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JOINT FIRE RESEARCH ORGANIZATION

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THE RELATIVE FIRE HAZARD OF DIFFERENT INDUSTRIES

by

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1. Introduction

For some purposes, such as fire protection legislation and fire insurance, it is desirable to have some measure of the inherent fire hazard of industries. Experience and knowledge of the materials and processes involved have led to the adoption of fire precautions of various kinds in most industries, but despite this there remains some degree of fire hazard which may be more pronounced in one industry than another and which is reflected both in fire frequency and in fire spread. This study has been made in terms of fire frequency only since there is at present no satisfactory quantitative measure of fire spread available to the Organization.

As the ultimate objective of fire prevention would be the total elimination of fires in industry it is not possible to define any specific level of fire frequency as being "acceptable", and the effort has therefore been directed towards deriving a method of comparing one industry with another.

2. Preliminary investigation

In comparing the fire hazard of industries of widely differing character it is clearly inadequate to consider only the overall frequencies of fire since these will be affected by a number of characteristic factors related to the size and activity of the industry (e.g. the number and size of the individual units, the number of operatives employed, etc.). Nor will it, in general, be sufficient to regard any one of these factors as being of such importance as to outweigh all others since each will contribute, in differing degree, to the overall character of most industries. For comparisons between industries to be meaningful, it therefore becomes necessary to devise a quantitative characteristic which can be regarded as descriptive of any of the industries concerned, and to which the fire frequency in the industry can be related. This has been done by the method of component analysis and a description of the procedure adopted has been given elsewhere(1).

For the component analysis a number of factors which might be expected to influence the fire incidence were taken from the Census of Production for 1958 and six main components were constructed. These components could be regarded as broadly descriptive of (1) size, (2) competetiveness, (3) productivity, (4) value of stocks in relation to size (5) proportion of expenditure on administration and (6) sensitivity to external economic conditions.

The frequencies were considered in relation to the main components and, for this purpose, the frequencies for the years 1957-1961 were added together. At this stage in the work it was convenient to group industries together and the grouping adopted was in line with that of the Standard Industrial Classification.

It was found that the frequency of fire in industry was dependent on the component measuring the "size" of the industry and no relationship was found between fire frequency and the other components examined. The "size component" was derived from the following factors:-

The number of establishments

Purchases of materials, fuels, etc.

Products on hand for sale

Stocks of materials and fuel

Payments for transport

Net output minus wages and salaries

Wages and salaries

Average number employed

New building work

Plant and machinery (acquisitions minus disposals)

Vehicles (acquisitions minus disposals)

3. Ranking of individual industries

Having established the general law it has been possible to rank industries, according to their fire hazard, by calculating for each an index of fires. The index used was the logarithm of the number of fires which would have occurred if the industry had been of average size, and lists of industries are given in the two tables at the end of this report. In table 1 the industries have been listed in descending order of the likelihood of a fire in a production area. Table 2 gives the equivalent list for fires in storage areas. Industries do not appear in the same order in the two lists, but it appears that, when size has been taken into account, those at the high frequency end of each list are approximately 70 times as likely to have a fire as those at the low frequency end.

4. Some features of the lists

The lists produced are subject to some uncertainty arising from chance variation and the order may undergo changes in time, particularly where industries are very close to each other in a list. In addition any pronounced changes in either materials handled or production methods used in an industry could affect its position in the lists. When due allowance has been made for these uncertainties, however, some interesting features can be observed in the lists as shown by the examples given below.

Miscellaneous wood and cork manufacture, furniture and upholstery, wooden containers and baskets appear high on both lists, while contractors plant and quarrying machinery, industrial engines, engineers' small tools and gauges are at the low end; the position of these industries would be expected from the nature of the materials they handle. On the other hand some industries, such as tobacco, and spirit distilling and compounding, although handling flammable materials, are low on both fire hazard lists; in the two industries quoted this is probably due to the stringent requirements of the excise laws. Other previously dangerous industries, such as explosives and fireworks, are fairly well down the lists; in these industries the dangers are well understood and stringent effective precautions are taken.

In some industries, of which linoleum, leather cloth, etc. is an example, the fire hazard of the production side has not been overcome, although there appears to be a smaller danger in the storage of the products. Again there are industries in which this situation is reversed; the pottery industry for example, which is 36th in order of fires in production areas, is 3rd on the list for storage areas presumably because of the nature of the packing materials used.

5. Conclusions

Ranking lists have been produced showing the relative fire hazard of the production and storage sides of different industries in terms of fire frequency. These may be useful in connection with fire protection legislation and insurance, and in revealing those industries in which existing fire precautions would repay further study. They are of interest also in showing the relative effectiveness of precautions in the production and storage sides of some industries.

REFERENCES

(1) HOGG, Jane M., and FIRTH, J. M. The ranking of some industries in Great Britain in accordance with their relative fire hazard. Department of Scientific and Industrial Research and Fire Offices' Committee, Joint Fire Research Organization. Fire Research Note No. 558, June 1964.

Table 1

Fires in areas of production

Index of fires at the average industry size*	Equivalent fire frequency	Industry
2.56	363	Miscellaneous wood and cork manufacturers
2.42	263	Linoleum, leather cloth, etc.
2.41	257	Furniture and upholstery
2.41	257	Wooden containers and baskets
2.33	214	Gas
2.32	209	Miscellaneous manufacturing industries
2.31	204	Textile finishing
2.28	191	Woollen and worsted
2.23	170	Timber
2.23	170	Bedding, etc.
2.21	162	Iron castings, etc.
2.20	158	Jute
2.20	158	Synthetic resins and plastics materials
2.19	155	Other textile industries
2.18	151	Plastics moulding and fabricating
2.16	145	Cans and metal boxes
2.16	145	Paint and printing ink
2.16	145	Shop and office fitting
2.15	141	Electricity
2.15	141	Domestic electric appliances
2.12	132	Leather (tanning and dressing) and fellmongery
2.12	132	Other chemicals
2.11	129	Tools and implements
2.11	129	Paper and board
2.11	129	Corsets, umbrellas and walking sticks, and other dress industries not elsewhere specified
2.10	126	Iron and steel (general)
2.10	126	Leather goods
2.09	123	Light and base metals
2.06	115	Railway carriages and wagons and trams
2.06	115	Vegetable and animal oils and fats
2.03	107	Toys, games and sports equipment
2.03	107	Carpets
2.02	105	Textile machinery and accessories
2.01	102	Sugar
2.00	100	Fur
1.99	98	Pottery
1.97	93	Bolts, nuts, screws, rivets, etc.
1.97	93	Metal industries not elsewhere specified
1.97	93	Production of man-made fibres
1.95	89	Cutlery
1.95	89	Wire and wire manufacturers
1.95	89	Other electrical goods
1.94	87	Jewellery, plate and refining of precious metals
1.94	87	Footwear
1.94	87	Dyestuffs
1.93	85	Perambulators, hand-trucks, etc.
1.91	81	Rope, twine and net
1.91	81	Canvas goods and sacks
1.90	79	Bricks, fire clay and refractory goods
1.90	79	Dresses, lingerie, infants' wear, etc.

*Logarithm of the weighted total of fires obtained from samples of reports from the fire year period 1957-61.

Fires in areas of production (Cont'd.)

Index of fires	Equivalent fire frequency	Industry
1.89	78	Steel tubes
1.89	78	Hats, caps and millinery
1.87	74	Other printing, publishing, bookbinding, engraving, etc.
1.86	72	Glass
1.85	71	Brushes and brooms
1.84	69	Polishes
1.83	68	Shipbuilding and marine engineering
1.82	66	Aircraft manufacturing and repairing
1.78	60	Soap, detergents, candles and glycerine
1.75	56	Weatherproof outerwear
1.75	56	Radio and other electronic apparatus
1.74	55	Cardboard boxes, cartons and fibre-board packing cases
1.74	55	Lubricating oils and greases
1.73	54	Grain milling
1.73	54	Ordnance and small arms
1.72	52	Locomotives and railway track equipment
1.71	51	Household textiles and handkerchiefs
1.71	51	Mineral oil refining
1.70	50	Bacon curing, meat and fish products
1.69	49	Hosiery and other knitted goods
1.68	48	Gelatine, adhesives, etc.
1.67	47	Motor vehicle manufacturing
1.67	47	Building materials etc. not elsewhere specified
1.67	47	Manufacturers of paper and board not elsewhere specified
1.66	46	Motor cycle, three-wheel vehicles and pedal cycle manufacturing
1.64	44	Printing, publishing of newspapers and periodicals
1.63	43	Narrow fabrics
1.60	40	Men's and boys' tailored outerwear
1.60	40	Fertilizers and chemicals for pest control
1.60	40	Explosives and fireworks
1.58	38	Bread and flour confectionery
1.58	38	Scientific, surgical and photographic instruments, etc.
1.57	37	Agricultural machinery (except tractors)
1.56	36	Asbestos
1.56	36	Toilet preparations
1.55	35	Women's and girls' tailored outerwear
1.55	35	Pharmaceutical preparations
1.55	35	Biscuits
1.55	35	Other mechanical engineering not elsewhere specified
1.52	33	Abrasives
1.51	32	Insulated wires and cables
1.49	31	Miscellaneous stationers' goods
1.48	30	Fruit and vegetable products
1.46	29	Lace
1.45	28	Milk products
1.44	27	Other machinery
1.42	26	Gloves
1.42	26	Metal-working machine tools
1.41	26	Cement
1.39	25	Office machinery
1.38	24	Brewing and melting
1.37	23	Water supply
1.37	23	Spirit distilling and compounding
1.36	23	Animal and poultry foods
1.33	21	Wines, cider, perry and soft drinks
1.31	20	Watches and clocks
1.29	19	Overalls and men's shirts, underwear, etc.

Fires in areas of production (Cont'd.)

Index of fires	Equivalent fire frequency	Industry
1.28	19	Cocoa, chocolate and sugar confectionery
1.27	19	Margarine
1.21	16	Tobacco
1.17	15	Engineers' small tools and gauges
1.13	14	Electrical machinery
1.11	13	Mechanical handling equipment
1.10	13	Coke ovens and manufactured fuel
1.06	11	Industrial engines
1.05	11	Contractors' plant and quarrying machinery
0.90	8	Industrial plant and steelwork
0.68	5	Telegraph and telephone apparatus

Table 2

Fires in storage areas

Index of fires	Equivalent fire frequency	Industry
1.89	78	Wooden containers and baskets
1.85	71	Wedding, etc.
1.83	68	Pottery
1.79	62	Furniture and upholstery
1.79	62	Miscellaneous wood and cork manufacturers
1.73	54	Canvas goods and sacks
1.65	45	Jute
1.61	41	Miscellaneous manufacturing industries
1.58	38	Timber
1.58	38	Toys, games and sports' equipment
1.55	35	Plastics moulding and fabricating
1.54	35	Brushes and brooms
1.52	33	Other textile industries
1.52	33	Electricity
1.51	32	Footwear
1.50	32	Gas
1.50	32	Paper and board
1.50	32	Gelatine, adhesives, etc.
1.48	30	Bricks, fireclay and refractory goods
1.48	30	Manufacturers of paper and board not elsewhere specified
1.47	30	Abrasives
1.46	29	Rope, twine and net
1.45	28	Textile finishing
1.45	28	Cans and metal boxes
1.43	27	Woollen and worsted
1.42	26	Glass
1.41	26	Other printing, publishing, bookbinding, engraving, etc.
1.41	26	Paint and printing ink
1.40	25	Shipbuilding and marine engineering
1.38	24	Carpets
1.37	23	Sugar
1.35	22	Domestic electric appliances
1.34	22	Watches and clocks
1.33	21	Narrow fabrics
1.33	21	Cardboard boxes, cartons and fibre-board packing cases
1.33	21	Corsets, umbrellas and walking sticks, and other dress industries not elsewhere specified
1.33	21	Metal industries not elsewhere specified
1.32	21	Leather goods
1.31	20	Margarine
1.28	19	Soap, detergents, candles and glycerine
1.25	18	Leather (tanning and dressing) and fellmongery
1.25	18	Other electrical goods
1.23	17	Fur
1.23	17	Light and base metals
1.23	17	Insulated wires and cables
1.22	17	Household textiles and handkerchiefs
1.22	17	Steel tubes
1.22	17	Perambulators, hand-trucks, etc.
1.21	16	Hats, caps and millinery
1.21	16	Tools and implements
1.21	16	Wire and wire manufactures

Fires in storage areas (Cont'd.)

Index of fires	Equivalent fire frequency	Industry
1.20	16	Toilet preparations
1.20	16	Brewing and malting
1.18	15	Fertilizers and chemicals for pest control
1.18	15	Explosives and fireworks
1.18	15	Scientific, surgical and photographic instruments
1.17	15	Shop and office fitting
1.15	14	Iron castings, etc.
1.15	14	Lubricating oils and greases
1.14	14	Dresses, lingerie, infant's wear etc.
1.14	14	Radio and other electronic apparatus
1.13	13	Synthetic resins and plastics materials
1.12	13	Overall's and men's shirts, underwear, etc.
1.12	13	Grain milling
1.11	13	Mineral oil refining
1.11	13	Other chemicals
1.09	12	Linoleum, leather cloth, etc.
1.08	12	Production of man-made fibres
1.08	12	Cutlery
1.07	12	Jewellery, plate and refining of precious metals
1.06	11	Building materials, etc., not elsewhere specified
1.06	11	Motor cycle, three wheel vehicles and pedal cycle manufacturing
1.06	11	Milk products
1.04	11	Bolts, nuts, screws, rivets etc.
1.04	11	Animal and poultry foods
1.03	11	Fruit and vegetable products
1.03	11	Wines, cider, perry and soft drinks
0.99	10	Railway carriages and wagons and trams
0.98	10	Miscellaneous stationers' goods
0.98	10	Bacon curing, meat and fish products
0.97	9	Iron and steel (general)
0.97	9	Textile machinery and accessories
0.95	9	Polishes
0.95	9	Bread and flour confectionery
0.95	9	Other machinery
0.93	9	Asbestos
0.92	8	Motor vehicle manufacturing
0.92	8	Dyestuffs
0.89	8	Pharmaceutical preparations
0.89	8	Other mechanical engineering not elsewhere specified
0.88	8	Hosiery and other knitted goods
0.88	8	Women's and girls' tailored outerwear
0.85	7	Gloves
0.85	7	Coke ovens and manufactured fuel
0.85	7	Cocoa, chocolate and sugar confectionery
0.83	7	Printing, publishing of newspapers and periodicals
0.82	7	Cement
0.81	6	Weatherproof outerwear
0.79	6	Biscuits
0.78	6	Telegraph and telephone apparatus
0.76	6	Office machinery
0.75	6	Water supply
0.75	6	Locomotives and railway track equipment
0.72	5	Men's and boys' tailored outerwear
0.70	5	Mechanical handling equipment
0.67	5	Vegetable and animal oils and fats

Fire in storage areas (Cont'd.)

Index of fires	Equivalent fire frequency	Industry
0.64	4	Aircraft manufacturing and repairing
0.62	4	Industrial engines
0.59	4	Ordnance and small arms
0.47	3	Spirit distilling and compounding
0.39	2	Electrical machinery
0.29	2	Industrial plant and steelwork
0.26	2	Lace
0.10	1	Agricultural machinery (except tractors)
0.09	1	Tobacco
0.04	1	Contractors' plant and quarrying machinery
-	-	Metal-working machine tools
-	-	Engineers'