from each country would e-mail details to Kalle Reivila of how their system currently determines different causes of fire. Categorisation details were received from Finland, Sweden, Bulgaria and the UK:

Table 1: Causes of fire in different European countries fire report pro formas

Finland (33 categories)

Unknown	Other
Short circuit	Overheated equipment
Insufficient distance to burning object	Spark from duct or stove
Cigarette etc.	Other electrical reason
Welding	Hot object or ash
Overheated process	Smutfire*
Lightning	Candle etc.
Crack in duct or stove	Spark from outlet or device
Campfire or other open fire	Mechanical spark
Friction	Loose wire (electric)
Trash burning	Heat from chemical reaction
Re-ignition	Controlled agricultural burning
Fireworks	Other energy
Installation fault in electric device	Sun
Explosion	Other natural cause

* or 'soot fire' i.e. soot in chimney flue

[1] See Annex for more information

Sweden (17 categories)

Intentional	Children’s games
Smoking	Technical fault
Smutfire*	Self Ignition
Hot works	Forgotten fireplace
Explosion	Spark
Friction	Candle
Transfer of heat	Re-ignition
Lightning	Unknown
Other (please specify)	

* or ‘soot fire’ i.e. soot in chimney flue

Bulgaria (14 categories)

Short circuit	Misuse of electrical heaters
Misuse of electrical appliances	Carelessness in handling open fire
Technical failure	Faulty technology
Natural phenomena	Arson
Unknown	Other
Construction failure	Hot works
Self-ignition	Children’s games

UK – most common main categories*

Smokers’ materials	Matches
Cooking appliances	Space heating appliances
Central and water heating appliances	Blowlamps, welding and cutting equipment
Electrical distribution	Other electrical appliances
Candles	Other
Unspecified	

* In UK fire causes are recorded in over one hundred different categories. Causes listed here represent the most common main categories from ODPM’s data ‘Accidental fires in dwellings and other buildings by cause, 1992-2002’.

It is evident that lack of information from other European countries makes reliable comparison difficult. Discrepancy between available categories is also a complicating factor.

For example, in the Bulgarian fire report form, ‘arson’ is included as a cause. In other countries deliberate and accidental fires are recorded separately, i.e. there is a different section in their pro forma indicating whether the fire was accidental or deliberate. The cause ‘unknown’ which is present in every available country’s list, also most likely refers to arson.

The unfortunate fact that the cause cannot be established in such a large proportion of recorded fires is a complicating factor for preventive measures.

In accidental fires, the source of ignition can be considered to be the actual cause of fire. However, in some of the pro formas the actual cause (which can be accidental or intentional) and source of ignition can be mixed into the same classification.

Although arson is and should be considered as a serious threat to historic buildings, accidental and deliberate fires should be registered separately. The reason for this is that the means of preventing fires in each of these two categories can be quite different. Best results for preventing arson fires are usually achieved by increased security measures whilst for accidental fires prevention involves eliminating the actual cause or source of ignition by a variety of means.

The number of categories used in these four countries varies from 14 to 33. The UK categories (11) represent the most common causes in accidental fires. To actually know what these most common causes are, and whether the aggregated information would be useful from the historical building point of view, the actual available data on fire causes should first be analysed.

Data available to test the hypothesis

During the Action's WG1 meeting on 16 – 17 July 2004 in Vienna, it was recognised that, in terms of management decision making, it would be difficult to plan investments without knowing what the main causes of fires in historic buildings are. It was therefore decided that the STSM would address the hypothesis that *identifying and setting eight levels of fire causes would be sufficient for European historic building managers to gain useful information.* By combining different categories into more general causes, it was thought possible to create a template setting out the eight most common causes for historic building fires. **In this exercise it was assumed that covering 80% of all causes would be sufficient to gain useful information.**

In advance, and during the STSM, Kalle Reivila gathered data on actual fire causes from the United States, the UK and Finland. Collated data, relevant to test the hypothesis, is presented below:

Table 2: U.S.A.
Data from the National Fire Protection Association (NFPA)
Database: NFIRS (National Fire Incidents Reporting System)

Libraries	Number of fires average per year	Causes	%
	146	intentional	36,30
		electrical distribution	17,40
		other equipment	11,10
		open flame, ember or torch	9,00
		heating equipment	7,00
Statistical data from 1994 - 1998		**Total:**	**80,80**

Museums and Art Galleries	Number of fires average per year	Causes	%
	61	electrical distribution	30,40
		other equipment	16,00
		cooking equipment	10,90
		heating equipment	9,00
		open flame, ember or torch	8,60
Statistical data from 1994 - 1998		**Total:**	**74,90**

Historic Buildings	Number of fires average per year	Causes	%
	35	intentional	29,70
		electrical distribution	16,60
		heating equipment	11,60
		other equipment	8,60
		natural causes	8,40
Statistical data from 1994 - 1998		**Total:**	**74,90**

Places of Worship	Number of fires average per year	Causes	%
	1735	intentional	20,40
		electrical distribution	19,80
		open flame, ember or torch	14,70
		heating equipment	11,10
		cooking equipment	10,60
Statistical data from 1994 - 1998		**Total:**	**76,60**

Table 3: Finland
All recorded alarms in buildings from 1999-2003 (Total number of events: 15886). Data from PRONTO[2]

All Events

Cause	*Frequency[3]*	*%*	*Cumulative%*
Unknown	2403	15,77 %	15,77 %
Other known	1739	11,41 %	27,18 %
Short circuit	1346	8,83 %	36,02 %
Match etc	1335	8,76 %	44,78 %
Overheat. equipment	938	6,16 %	50,94 %
Insufficient distance to burning object	838	5,50 %	56,43 %
Cigarette etc	776	5,09 %	61,53 %
Spark from duct or stove	688	4,52 %	66,04 %
Lightning	650	4,27 %	70,31 %
Other electric	595	3,90 %	74,21 %
Hot object or ash	572	3,75 %	77,97 %
soot in chimney flue	503	3,30 %	81,27 %

Alarms in 'Pre 1940 Built Buildings'

Unknown	297	20,05 %	20,05 %
Match etc	178	12,02 %	32,07 %
Other known	156	10,53 %	42,61 %
Short circuit	107	7,22 %	49,83 %
Cigarette	90	6,08 %	55,91 %
Lightning	87	5,87 %	61,78 %
Smutfire	66	4,46 %	66,24 %
Spark from duct or stove	61	4,12 %	70,36 %
Other electric	51	3,44 %	73,80 %
Insufficient distance to burning object	49	3,31 %	77,11 %
Crack in duct or stove	48	3,24 %	80,35 %

Alarms in 'Pre 1920 Built Builidings'

Unknown	83	17,66 %	17,66 %
Match etc	64	13,62 %	31,28 %
Other known	49	10,43 %	41,70 %
Shortcircuit	34	7,23 %	48,94 %
Smutfire	24	5,11 %	54,04 %
Insufficient distance to burning object	23	4,89 %	58,94 %
crack in duct or stove	21	4,47 %	63,40 %
Other electric	21	4,47 %	67,87 %
Spark from duct or stove	20	4,26 %	72,13 %
Lightning	19	4,04 %	76,17 %
Cigarette etc	18	3,83 %	80,00 %

[2] For more information on PRONTO, see Annex 1
[3] Refers to number of events

Table 4: UK
Accidental fires[4] in dwellings and other buildings by source of ignition, 1992-2002

Cause:	Fires (thousands)	%	Cumulative %
Cooking appliances	386,2	43,59	43,59
Other electrical appliances	138,8	15,1	58,69
Smokers' materials	88,7	10,01	68,70
Other	74,1	8,36	77,06
Electrical distribution	54,2	6,12	83,18
Space heating appliances	41,2	4,65	87,83
Blowlamps, welding and cutting equipment	23,5	2,65	90,48
Matches	22,6	2,55	93,03
Central and water heating appliances	22,1	2,49	95,52
Unspecified	20,9	2,36	97,88
Candles	19	2,14	100,02

Analysis of the data

Table 2 presents the NFPA USA data from the period 1994-1998 by building type. Presented types are restricted to the categories relevant from a historical point of view. The categories for the causes of fire are a mixture of source of ignition and deliberate fires, as the class ‘intentional’ is not a source of ignition. With each type of building, the five available categories cover about 75% of all fires (80% in libraries). However, the broad categorisation used in this data set could cause loss of valuable information. For example, it is unclear whether ‘hot works’ or equivalent is included in any of these categories.

Data extracted from the Finnish rescue service system PRONTO[5] is listed in Table 3. Data includes all events (including near misses and minor fires) during the period 1999 – 2003. Analysis of the 3 Finnish data sets (‘all events’, ‘pre 1940 built buildings and ‘pre 1920 built buildings) shows that the 11 most common (12 in ‘all events’ group) categories cover about 80% of all events. However, the ‘other’ and ‘unknown’ classifications add up to about a third of all events, a fact that is not very useful for preventative purposes. ‘Unknown’ most probably refers to arson. In comparison with the NFPA USA data, the categorisation of Finnish data might be somewhat too detailed, since 12 causes cover about 80% of all events**,** and the remaining 21 causes only about 20%. This suggests that **setting up definitions or categories for eight levels of causes (as mooted at the Action’s WG1 meeting in Vienna) would be sufficient, and probably close to the optimum balance between ‘too-detailed’, versus ‘loss of information.’**

When the Finnish data is analysed by building date the most common causes of fire in all three data sets are almost the same[6]. This suggests that causes of fire in old buildings do not

[4] There were changes in the recording of deliberate and accidental fires, which affect comparisons, before and after 1994.
[5] See Annex 1 for more information on PRONTO
[6] However, the category ’Overheated equipment’, which is the 5th common cause of fire in the Finnish dataset for all fire events, is not present in the pre 1940 and 1920 subsets. With the data available, it is hard to find a causal explanation for this.

differ radically from those in the broader datasets. This assumption will be used when addressing the hypothesis, as old buildings are more likely to be historic buildings.[7]

The results from analysis of UK fires (Table 4) are similar to the Finnish data, although the categories are broader and not directly comparable to other countries' data sets. In total the first five causes add up to about 80% of all fires.

There are several factors that make direct comparison of the available data from the three countries difficult. Firstly, the Finnish data includes all events, including automatic alarms and 'false alarms' and is not restricted to fires that cause damage. Secondly, categorisation across different data sets is not uniform. Thirdly, it is unclear whether the circumstances for the ignition of fires are similar. In Finland, for example, the most common room for a fire to start in is the sauna, which is unlikely to be the case in UK. Conversely, gas is used more in UK than it is in Finland, and this might explain the high percentage of cooking fires that occur in the UK.

Conclusions

From the limited available data it is considered that establishing eight levels of fire causes would be sufficient for European historic building managers to gain useful information. However, due to insufficient and inconsistent common national data it is not possible to specify exactly what those eight levels would be without first reaching a broader agreement in each country as to the appropriate categories. This would involve further detailed discussion to determine the relevant required data on historic building fires at a pan-European level.

However despite this shortcoming, from the available data, the most common causes of fire in historic buildings could be summarised as follows:

1. Arson
2. Electrical fault
3. Match
4. Smoking Materials
5. Candle
6. Heating equipment
7. Natural causes (lightning)
8. Hot works

In presenting this list it should be considered as the result of an initial explorative analysis made possible by the STSM. From a statistical point of view the empirical data is insufficient to be able to verify the figures and conclusions.

---

[7] COST C17 Management Committee Chairman's Note: The observation that the Finnish statistics show little numerical difference between fires in modern and old buildings is interesting and begs the question as to whether the same assumption can be applied to other countries where the lack of separate identification of historic buildings in the reporting forms has previously been seen as a problem in obtaining any meaningful statistics. (Ingval Maxwell: 3 November 2004).

What the STSM did make clear is that pursuing the development of electronic fire reporting systems in European countries is the way to raise the monitoring of historic building fires to an adequate level. As the visit to the UK ODPM demonstrated, a view is held that acquiring relevant empirical data on fires which have occurred is probably too burdensome a task to undertake.

Moreover, with today's computer network technologies, every modern country should be able to assemble a national database of fire incidents using standardised coding. This could either involve creating full data sets or a statistically valid sample. Insurance sources and other vital records can also be useful, but the public fire brigades in each country tend to be the primary suppliers of information and facts about the major fires experienced by each country.

Initial experiences with comprehensive electronic fire reporting systems (the Finnish PRONTO being a pioneer in this), and the extraction of statistical data from them, illustrates that any system is only as good as the information input into it. For preventative and managerial purposes, having a first class statistical tool is of little use if the input does not represent the reality. To help overcome this issue, training and development of any electronic systems should be effected through cooperation with fire brigades and cultural heritage professionals.

Date: 3rd November 2004 **Signature:**

Kalle Reivila

Annex 1

PRONTO: Finnish Accident Reporting Software System

The Finnish accident reporting software system “PRONTO (Version 3.0)” can be summarised as:

• Web-based system for recording accidents and rescue resources
• Maintained by Ministry of Interior
• Newest generation launched in 2000
• It records all incidents, including fires and accidents.
• Events from 1996 onwards are included
• All material is readily available online
• Reports, statistics, user enquiries and sampling, time series & GIS information
(Buildings Register)

Reports

A large range of attributes are available to choose from in preparing User Defined Reports and constant, parametric~~,~~ reports are also possible. These include the physical characteristics~~,~~ and an appraisal of the fire incident. All emergency calls are reported on the Internet through the PRONTO system within 30 minutes of being accepted. Electronic feedback is immediately available on the incident, offering full details; the approach adopted, and the level of assistance given. This includes a considerable amount of data and information on the level of participation by all emergency services. The system also includes data on all false alarms.

Different information can be logged in different ways in the Building Report. All attributes can be interrogated through a multiple enquiries approach. Interrogation is available through the WWW to any enquirer possessing privileges to access the system. Reports can be exported to Html, Excel, Mapinfo and CSV text files. However, although it is a very sophisticated system, the quality of the available data is to a great extent dependent upon the competence and willingness of the individual inputing information to complete all the fields in appropriate detail in the first instance. Therefore, although it is a very sophisticated system, much depends upon the attitude and approach of the individual completing the electronic pro-forma.

The pro forma exists in three parts:
• Alarm report
• Accident report
• Building report

PRONTO and Historic Buildings
At present use of the system in this area is just explorative in use. Linking Historic Buildings Information to the PRONTO system would be useful as a monitoring and research tool.

PRONTO is under constant development - involving the Federation of Insurance Companies and the National Board of Antiquities. Although National inventories in Finland are slowly improving it would be highly useful for monitoring / research if an appropriate list existed.

Annex 2

The Scottish Historic Buildings National Fire Database - Background Information

Inaugurated in August 2002, the overall aims of the Scottish Historic Buildings National Fire Database project which is an on-going partnership between Historic Scotland and the eight Scottish Fire Brigades covering Category 'A' Listed Buildings, are as follow:

- To improve the effectiveness of fire-fighting operations at historic buildings by making available relevant information in a format suitable for use by fire crews attending an incident at these properties.
- To facilitate the improved reporting and gathering of statistics on fires in Scottish historic buildings.
- To inform future Historic Scotland Technical, Conservation, Research and Education Division (TCRE) research programmes.

The database has been developed as a 'living document' that provides an exchange of information between Historic Scotland, the National Monuments Record of Scotland (held at the Royal Commission on the Ancient and Historical Monuments of Scotland) and the eight Scottish Fire Brigades. The output from the database is an amalgamation of information gathered from the NMRS and other archives by a historic buildings researcher which is then verified and expanded by seconded Fire officers following site visits to each of the circa 3500 Category 'A' listed properties in Scotland. The type of information incorporated in the database includes architectural descriptions, photographs, plans, access routes and details of water supplies. In addition, priority areas within a property that are of highest historic significance are identified, as are ways in which a building's structure may adversely affect fire-fighting operations.

An immediate benefit of the database is the improved awareness of the location, significance and importance of historic buildings within the Scottish Fire Brigades' areas. The longer-term benefit of the project will be in helping to mitigate the devastating effects that fire can and does have on Scotland's built heritage.