

# INSURANCE PERSPECTIVE: CAUSES AND EFFECTS OF INDUSTRIAL FIRES

By  
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## Abstract

*Fires do not simply happen. They are almost always caused by a hazardous act. Lack of suitable written material on different causes of fires that have occurred in Tanzania makes it difficult to diagnose and suggest appropriate remedial measures to prevent their recurrence in future. Faulty approach by experts in identifying and analysing causes of fires has also rendered the exercise to establish causes of fires to be mere guess-work. The "cause unknown" syndrome has invariably featured in most reports submitted by Insurance Fire Loss Adjusters and Assessors. The National Insurance Corporation of Tanzania has not kept appropriate statistical records on causes of fires which is a problem likely to militate against making appropriate decisions aimed at fire prevention and control.*

*The effects of fires are, however, always immense. Fire affects not only the person whose property is destroyed but also many others such as traders, creditors, employees, members of the public, and the Government. Property worth billions of Tanzania shillings has been destroyed between 1978 and August, 1995. Although the owner of such property may be properly reimbursed by insurance physical items destroyed by fire are a loss to the national economy and labour and materials must be expended to replace them. There is not only loss of the property but also the consequential loss should be considered, such as the interruption of normal production.*

## Introduction

Since early times fire has been one of man's greatest aids to his advancement: It gives him a source of both heat and light. "Today fire is still of great benefit to men's well being if it is controlled, but if allowed to start and spread without control it can be one of the greatest hazards man has to face"<sup>1</sup>

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Fire has no respect for persons or place: it can and does break out in all forms of buildings. Industrial Fire outbreak is a monster. It may dislocate the economic activities of industry which in turn may affect the national economy. Even if there would be insurance to pay for the financial loss yet the property and goods are lost to the nation. Still further, the nature of manufactures may militate against rehabilitation due to uncertainty to regain supplies or customers and skilled workers. Where it would be possible to reinstate the business it does not easily come-by. Lack of building materials and price hikes may entail a protracted period of construction.

Fire losses on a large scale threaten the national economy and the only recourse to contain these incidence is to aim at industrial fire safety. But the fact that the Central Bank head office building could burn right from ground floor to the top means that the nation is unguarded against the risk of fire. The tragedy of the Bank of Tanzania building that went ablaze in May, 17, 1984 should serve as warning to all of us that something is amiss in our management system. Another terrifying fire took place at the Arusha based MB Textile, which occurred on August 1, 1982. The Banco Products of Dar es Salaam sustained three fires in a spell of seven years. What is the cause of these fires. Do we know the total number of fires that have affected industry and the consequent sums of money that have been spent in replacing property destroyed by fire? The trend of fires in Tanzania has continued unabated.

Although the Law regulating industry (Factories Ordinance) is adequate, lack of compliance by the Factories Inspectorate is in part responsible for encouraging laxity among industrialist thereby slackening efforts for the intended fire prevention and control. For example, some factories have not been inspected since their inception. According to Mr. Mwambipile, "there has also been very minimal efforts on the part of the Inspectorate to take to court those found infringing the law"<sup>2</sup> The issuance of the certificate of occupancy to factories which is a critical requirement is, in some case done without involving others interested in fire prevention and or control such as, the Fire Brigade, Factories Inspectorate and Insurance business.

**Purpose:** This paper aims at providing an indepth analysis of the different causes of fires generally and in particular those causes which have contributed to industrial fire losses. The paper provides an overview of the effects of fires especially as most of the victims of the fire risk depend on insurance indemnity to sustain their businesses following a fire loss.

## 1. Causes of fires

Any study of fire causes would be incomplete if the fire hazards are not considered first. A fire hazard may be defined as any material condition or act that will contribute to the start of fire or will increase the extent and severity of a fire<sup>3</sup> In other words, a fire hazard is a term which includes not only the causes of fires but also embraces those circumstances which increase the probability of a fire occurring or which enable or permit fires, once started, to spread and increase the resultant loss<sup>4</sup> In order for fire to occur the three essential elements namely oxygen, fuel, and heat, must all be present. While nothing can be done to control the oxygen supply under normal conditions, heat and fuel supply can be controlled by removing to a safe place any fuel supply sources, such as waste and other ignitable materials. Also by keeping naked lights or flames, etc. from the fuel sources possible ignition may be avoided.

The presence of any material that will ignite when heat is applied is a fire hazard in so far as there will be present any source of heat or light, such as a burning candle. The fuel side includes such things as liquids, gases, solids, etc. Basic causes of all fire hazards are threefold:

- i) Violations-this may be brought about through ignorance, criminal neglect, and apathy.
- ii) Deviation -this results from environmental accessibility, production requirements, and other economic factors.
- iii) Inherent problems - caused by occupancy process, location and improper standards.

### 1.1 Types of Fire Hazards

There are several types of fire hazards, but for the purpose of this paper only nine will be briefly discussed:

1.1.1 Hazards of occupancy: All processing activities in a factory give rise to occupancy hazards. People and machinery when in direct contact give rise to a process of activities. People cause a hazardous act while machinery cause a hazardous condition. It is, therefore, not uncommon to talk of common and personal hazards. The former are likely to be found in almost all occupancies and include such things as heat and lighting, general housekeeping conditions, power used, storage arrangements etc. Personal hazards involve the subjective characteristics of people around, e.g. individual traits, habits, management style, etc.

1.1.2 Special hazards: Since each factory is different, the trade processes for each are also distinct from each other, and these may give rise to a peculiar fire hazard which may not necessarily be found in other factories.

1.1.3 Target hazards: A target hazard is a condition, facility or process which would produce or stimulate a fire that would involve a possible large life loss involving a large concentration of materials of high monetary value. Target hazards embrace all places where there is accumulation of property of high value, or material that is amenable to catch fire easily. They also embrace warehouses and similar storage buildings. A storeroom which keeps materials together with dangerous chemicals is an example of a target hazard.

1.1.4 Exposure hazards: The neighbourhood in relation to the fire risk is an example of exposure hazards. Especially important would be the activities carried on in the neighbourhood, distance between buildings, nature of construction of building etc. A much more congested area makes the risk of exposure hazard to be greater than where a building is located in an open and widely spaced environment.

1.1.5 Conflagration hazard: This refers to sweeping fires that spread beyond control and over a considerable area crossing natural or prepared barriers and destroying any building. The Great Fire of London (1666) was an example of sweeping fires. The then London town was engulfed by fire from a bakery which spread to nearly the entire town, and destroyed over 13,000 buildings covering an area estimated to be 85% of the whole town".<sup>5</sup>

1.1.6 Hazards of materials: Most products are converted and treated with some chemical elements while others are, themselves, chemical products. Depending on temperature and storage arrangements, many chemical products and materials are prone to varying chemical reactions due to their flammability and reactivity when kept either in the open closer to other materials. Unless they are properly labelled and carefully handled, they may be a snare to both life and property. Most products in Tanzania are not properly labelled to warn or instruct users as to how to use them. Sometimes even medicinal bottles in hospitals are kept without proper labels.

1.1.7 Hazards of buildings: Materials used in construction have an important bearing on the fire hazard. Much timber and other easily ignitable materials all constitute a fire hazard. A structure intended for industrial use should be firm enough to withstand a fire. Certain materials such as steel and reinforced concrete can withstand any conceivable amount of heat for one hour or so,

while timber will only do so for half an hour only or less. To prevent fire from spreading internally, a strong party wall or a perfect party wall must be constructed. Also a building must have a hard roof and concrete floor. To prevent the fire attack from outside, the outer walls must be hard enough to resist any easy collapsing.

The significance of a hard roof cannot be over emphasized. A roof may spread fire by: (a) dropping burning articles (b) radiating heat from the underside and causing ignition on materials below, (c) allowing penetration from below and thus, igniting combustible materials in the outer surface (d) exposure from fires in other buildings, and (e) spreading of fire laterally at roof level.

It should be noted that the first essential of a fire resisting building is that the structure itself should not burn. Most buildings, whether they are shops or factories, warehouses or dwelling houses, have some contents which are combustible in greater or lesser degree. If, however, the building itself will also burn, then, quite obviously, there is a greater possibility of a fire spreading rapidly and getting out of control.<sup>6</sup>

1.1.8 Wastes and records: Wastes and record files or other paper may also endanger the premises if not properly handled. Regular sweeping and proper disposal of wastes as well as proper record keeping is likely to avert the danger of fire.

1.1.9 Machinery hazards: Very common hazards with machinery are: overheated bearings friction caused by belts and other mechanical parts, electrical and mechanical sparks.

Overheating bearings may be due to insufficient lubrication, faulty assembly or the presence of fire dusts, overuse and lack of proper maintenance.

Friction caused by belts arises from continuous use of machinery rendering exhaustion of belts. Sparks may be caused by constant movements of mechanical parts by rotation or otherwise thereby causing wear and tear which may produce sparks in the process. Electricity may also produce sparks through leakage.

Inspections, maintenance and lubrication are the only precautions against machinery hazards. Lack of knowledge of what a fire hazard is and

how to eliminate it is a critical issue to many people. Fire loss would not be that much serious if there were no fire hazards around. Even the fire outbreak would be very much discouraged ~~where there are no fire hazards. A fire insurance risk surveyor should never~~ compromise with the owner of premises where there are many fire hazards. Nor should the fire insurance underwriter issue a policy until the hazardous condition has been eliminated. Resurveys should also be made in order to ensure that everything conforms to insurer's terms and conditions of the policy. Reliance on fire warranties has proved ineffective owing to inability to prove a breach for various reasons.

## 2. Fire causes

It is important to ascertain the causes of fires so that they can be eliminated. But the critical issue about this matter is how to establish them. It is so difficult an exercise that most insurance Loss Adjusters record it as "Cause unknown", and even records from the government sources suffer from the "cause unknown" syndrome.

Since many fire outbreaks are listed as "cause unknown", it has been very difficult to list down remedial measures to prevent future recurrences. The problem is not mainly due to the fact that causes are unknown but rather, due to lack of techniques on the part of experts in diagnosing them.

Possible causes of fires are too numerous to list. An attempt has been made to classify them into four broad categories, viz: mechanical; electrical; natural and human agency. It has also been natural to identify, arrange, and analyse them on the basis of the manner in which they result in fire outbreaks.

### 2.1 Mechanical Fire causes

There are four distinct types of mechanical causes of fire: Breakdowns, friction, overheating, and explosion.

#### 2.1.1 Mechanical breakdown

Insufficient lubrication maintenance of machinery may lead to mechanical breakdowns. Also dust and damp in the windings and other insulated portions often lead to explosive breakdown: in both cases fire may ensue.

### 2.1.2 Friction

The wobbling of mechanical surface during the functional process may lead to severe friction. This may also increase wear and tear whereby parts are torn apart. In both the case sparks may be emitted which may fall onto ignitable property and cause fire. But the major risk is that of mechanical breakdown with consequent fire outbreak.

### 2.1.3 Overheating

Electroplates may be overheated by excessive loads of electrical supply and burn. Coils of electrical wires may also fire up if they excessively shoulder an electrical current and this may result into electrical short circuiting. However, overheating effects the strength of metallic parts which may eventually breakdown.

### 2.1.4 Explosion

Any sudden mechanical outbreaks of a mixture in the air is explosion. There are many things which are liable to a sudden mechanical outburst but it is intended to take into consideration only gas and dust explosions.

2.1.4.1 Dust explosions are due to material dusts held in suspension in the air in the form of a cloud. If this comes in contact with oxygen combustion is possible and contact with any source of heat would give rise to a serious explosion.

2.1.4.2 Corn mills e.g. the ailing National Milling Corporation, Sugar Factories as well as wood and other dust-emitting operational plants are, but some of the environments within which dust explosions are obvious.

Gas explosions also behave similarly as dust explosions, except that most gases and vapours are heavier than air and will tend to flow into pits and drains where concentrations may build up to dangerous levels. Contact with any source of heat or light may lead to a thunderous explosion.

## 3. Electrical fire causes

Electricity is now a source of power and is so used nearly every where, in urban as well as in rural areas and finds its greatest use in industries to turn the

wheel, to illuminate, to heat, and to be put to a host of other uses. Moreover, is cheaper than other forms of powers and it is safer to use than say, gas.

It is intended here to discuss briefly three main electrical fire causes, namely naked wires, worn out insulators and over-heating.

### **3.1. Naked wires**

This is the cause of short circuiting arising from coming into contact of the three wires thereby blocking the flow of current. Electrical sparks would start shelling around and may fall onto some ignitable property causing fire.

### **3.2. Overloading**

An electrical circuit should be made to take more current than it is designed for. The resultant heat may melt the insulation hereby exposing wires and rendering them naked. The connecting of many plugs or adaptors to one socket may also generate abnormal heat due to unnecessary overloading of electrical current in too small wires.

### **3.3. Worn-out insulator**

An insulator is meant to oppose the flow of electricity in whatever direction; as such, it is a non-conductor of electricity and causes it to flow along metal wires to required appliances.

Excessive pressure, overheating, old age, dampness or mechanical damage will cause the insulation to break or pill off and permit leakage of electrical current. Wire insulation has in the past decade or so been a serious problem and a cause for concern in Tanzania. Electricity was left to flow through very old wiring system and/while wires were not changed for many years to the detriment of people's lives.

## **4. Natural causes**

Lightening and spontaneous combustion are some of the examples to be discussed here:



## **4.1. Lightning**

Encyclopaedia Britannica 1968 vol. 14 defines lightning as: any of the various forms of visible discharge of atmospheric electricity. For lightning to occur there must be a production of electricity and separation in space into centres carrying positive and negative charges. When lightning strikes several phenomena occur caused mainly by the current surge of the return stroke. Forces associated with the pinching section of the strong magnetic fields can crush hollow conductors. Immediate damage to buildings is small, but heavy currents may pass along wires and such accessories of civilization as telephones, and electrical equipment are therefore particularly vulnerable.

## **4.2. Spontaneous ignition**

Any substance which has chemical oxidizing properties absorbs air moisture; oxygen in particular, and heat is generated, and at a certain temperature oxidization becomes rapid and ignites into visible flame. Oily rags may result into self ignition provided they accumulate for a long time. A number of inorganic chemicals like chlorates and some of the nitrates, while not themselves inflammable, can react violently with organic substances to start a fire. Particularly dangerous are the peroxides, such as hydrogen peroxide used in dilute solution as a bleach or dye in manufacturing of cloth. It is a strong oxidizing agent and spontaneous ignition is possible when in contact with other substances.<sup>7</sup> Other materials liable to spontaneous combustion are coal, hay, rapeseed, tobacco, etc.

## **5. Human Agency**

People are the number one cause of fires. It is their mistakes or negligence or undue bad moral hazard that can cause a fire. They are though, if properly trained, can prevent or minimize the occurrence of fires.

The broad categories through which loss due to fires attributed to human action are: negligence, bad management, and Arson.

### **5.1. Negligence**

It is duty of care and a breach of this duty that results in injury to the person. It is owed duty that constitutes negligence. In factory where there are several workers some skilled, others not etc., mistakes may be committed at

one point in time or another. Such mistakes may at times have devastating consequences.

## 5.2. Bad Management

It is difficult to provide the exact meaning of bad management but it must include the unsatisfactory way in which the business is carried on and the poor condition in which the premises are maintained. The condition of the factory reflects the character of those controlling it in the same way as the conduct of employee matches the behaviour of the employer.<sup>8</sup>

Any tendency to allow the building to fall into a poor state of repair are sure signs of bad management which also suggest that other more obvious matters are neglected. Overcrowding and congestion not only lead to possible occurrence of fires but also, owing to the concentration of materials or machinery, enable a fire to burn more fiercely and render it more difficult to locate and extinguish. It also reduces possibilities of salvaging stock or machinery. Supervision of work people requires proper control and can only be achieved if the management maintains a good and sound relationship with them.

## 5.3. Arson

The term arson may be defined as the wilful and malicious burning of property of value whether it is the property of the arsonist or that of another.<sup>9</sup>

The number of known or suspected arson fires in Tanzania is not officially; yet such cases no doubt exists. In the United State of America losses of 2 billion dollars were recorded in the year 1976 and the National Commission of Fire Prevention and Control submitted in its report, "America Burning States", that Fire Chiefs believe almost half of all fires in their experience have been set. The crime of arson perpetrated by both organised criminals and private property owners was reaping an annual harvest estimated in excess of a billion dollars a year from insurance companies, according to the report.

Fires which are incendiary in origin have been found to have received an impetus by (a) accelerant, such as a petrol jelly can stored in building or an inflammable gas container which can easily be removed. Other flammable chemicals have also been used. In each case they would normally be found in places not ordinarily intended for their storage. (b) Electricity, whereby electrical wires are so connected as to result into fire at intended times. A possibility also exists where an outsider agitated by any motive throws a burning piece

through an aperture, or oxidising chemical which would erupt into fire after few hours. This would be possible where particular premises have a near-by main or side road or passage-way since this would not hinder anybody approaching the walls to slot in a dangerous material.

Motives of arsonists are many but only two will be briefly discussed in this paper:

### 5.3.1 Money Making

a) Individual owners of property themselves may set fires in order to collect insurance indemnity money to pay off bills and debts, such as a credit loan; to liquidate a mortgage loan; a desire to relocate a business that has out-grown existing facilities or to simply avoid impending failure or bankruptcy; or by the insurer to cancel the policy etc.

b) Fires set for economic gain: such as by a Mortgagee who desires to liquidate the mortgage; a competitor seeking to eliminate a rival in business; etc.

### 5.3.2 Vandalism, revenge, jealous, and pyromania

These include racketeers intimidating businessmen; hateful revenge, committing a crime either to eliminate a person or to cover up evidence of burglary, theft or pilferage; sociopolitical purposes, e.g., fires set to focus attention on their cause or to force recognition of their demands; "pathological persons such as those who set fires for thrills, sexual relief, or those who are simply pyromanic or mentally retarded, senile or insane."<sup>10</sup>

A more serious form of arsonists are those organised syndicate criminals who train and sponsor culprits to set ablaze insured buildings in case it is to gain from insurance money. If it stems from sociopolitical motive, then a building would be set ablaze not for any economic gain but for sabotage. In the United States of America there are organised syndicate criminals who have established themselves as professional criminals"<sup>11</sup>

## 6. Effect of fires

Fire causes damage or destruction to property. It is not the flame alone; heat, smoke, falling walls, explosion, exposure to the open, materials used in extin-

quishing a fire and the action by fire brigade, all contribute to a loss by fire in the following ways.

6.1 Flame attacks combustible materials such as wood, plant, electrical insulation, wallboard, records, etc. Fire flames can burn anything given sufficient time.

6.2 During a fire, intense heat is generated and this is an essential element for fire to spread through conduction, convection, or radiation. More damage is done by heat than flame. Different types of materials behave differently under heat conditions. Some materials sag or collapse, others, such as glass crack even at relatively low temperature while paint softens and blisters. Metal and metal sheets expand and twist while wood shrinks slightly on losing moisture.

6.3. Smoke: Incomplete combustion is responsible for smoke. Paul Thomas<sup>12</sup> reported that there are two kinds of smoke that occur during a fire, (a) hot smoke which is relatively close to the damage is caused by hot smoke because it penetrates porous surfaces and when in contact with cool surfaces it condenses, leaving heavy stains of tar and resins. Pungent smoke odour is always smelled as a consequence (b) Cold smoke is carried some distance away from the fire and in the process it cools and condenses in the air before it reaches the areas or surface which catch fire easily and will also dirty materials.

6.4 Fire brigade: Fire chiefs may have to blow up other buildings not on fire in order to prevent a conflagration or to gain entry. Glass may be smashed open, windows or skylights may be chopped through a roof to let out smoke and heat, floors may be chopped through in order to trace the cause of the fire or to drain water down floors, etc.

6.5 Extinguishing agents: Electric cables and conductors in walls or floors may suffer damage from wetting. Water may cause electrical shock when in contact with electricity, while chemicals may stain or discolour decorated surfaces.

6.6 Falling walls; Walls left in a weakened condition may fall on surrounding property and cause or increase damage. This may cause third party property damage with consequent legal suit being instituted.

6.7 **Explosion:** things such as sealed drums or other cylindrical items not themselves explosive, yet due to expansion by intense heat may explode. Thus as already noted, soot or fumes, chemicals, gas and dusts are all liable to explosion.

6.8 **Exposure:** Some property may be damaged whilst lying exposed in the open after it has been removed from a burning building. Damage may be due to rain, wind, falling fragments or the auctions of people, etc.

## **7. Parties affected by fire**

Everybody is affected by fire loss. Property owners, employees, members of the public, insurers, and the government, all get affected in one way or the other.

7.1 **Property Owner:** The effect of fire on the property owner or industrialist is one or more of the following:

7.1.1 **Loss of production:** The industry may lose production pending rehabilitation with the consequent interference with the volume of production or turnover.

7.1.2 **Loss of property:** The building(s) and, or machinery may be severely damaged/destroyed entailing reinstatement and or replacement. Most of the component parts of reinstatement or replacement have to be imported and require foreign exchange to import them which item is scarce as far as poor countries like Tanzania are concerned.

7.1.3 **Recovery from Insurers:** Depending on the fire insurance policy terms and conditions, the insured may or may not be able to recover by way of indemnity from his insurers. Where it is possible to recover, the insurance money would act as a fresh capital which may be used for rehabilitation purposes.

7.1.4 **Liability Loss:** Property of third parties or their lives may be affected by fire with consequent legal suits against the property owner. Where the defence fails compensatory damages are usually heavy.

In the absence of insurance protection or repudiation of claims by insurers to pay on account of breach of a vital condition or term of the policy, the insured would have to make good the loss from his own resources which may prove to be too burdensome.

7.1.5 Loss of customers: In a competitive market it is not uncommon to find customers shifting their loyalty to other producers especially if there is likely to be a protracted period of business rehabilitation.

7.2 Employees: To reduce administrative costs when there is no production, workers may have to be laid off. The loss of a job has impact on employees' livelihood. The family may suffer from: starvation, loss of clothing, shelter, school fees, health services, other enjoyments of life, etc. Another impact is loss of lives following fire outbreak: employees may be caught in and die or be incapacitated owing to fire.

7.2.1 Members of the public: These may be affected by fire causing death or bodily injury or their property may be damaged. Another important aspect is loss of employment opportunity as well as deprivation of products or services which used to satisfy their needs and wants.

7.2.2 Impact on insurance premium: Frequent and severe fire losses may threaten the insurance fund which may have to be replenished by way of increased premium rates: As insurance premiums become more expensive, people may not afford insurance and thereby miss a vital protection which society requires.

7.2.3 The Government: An operating industry earns the Government revenue through taxation as well as foreign exchange if the products can be exported. Other sources of Government income come from employees' taxes on their wages.

## Conclusion

In recent years many fires have occurred in Tanzania and their impact have differed from the fire that gutted down the Arusha Based M.B. Textile factory to that of the Bank of Tanzania Head Office and the NASACO buildings. The Arusha M.B. Textile disaster apart from causing loss of property, also set a precedented death toll record of people. The Bank of Tanzania traged destroyed all records and a substantial part of the building structure. The NASACO building fire was also unique in that every tenant was affected from ground floor to the roof top.

In all these huge fires insurance arrangements, were either inadequate or non-existent. Risk awareness through industrial drills is almost ignored let

alone the issue of risk management and disaster planning which are unheard of in Tanzania.

Nobody is very sure of the causes of all these fires owing to inadequate knowledge and skills in understanding and identifying the true cause of fire. A fire cause involves three controllable conditions: the fuel supply; the heat source, and the hazardous act. A fire is caused when the fuel supply and the heat source are brought together by some hazardous act. Fires are frequently reported erroneously because the reporter fails to consider all these factors. For example, a cigarette carelessly discarded, which ignites a pile of trash could be reported as cigarette fire in one instance, and as a rubbish fire in another.

Neither of the two is the cause. The real cause is carelessness by the smoker. Fire insurance claims loss adjusters and underwriters should be very clear on this aspect and should co-operate with other institutions like the Fire Brigade Officials in order to lessen the risk of losses by fire.

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