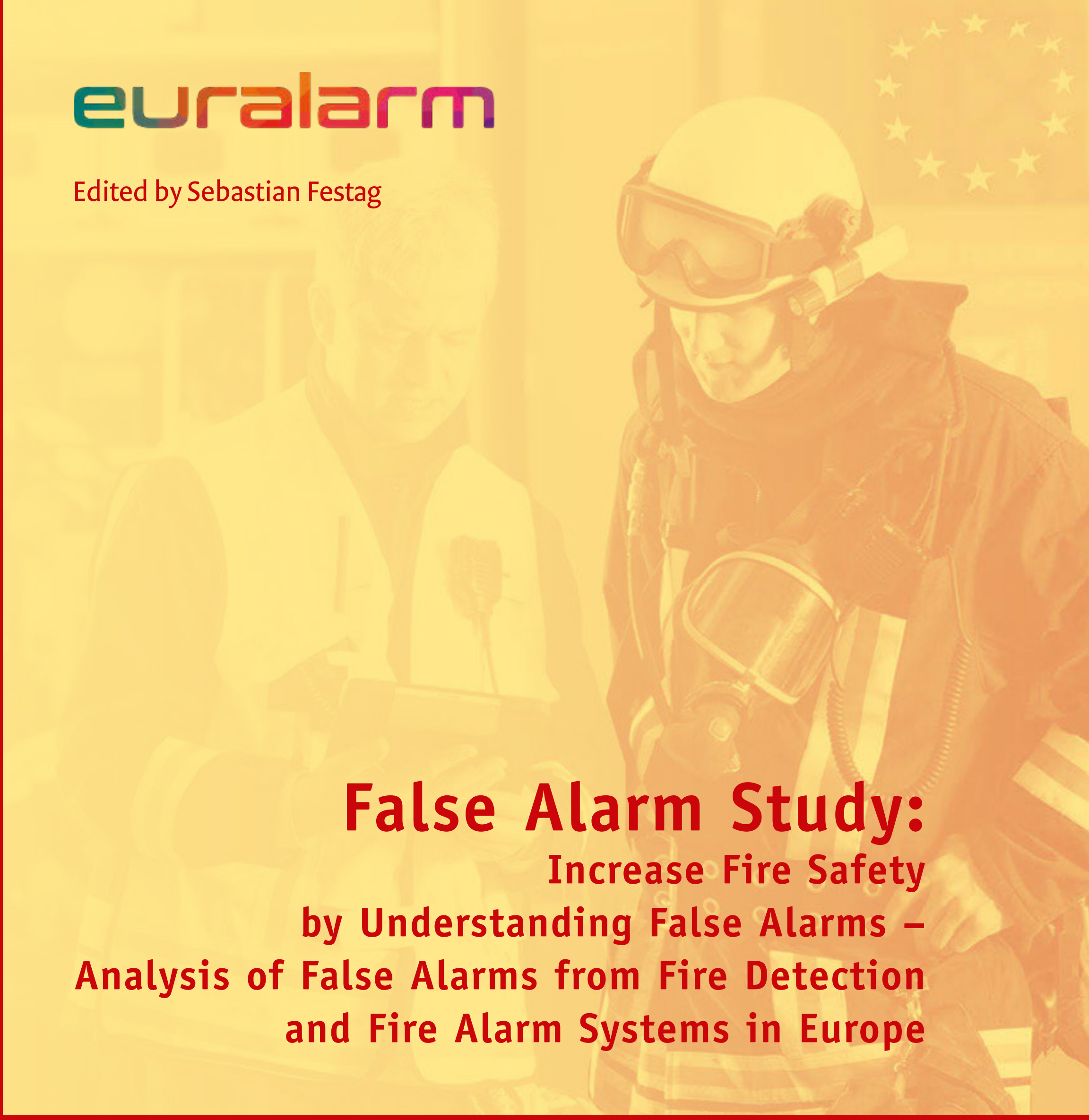

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Edited by Sebastian Festag

False Alarm Study:

Increase Fire Safety by Understanding False Alarms – Analysis of False Alarms from Fire Detection and Fire Alarm Systems in Europe

2nd, revised and expanded edition

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False Alarm Study:

Increase Fire Safety by Understanding False Alarms – Analysis of False Alarms from Fire Detection and Fire Alarm Systems in Europe

Edited by

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About Euralarm

Euralarm represents the electronic fire and security industry, providing leadership and expertise for industry, market, policy makers and standards bodies. Our members make society safer and secure through systems and services for fire detection and extinguishing, intrusion detection, access control, video monitoring, alarm transmission and alarm receiving centres. Founded in 1970, Euralarm represents over 5'000 companies within the fire safety and security industry valued at 67 billion Euros. Euralarm members are national associations and individual companies from across Europe.

Foreword (First Edition) by Enzo Peduzzi

Since Euralarm was founded in 1970 by pioneers in modern electronic fire detection, quality of products and reliability of the systems were the declared aim of the newly established association.

For the founders it was clear, that only if the systems installed at the customer's facilities were living up to their expectations, the new technology would have a chance to succeed.

Therefore, the reliability of fire detectors to detect a dangerous event was a big concern right from the beginning and the frequent false alarms nearly forced the engineers to abandon the new technology in its infant stage. Products and systems where soon improved and the credibility in the new technology was restored. Nevertheless, to guarantee the sustainability of the improvements, Euralarm and its members had to engage in the development of international standards which define the minimum level of quality and performance for the products and systems. At that time this was a "heroic" task since nobody had experience with the installation and operation of fire alarm systems. As we know today, the effort was successful!

Based on this success, the number of installed fire detectors in the world grew rapidly and the field of application expanded dramatically. With this, however the number of false alarms started to grow again. What went wrong? Experts in the industry soon recognized, that quality and reliability of fire alarm systems were not only a question of product quality but, or even more, on how and where the products are installed and operated.

After the development of product and systems standards, application standard have been developed. In a recent third step, the family of standards has been complemented by a service standard, which defines minimum quality requirements for the design, installation, operation and maintenance of fire alarm systems.

Thanks to this, the fire alarm industry is one of the best regulated in the world and respected by the various stakeholders including fire brigades and first responders.

An earlier study showed that the efforts have not been in vain. The quality and reliability of the products and systems has increased dramatically due to new and more sophisticated technologies, but also to the increased awareness for the proper installation and the increased competence of the personnel involved.

However, this new study shows that there is still a long way to go and there is room for improvement at all levels. In particular it highlights the different definitions of false alarms across the Europe. It also underlines the need to establish common terminology and methods to collect and analyze data on fire alarm events so as to come to new insights that would lead to changes in product characteristics or appliation & maintenance guidelines. To improve this situation an international standard should be considered.

Euralarm and its members remain fully engaged in adapting standardization and driving quality and reliability of products, systems, and installations to meet the demand of the users.

Enzo Peduzzi
President – Euralarm

Foreword (Second Edition) by Martin Harvey

The world around us is changing rapidly. New tools, communication methods and technologies are introduced on an almost daily basis. It affects our society in many ways and causes a transition in the way we communicate, commute, work and live. What did not change is the importance for people to live, work and travel in a safe and secure environment.

Besides the technological developments there is also a green wave going across Europe. The Green Deal reinforces the trend towards electrification and reduced emissions and calls for more attention for hazardous substances. This will not only create new challenges on the fire safety side but will also make reliable systems even more important. Together with its members Euralarm has been working for over 50 years to contribute to a more safe and secure environment.

A lot has been done to ensure that homes, buildings and public places are equipped with fire safety systems to create this safe environment and give people and alarm responders the opportunity to react in an early stage on an incident.

In the background Euralarm members have contributed to the development of many of the fire and safety standards commonly used across Europe . Today a complete family of product, system and services standards make our fire safety industry one of the best regulated in the world and respected by various stakeholders. Next to protecting people and property there is now also more attention for the positive impact fire safety systems can have on the environment. In this area early detection and action can prevent the big negative environmental impact that fires can have on the environment.

With the increase in the number of fire safety products and systems installed it is important to ensure that these products and services meet requirements through regulation and European standards.

However, with the increase in the number of systems we have also seen that the number of unwanted / false alarms have increased as the fire detector population has grown. False and unwanted alarms can have a negative impact on both people and alarm responders. Analysing the root causes of this is essential for the effectiveness of any fire detection and alarm system. This analysis is the foundation of the activities carried out with key stakeholders to continuously improve the alarm system.

After publishing the first full study in 2018 the data and recommendations for improvements have now been updated in this second edition of the false alarm study. It once again underlines the importance of understanding how false alarms are created. That understanding will help to reduce the false positive alarms and will ensure that the people and alarm responders timely can take the necessary action.

Euralarm and its members remain fully committed to support the quality, reliability and performance of fire safety products, systems, and services to meet the demands of the users.

Martin Harvey
President – Euralarm

Foreword (First Edition) by Dominique Taudin

Since 1970, the Fire Section of Euralarm is the voice of the European manufacturers of Fire Detection and Fire Alarm Systems who are committed to enhance fire and life safety in buildings. Over the past decades, our members have been actively involved in European and International standardization of their products – the components of a Fire Detection and Fire Alarm System – but also in standardization of the performance of the system itself. We estimate that more than 200 experts participate in the various technical committees developing those standards.

Undoubtedly, this investment from our members – complemented by third-party certification of the products to demonstrate conformity with the standards – has considerably improved the quality and reliability of our systems. This was necessary but not sufficient to guarantee a high level of reliability of the systems operating in buildings. Quality of the design, of the installation and of the maintenance of Fire Detection and Fire Alarm Systems is crucial to ensure the highest level of operational reliability of increasingly complex systems. Therefore, application standards and Codes of Practice complementing product standards have also been developed by our members in cooperation with other stakeholders: customers, contractors, installation and service companies, fire brigades, approval bodies, etc. ...

While acknowledged that Fire Detection and Fire Alarm Systems don't cause false alarms, mismanagement or improper maintenance of these systems can dramatically increase the false alarm rate that our customers – and also first responders – have to cope with.

When the Fire Section of Euralarm decided to create a dedicated group of experts to address the concern of false alarms, the objective was to identify the main causes of false alarms and to propose changes in product, installation and maintenance standards to resolve the problem. While the overall objective remains unchanged, one of the first findings that we present in this study is that there is no common methodology to quantify the false alarm rate. Even the definition of a so-called "false alarm" varies from one country to another.

Euralarm supports the development of quality and performance standards substantiated by scientific research and data collection. In the case of false alarms, this study demonstrates that the problem cannot be properly addressed without commonly agreed – in other words standardized – definitions and data collection methodology.

Dominique Taudin
Vice-President, Fire Section Chairman – Euralarm

Foreword (Second Edition) by Lance Rütimann

Since the 1950's, the use of automatic fire detectors has increased year on year into every kind of infrastructure. Through the decades, technological developments have brought about detectors that can sense combustion gases or flames along with smoke or heat. The application of such technology has made early detection of fires the norm, at least in commercial and industrial buildings. Building occupants can safely evacuate, and intervention forces gain precious time to stop the fire from growing. This status is important to remember. Every fire detection and alarm system is designed and operated with the purpose to protect lives and property from the devastating consequences of a fire and its by-products.

As with any early warning system, there can however be times when an alarm is triggered, even though there is no event; a false positive. Detecting phenomena such as smoke and heat is quite simple. The true challenge for any fire detection and alarm system designer or service engineer is getting the right balance of detection and alarm between as "early as possible", and as "early as needed". The introduction of microprocessors more than 20 years ago enabled fire detectors to analyse the physical phenomena in its environment and look for fire patterns. Modern detectors are much better at tuning into a real event whilst ignoring false events. Compared to former threshold type detectors, this has significantly reduced the number of false (or unwanted) alarms by at least two thirds. But technology alone cannot eliminate false positives.

Other key factors must be considered to increase the overall "alarm reliability" of a fire detection and alarm system. These are design, commissioning, and maintenance. If these are overlooked, then the alarm reliability degrades, and the system will not meet its intended purpose of protecting lives and property. As the building use is adapted to the needs of the occupants, so must also the design and maintenance be accordingly adapted, to secure the alarm reliability.

Fire services capture the information on the cause and location of fire alarms during their intervention. It is the responsibility of the building owner or operator to discuss false activations with their fire alarm system supplier and service provider. In doing so, recommendations can be made that even heighten the quality of the system.

The study you have in front of you is focusing on the statistical data of fire alarms, moreover the methodology in the collection and evaluation. Anyone studying the data of the different countries comes to the same conclusion, that there is no unified approach. This greatly hinders comparisons, which are invaluable when trying to better understand the overall situation and develop effective and simple countermeasures against false fire alarms. This 2nd publication will be the basis to help guide the industry and its stakeholders towards a more uniform approach across Europe, by working together with the European standardisation Technical Committee 72 to implement a common technical language.

The authors and contributors encourage all stakeholders to work towards the further reduction of false fire alarms. The study in front of you will help to do so.

Lance Rütimann
Vice-President Euralarm & Chair Fire Section

Preface (First Edition) by Sebastian Festag

The present *False Alarm Study* is the result of a 3-year empirical work by the Euralarm Task Group on *False Fire Alarms*. In hazardous situations, it is crucial to alert those affected and intervention services. In some cases, however, there is a lack of evidence of any hazard at the location of the incident. We refer to such cases as false alarms. There are many different causes for false alarms and the phenomenon is widespread. They occur, for example, in alarm and early warning systems, people screeners, in the diagnosis of diseases, in journalism and in politics.

The Task Group investigated the issue of false alarms in fire detection and fire alarm systems in several European countries. The material was carefully collected and objectively processed, using a comprehensible basis, to achieve comparable calculations and identify trends and risk priorities. For the first time, facts and trends relating to the issue of false alarms in fire detection and fire alarm systems, with a view of several European countries, are presented and made available to an international audience. The study provides fundamentals relevant to the fire safety industry concerned, but also to fire departments, associations, insurance companies, testing facilities, planners and installers, building operators and science.

I thank the members of the Task Group for their dedication (in alphabetical order): Jan Blomqvist, Kjell Ericsson, Lance Rütimann and Graham Simons. They established contact with the responsible institutions, associations and people in their countries, prepared and supported meetings, and critically examined the data material and texts. I would especially like to thank Lance Rütimann. He is an outstanding expert and networker, and has supported me with his help and advice in many matters of detail, right to the end – this result would not have been achieved without him.

I would also like to thank the Advisory Group. In particular: Josua Ambrosi (*SES, the Swiss Association of Installers of Safety and Security Systems*), Dr Kurt Giselbrecht (*Brandverhütungsstelle Vorarlberg, Austria*), Colin McIntyre (*MSB, Swedish Civil Contingencies Agency*), Bert Paulusson (*Fire Services Gothenburg*), and Robert Yates (*Fire Industry Association*). They have received us in their countries and supported us with background information and data. With impressive dedication, these colleagues have collected the information that we have used here, sometimes gathering and managing it for many years, to filter out valuable findings. I thank all the other experts who enriched the meetings with their participation.

I thank Euralarm for providing the framework which enabled us to carry out our work. I would like to express special personal gratitude to the President, Enzo Peduzzi, and the Chairman of the Fire Section, Dominique Taudin. Thank you for the trust you have shown in us.

I thank the trade associations and companies that have supported us in our work: *Fire Industry Association* (FIA) [GB], *German Electrical and Electronic Manufacturers' Association* (ZVEI) [DE], *SaekerhetsBranschen* [SE], *the Swiss Association of Installers of Safety and Security Systems* (SES) [CH].I would especially like to thank my assistant, Alina Pfaff, who, with great patience, has supported me in the checking of the material, and also in many organisational details and the finalisation of the study.

The False Alarm Study represents a step in the study of the phenomenon of false alarms. Further work is necessary and planned.

Sebastian Festag
Editor/Author

Preface (Second Edition) by Sebastian Festag

In the second edition of the False Alarm Study, the results and findings of the first edition have been enhanced by the analysis of the situation in Denmark (see chapter 4.6), and the task group offers a recommendation for the central terms (see chapter 5). The measures for the reduction of false alarms have also been restructured (see chapter 7), some data have been updated, and newer content has also been added (e.g. the causes of false alarms).

False alarms are a key topic regarding the exchange of information, including in the context of hazard warning systems. They are also a subject that relates to fire detection and fire alarm systems. The inappropriate planning and application of technical systems are the main causes of the false alarms that are triggered by fire detection and fire alarm systems, and may also be referred to as "deceptive alarms". In some regions, approximately 30% of the false alarms from fire detection and fire alarm systems take place at just 5% of locations.

The lack of shared data and terminology – as seen in the first study – makes the further analysis and the development of prevention strategies difficult. Reducing the incidences of false alarms requires an understanding of the phenomena and the conditions.

Again, I would like to thank the members of the task group for their support (in alphabetical order): Jan Blomqvist, Morgane Duverger, Lance Rütimann, Baptiste Néron and Phil Watson. In the second edition, I would like to thank Vibeke Østergaard Thomsen (the Danish emergency management agency) as a new member of the advisory group. I would also like to thank Euralarm for the mandate and framework of our work on false alarms. Many thanks also goes to the trade associations and companies that have supported our work. I would also like to thank my staff member Chiara Herbster for the editorial support in the second edition of the study and Marion Meinert for establishing contact with Denmark.

False alarms occur in other safety or security systems, such as scanners at airports, medical diagnostic equipment, and in a wider sense, the worlds of journalism and politics as well. Although they are largely seen as something negative, it is also possible to learn a lot from them (in terms of addressing vulnerabilities in the technical and organisational alerting process, for example).

Sebastian Festag
Editor/Author

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1 Objective and Structure of the Report

The purpose of installed (and connected) Fire Detection and Fire Alarm Systems (FDAS) is to detect fires at an early stage allowing for the initiation of processes that protect lives and keep damage to a minimum. This calls for sensitive detection and fast analysis. The performance of an FDAS is a mix between early detection sensitivity and resistance to false alarms. In terms of fire protection engineering, false fire alarms occur when there is no real fire condition established by the fire services [1]. False alarms are a side effect of fire detection, with real and false alarms having different assessment criteria.

To date, in spite of comprehensive databases from different countries, there are no reliable facts on the ratio of false alarms from FDAS. This research aims to understand the specific regional situations and establish an methodological approach to derive false alarm ratios on a common empirical basis. The research uses available data from fire services, industry associations and public authorities, where the quality and boundary conditions of the data varies.

The principle discussion today is that the number of false alarms should be reduced. This objective must not allow the risk of real fires not being detected in time. In order to consider both aspects, an evaluation basis is required. A discussion is needed, because false alarms bind and absorb public and private resources.

This report contains:

- clarification of false alarms as a phenomenon
- description of the processes to initiate fire service intervention
- formulas to calculate false alarm ratios
- methodology of the present analysis
- false alarm situation in certain European countries (Germany, Great Britain/England, Switzerland, Sweden, Austria/Vorarlberg and Denmark)
- summary conclusions and recommendations

The analysis reviews the approaches of the different countries to false alarms and the collection of associated data and then looks for a common basis for quantification. The report also gives an overview on some important false alarm issues as well as strategies to reduce false alarms as best practice.

2 Theoretical Basics

This chapter contains a description of false alarms as a phenomenon and an explanation of the principle function and structure of FDAS. The four formulas to derive the false alarm ratio are also explained.

2.1 False Alarms as a phenomenon

Fire alarm activations result from real fire as well as non-fire conditions. Unfortunately, in a considerable number of activations, it is not possible for fire services to determine in advance of their intervention if a real fire condition exists or not. Fire situations are very complex and with many people involved in the alerting process, individual perceptions can vary greatly.

For the purpose of this report, we are looking at two cases:
Case I: A real fire condition (fire alarm) leads to a fire service response.
Case II: A non-fire condition (false alarm) leads to a fire service response.
Case II can be further divided into:

- There is neither a real fire nor are there signs that a fire occurred.
- The event that led to a fire alarm has already been stopped by local intervention (e.g. fire extinguisher), or extinguished itself (these instances would not normally be considered false alarms as the FDAS has fully achieved its purpose; however some fire services still view this as an unnecessary call).
- Fire services are confronted by another event such as a burst water pipe.

Differences between the real and the reported situation can make it difficult to attain a clear picture of the false alarm situation. It is a fact that in the time between the first alert of a fire and the intervention of fire services or police, the situation can change as is shown in Figure 1.

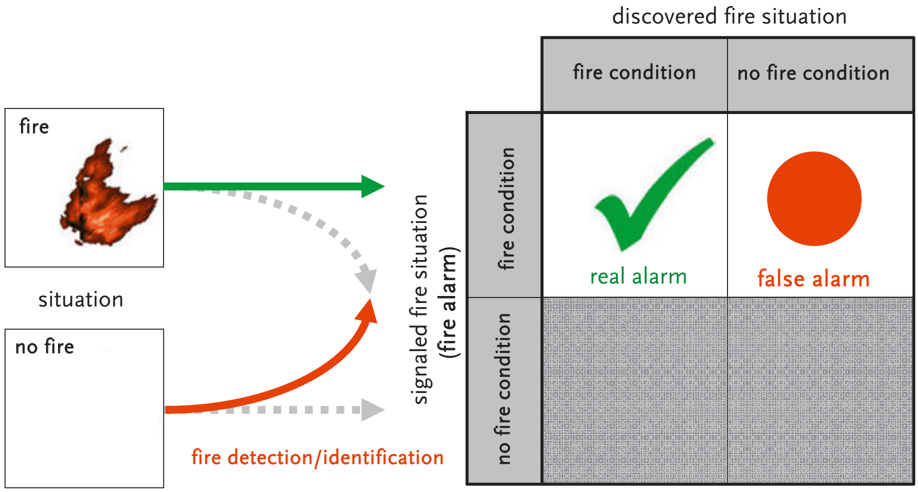

Figure 1: Real, signaled and discovered situation with real and false fire alarm (cf. [2])

For fire services, there is sometimes no clear distinction between a real and a false alarm. The statistical data in this report is based on evaluation.

The false alarm issue is not new. A number of papers exist on this subject e.g. [3], [4], [5], [6], [7], [8] and [9].

2.2 Fire Detection and Fire Alarm Systems (FDAS)

A call for help provides fire services with information about a (fire) event through various paths. One of these paths is the activation of an alarm via an FDAS. The fire services can also be notified of a fire through calls via a fixed line or mobile network, via automatic fire extinguishing systems. False alarms can occur in all of these paths. The present paper, however, only deals with false alarms from FDAS. An FDAS comprises a fire alarm panel, control indicating equipment and peripheral devices such as manual call points and automatic fire detectors [10]. Automatic fire detectors are designed to measure smoke, heat or combustion gases (e.g. carbon monoxide). These devices can be fitted with a combination of sensors. Older detectors (e.g. threshold fire detectors) trigger an alarm when a set threshold is measured. They are susceptible to false alarms. Modern detectors have on-board microprocessors that enable them to analyze sensor readings using algorithms. This feature makes detectors more immune to deceptive phenomena such as cigarette smoke. An additional aspect that must be considered is the proper design of the FDAS including type selection, placement and adjustment of automatic fire detectors and manual call points to avoid false alarms.

An FDAS can transmit fire alarms via an automatic alarm transmission device. The signal can be routed directly to the fire services or through an alarm receiving centre (ARC). The direct connection between the FDAS and the fire services is intended to ensure quick reaction in the event of a fire and a short response time of the rescue forces (cf. [10]). It is assumed that real and false alarms transferred to the fire services approximately correspond to the total numbers of alarms triggered by these systems. The alarm transmission via an ARC may filter out and reduce the number of false alarms.

False alarms can be of various origins and are essentially subdivided into categories. These categories vary from country to country and they include different definitions and terminologies – the reality is more complex than the categories indicate. Reasons for false alarms are, for example, "technical defects" which are triggered by defects in the technical equipment or components (e.g., sensors, detectors, control panels or cables). Another cause category is characterized by deceptive alarms. In this case, an alarm is triggered although there is no fire, and technical devices are functioning properly. However, the sensors react to parameters of fire-like phenomena (e.g. water vapor, dust, and solar radiation). Another group contains malicious (intentional) and unintentional alarms triggered by human activities. In the event of malicious alarms, for example, persons trigger manual call points or hold matches underneath fire detectors with malicious intentions. In the event of unintentional false alarms, the persons in question alert the fire services in an act of (mistaken) good faith, although there is no fire (cf. [11]). This group of alarms is similar to spurious alarms because, here, the equipment functions as intended but, essentially, the alarms are not triggered by physical or chemical parameters as is the case with deceptive alarms. Instead, human behavior plays a decisive role in this group. The difference between malicious and unintentional activities lies in the particular person's intention. This is often unknown.

3 Methodology of the Analysis

The present report deals with the question of which facts exist for estimating the ratios of false alarms from FDAS in various European countries. The aim is an understanding of the false alarm situations and the reduction of false alarms and improvement to FDAS performance. Data availability and reliability is a challenge, but it is possible to calculate the false alarm ratio on a common approach as described in the previous chapter.

With this calculation basis, we arrive at a benchmark that allows an assessment of the existing situation and a means to describe false alarms as a phenomenon. At the same time, this offers a comparative basis for future analysis.

The task group visited selected countries to meet their respective experts in the area of FDAS and fire statistics. The false alarm situation, the commonalities and differences were discussed. The available data was shared and reviewed.

In the analysis, the following points were considered for each country:

a. the general procedure
b. relevant standards
c. terminology used
d. alarm transmission path
e. methodology for the collection of data
f. false alarm ratio (e.g. number of fire alarms, false alarms, other alarms)

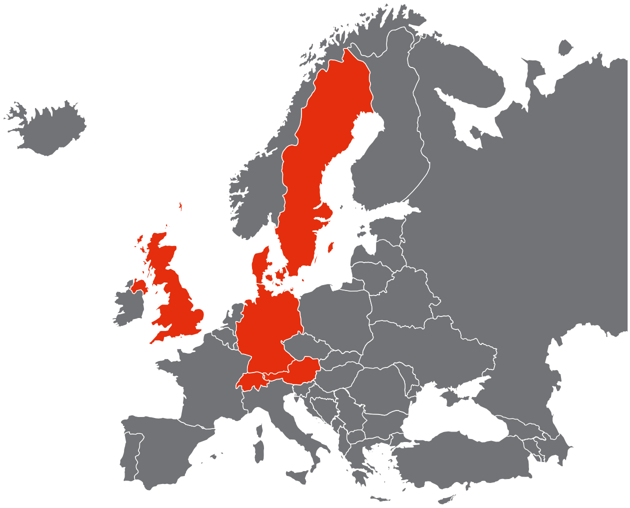

Figure 2: Analyzed European Countries (red analyzed country)

Before the false alarm ratio can be calculated, it is important to note that the available data varies from country to country as well as the data mining approaches. Additionally, a distinction between data from FDAS (commercial applications) and smoke alarm devices (domestic applications) must be made.

In a new approach, the following options for calculating the false alarm ratio are given – the choice to use the formulas depends on the availability and validity of the data (see [12]). These six formulas are as follows:

$$FA_0 = n_{FDAS,FA}/100.000 \text{ inhabitants} \qquad \text{eq. 1}$$

Description: FA_0 = False alarm ratio based on the number of false alarms from FDAS ($n_{FDAS,FA}$) per 100.000 inhabitants.

$$FA_1 = x_{FA} = n_{FDAS,FA}/n_{FO} \qquad \text{eq. 2}$$

Description: FA_1 = x_{FA} = False alarm ratio based on the number of false alarms from FDAS ($n_{FDAS,FA}$) in relation to the number of all fire fighting operations (all fire alarms, activations; real and non-real fire conditions; n_{FO}) of the fire services and the same time interval (e.g. per year).

$$FA_2 = X_{FA} = n_{FDAS,FA}/n_{FO,B} \qquad \text{eq. 3}$$

Description: FA_2 = X_{FA} = False alarm ratio based on the number of false alarms from FDAS in relation to the number of all fire fighting operations (fire alarm activations) in buildings ($n_{FO,B}$) of the fire services and the same time interval.

$$FA_3 = \varphi_{FA} = n_{FDAS,FA}/n_{FDAS,I} \qquad \text{eq. 4}$$

Description: $FA_3 = \varphi_{FA}$= False alarm ratio based on the number of false alarms from FDAS in relation to the number of FDAS ($n_{FDAS,I}$), of the same region, fire services and time interval.

$$FA_4 = \varepsilon_{FA} = n_{FDAS,FA}/n_{FDAS} \text{ with } n_{FDAS} = n_{FDAS,FA} + n_{FDAS,RF} \qquad \text{eq. 5}$$

Description: FA_4 = ε_{FA} = False alarm ratio based on the number of false alarms from FDAS in relation to the number of all fire alarm activations caused by FDAS (real and non-fire conditions by FDAS; n_{FDAS}), of the same time interval (e.g. per year).

$FA_{5=}\ n_{FDAS,FA}$/1.000 fire detectors	eq. 6

Description: FA_5 = False alarm ratio based on the number of false alarms from FDAS ($n_{FDAS,FA}$) per 1.000 fire detectors.

All formulas require the total number of false alarms from FDAS and at least one absolute number from the reference figures (1–4).

In summary, the given definitions and formulas should be used for the calculation of false alarm rates

4 The False Alarm Situation in Different Countries

This chapter describes the results of the analysis shown country by country (Germany, Great Britain/England, Switzerland, Sweden and Austria/Vorarlberg). The results are divided into: 1) general procedure, 2) some relevant standards, 3) terminology used, 4) alarm transmission connection (rough work flow from FDAS) and 5) false alarm ratio (on the basis of the statistics from those countries).

4.1 Germany

Germany comprises 16 Federal States. Fire protection is regulated independently in the Federal States.

4.1.1 General procedure

In Germany, representative information and unified statistics in particular, for the topic of false alarms from FDAS, are not given.

Some data sources exist which contain more or less the required information. In Germany, the following statistical resources are given: a) annual statistics from the fire services, b) health statistics on fire fatalities, c) statistics from insurance claims of fire damage to properties and d) statistics from specific research activities. All resources are provided for specific purposes and are limited in the context of (false) fire alarms from FDAS. Separate research projects must be undertaken with individual fire services, and their data must be used to analyze the situation [12], [13]. In our research activities on this topic, we have collected useful information from the existing statistics. The results are not necessarily representative for Germany and results from other fire services could produce different values (see below and in detail [14], [15] and [16]).

4.1.2 Some relevant standards

Product standards	DIN EN 54-series [17]
Application standards	DIN 14675 [18], DIN VDE 0833-series [19], VdS 2095 [20], VdS 3178 [21], CPR [22]

4.1.3 Terminology used

There is no standardized use of terminology. The German term false alarm is often referred to as unwanted alarm (but in the present context, the two terms refer to different circumstances in Germany (see Figure 3). For example, in the US and Switzerland, the term unwanted alarm is used for the German (see also EU and UK) term false alarm.

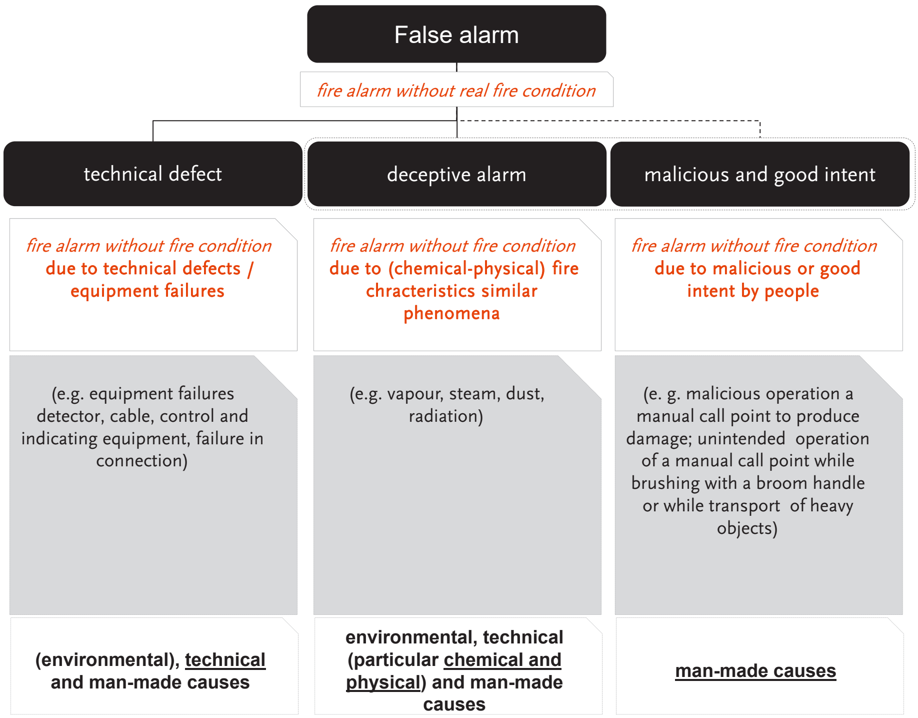

Figure 3: Definitions of false alarms in Germany (simplified categories) [12]

False alarms can have various origins and are essentially subdivided into three groups [12]. These include “technical defects” which are triggered by defects of technical equipment or components (e.g., sensors, detectors, control panels, or cables). Another group is characterized by deceptive alarms. In such cases, there is no fire and the technical devices are functioning properly. However, the sensors react to parameters of fire-like phenomena (e.g. water vapor, dust, and solar radiation) in the absence of an actual fire. The third group contains malicious alarms and alarms with good intent triggered by human activities. In the event of malicious alarms, for example, persons trigger manual call points or light matches underneath fire detectors with malicious intentions. In the event of false alarms with good intent, the persons alert the fire services in an act of (mistaken) good faith although, here as well, there is no fire. This third group of alarms is similar to deceptive alarms because, as before, the equipment functions as intended, but the alarms are not triggered by physical or chemical parameters as is the case with deceptive alarms. Instead, human behavior plays a decisive role in this third group. The difference between malicious and good intent activities lies in the person's particular intention. Since this intention is often unknown, different types of alarm triggers are included in one group for investigation purposes (see Figure 3).

In reality, a false alarm is a mixture of these artificial categories.

4.1.4 Alarm Transmission Connection

Figure 4 shows a rough and simplified work flow of the alerting process in Germany. The first call for help provides fire services with information about a (fire) event through various paths. One of these paths is the automatic activation of an alarm via FDAS. In most cases, the FDAS reports events via a transmission device directly to the fire services [10]. In Germany, an alarm verification is generally not performed (unless the FDAS is, in rare cases, connected only to a private ARC).

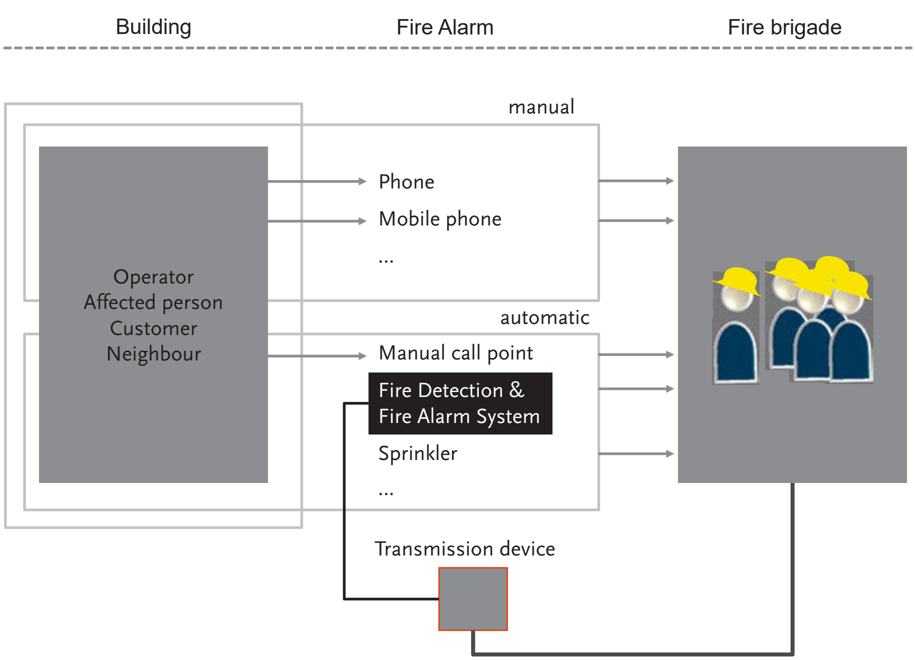

Figure 4: Alarm transmission by FDAS in Germany

4.1.5 False alarm ratio

No statistics exist that give a complete and general answer to the question how high the false alarm ratio from FDAS is in Germany. We have carried out some projects on the basis of an empirical analysis of fire services data, thus limiting the results to this perspective. For details about these studies, see the references in literature [2], [11], [14], [15], [16] and [23].

If all results from our investigations are averaged and summarized in a meta-analysis [12], we get:

$FA_1 = x_{FA} = 35.02\%$, $FA_2 = X_{FA} = 63.63\%$, $FA_3 = \varphi_{FA} = 78.49\%$ and $FA_4 = \varepsilon_{FA} = 87.52\%$.

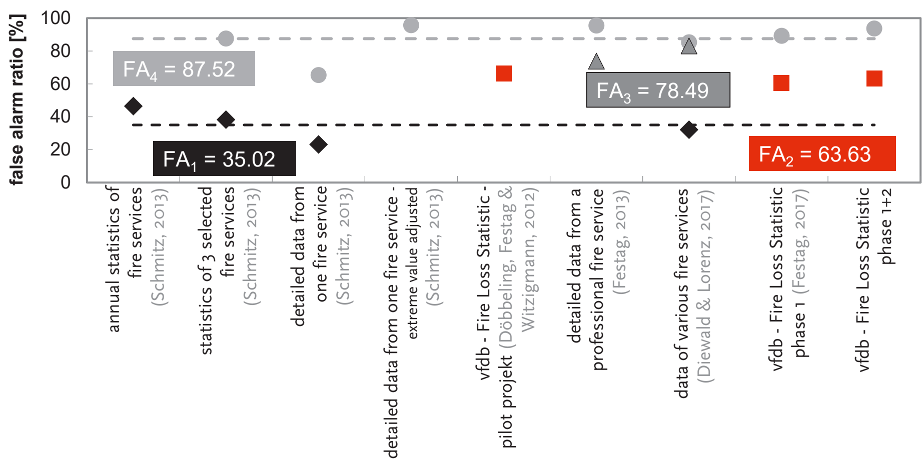

Figure 5: Different data basis of false alarms

Owing to the reference variable used, the informative value of the behavior of FDAS increases in the order from FA_1 to FA_4.

An object-specific analysis shows that only a few buildings (5.64%) are related to a high ratio of false alarms from FDAS (29.57%). This finding is confirmed in practice and shows that not only the technical part of FDAS plays an important role in the effectiveness of such systems and in the reduction of false alarms.

A professional fire service from North Rhine-Westphalia (Germany) has compiled fire alarm data from FDAS for each of the years 2003 to 2010, see Table 1.

Table 1: Operation values of one professional fire service in Germany [24]

	Year								
fundamental values	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**average**
Number of installations (FDAS)	948	948	1,050	1,050	1,204	1,351	1,350	1,350	1,156
Number of fire alarms (FDAS)	811	726	761	945	888	902	1,003	1,060	887
Number of real fire alarms (FDAS)	8	18	40	56	47	51	42	65	41
Number of false fire alarms (FDAS)	803	708	721	889	841	858	961	995	847
false alarm ratio									
FA_3 [%]	85	75	69	85	70	64	71	74	74
FA_4 [%]	99	98	95	94	95	94	96	94	96

Table 1 shows the development of fire alarms triggered by FDAS in the years 2003 to 2010. As the data shows, the false alarm ratio (FA_3) decreased from 84.70% in 2003 to 73.70% in 2010. The number of real fire alarms triggered by FDAS remained almost static but with a slightly rising tendency.

Figure 6 represents the values and shows the development of the false alarm situation.

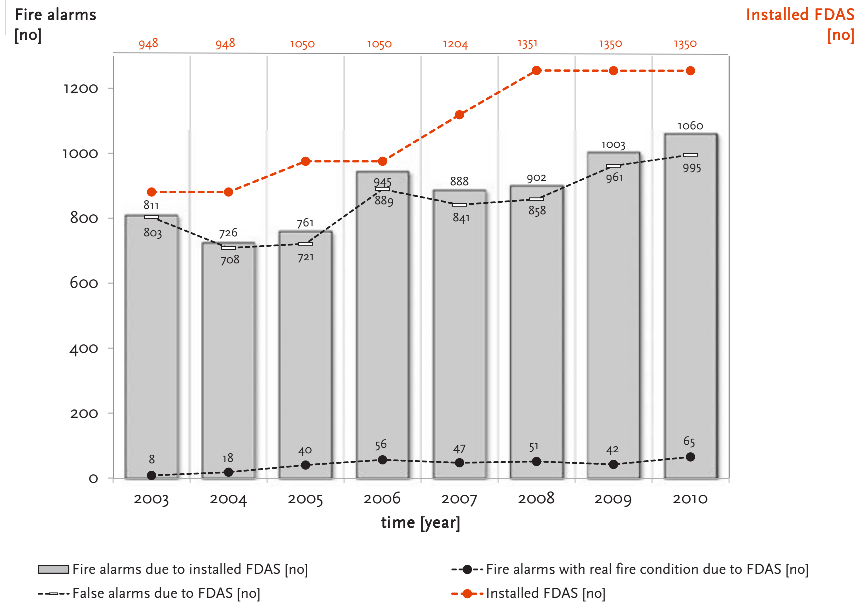

Figure 6: Development of fire alarms from FDAS of a professional fire service [12]

If the number of false alarms are related to the numbers of installations it is visible that FA_3 is decreasing, see Figure 7

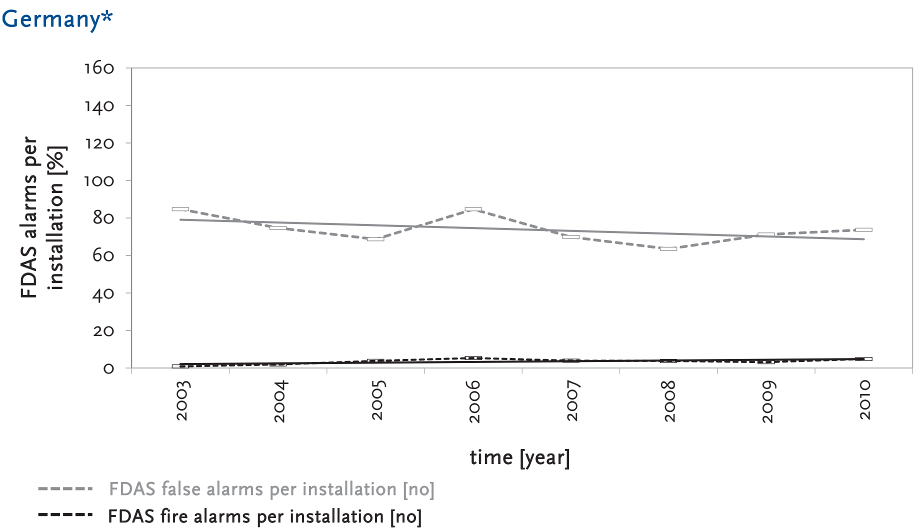

Figure 7: Real and false FDAS alarms per FDAS installation in Germany

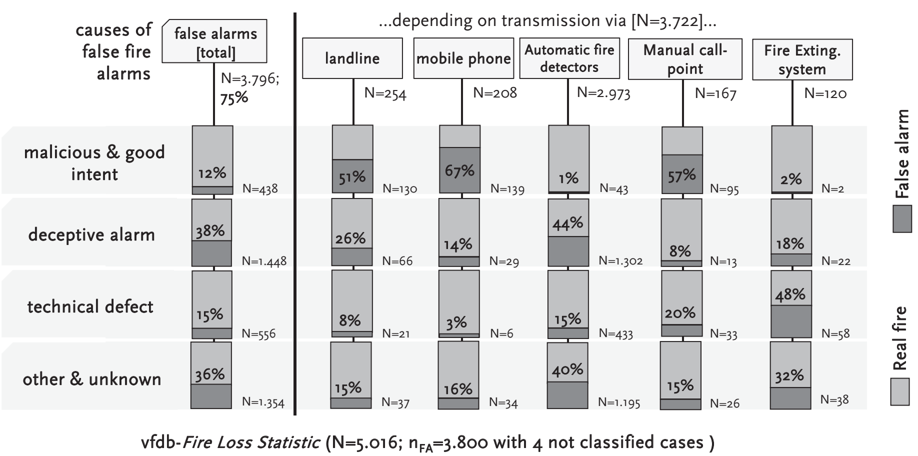

Figure 8: Causes of false fire alarms depending on transmission [2]

Figure 8 shows a detailed overview of the detected false alarms in relation to the different alarm transmission and their causes. It shows 3,796 false alarms from a total of 5,016 building fire alarms. This corresponds to 75% across all alarm transmissions. The largest part of the false alarms in relation to the alarm transmissions is attributable to fire alarm systems (80%). False alarms caused by fire alarm systems are dominated by false alarms (44%) and unknown causes (40%), followed by technical defects (15%). A malicious and good intent alarm is rare in fire alarm systems, but this cause makes up the largest share of alarm transmission via cell phone and manual call points [25].

4.2 Great Britain/England

The United Kingdom (UK) consists of Great Britain (England, Wales and Scotland) and Northern Ireland. Each country publishes its own annual fire statistics (Great Britain [26], England & Wales [27], Scotland [28]). This report refers to data from Great Britain and/or England.

4.2.1 General procedure

The Department for Communities and Local Government publishes an Annual Report on fire statistics for Great Britain. The report compiles statistics from Fire and Rescue Service records of incidents attended by fire and rescue authorities across Great Britain. This is an annual report, along with several Excel spreadsheets, that contains the data that has been used to compile the reports for England, Scotland and Wales. Until 2008, this was a UK publication. Since then, it has covered Great Britain – because the new Incident Recording System with electronic data capture and transfer was adopted by fire and rescue authorities across Great Britain in 2009. However, the 2014 report only provides statistics for England and Wales.

4.2.2 Some relevant standards

Product standards	BS EN 54-series [29], CPR [22]
Installation standards	BS 5839-1 [30], BS 5839-6 [31], BAFE 203 [32]

4.2.3 Terminology used

There are two distinct views of the terminology commonly used in fire statistics. The Fire and Rescue Service provides the following definitions and these are used within their annual report:

A false alarm is defined as an event in which the Fire and Rescue Service believes they are called to a reportable fire and then, on arrival, discovers that there is no such incident [26].

False alarms are categorized as:
Owing to Equipment – the call was initiated by fire alarm and firefighting equipment operating (including accidental initiation of alarm equipment by a person).

Good Intent – the call was made in good faith in the belief that the Fire and Rescue Service really would attend a fire.

Malicious – the call was made with the intention of getting the Fire and Rescue Service to attend a non-existent fire-related event. This includes 'deliberate' and 'suspected malicious' intentions.

The Code of Practice BS 5839-1 defines a false alarm as a *fire signal resulting from a cause(s) other than fire* [30]. According to this standard, false alarms may be subdivided into four categories:

1. **unwanted alarms –** in which a system has responded, either as designed or as the technology might reasonably be expected to respond, to any of the following:
   a) a fire-like phenomenon or environmental influence (e.g. smoke from a nearby bonfire, dust or insects, processes that produce smoke or flame, or environmental effects that can render certain types of detector unstable, such as rapid air flow)
   b) accidental damage
   c) inappropriate human action (e.g. operation of a system for test or maintenance purposes without prior warning to building occupants and/or an ARC)
2. **equipment false alarms** (in which a false alarm has resulted from a fault in the system)
3. **malicious** false alarms (in which a person operates a manual call point or causes a fire detector to initiate a fire signal, whilst knowing that there is no fire) and
4. false alarms with **good intent** (in which a person operates a manual call point or otherwise initiates a fire signal in the belief that there is a fire, when no fire actually exists).

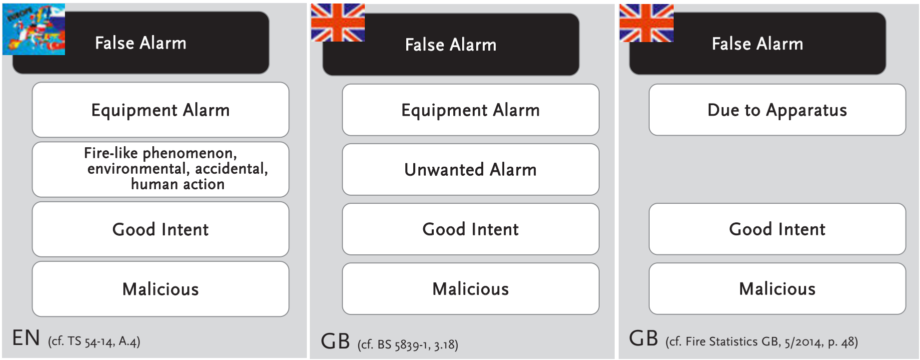

Figure 9: False alarm dependent on sources for Great Britain

These definitions are intended for use by the building owner or a maintenance company to help measure, manage and reduce false alarms.

A summary of the definitions is given in Figure 9.

4.2.4 Alarm Transmission Connection

The following figure illustrates a rough and simplified work flow of the alerting process in the UK. The normal and most common route is a telephone call (either a landline or mobile phone) to the emergency services call center, "999". A small number of premises, estimated to be about 10% of the FDAS, are connected to a commercial ARC. This arrangement is used for high-risk premises such as hospitals, care homes or unoccupied high value properties for the purpose of property protection. The ARC is responsible for determining the facts of the situation and taking appropriate action. That action will range from making a report, contacting a key holder to finally contacting the emergency services call center to relay the location and circumstance of a fire, see

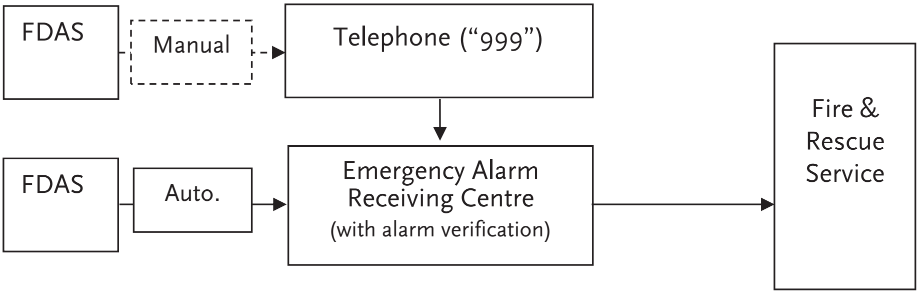

Figure 10: Alarm transmission by FDAS in Great Britain

4.2.5 False alarm ratio

In Great Britain, different statistics and values are available to describe the false alarm situation of FDAS. Each set has its weaknesses.

A) GB Statistics

The GB statistics result from the Annual Report on "Fire Statistics: Great Britain April 2013 to March 2014" published by the Department for Communities and Local Government. It contains data from England, Wales and Scotland and shows that in 2013–14, local authority Fire and Rescue Services attended 505,600 fire and false alarms with 212,500 fire alarms and 293,100 false fire alarms. This describes the false alarm situation in general, but not divided into values of false alarms owing to FDAS. The number of false alarms has decreased over the years (see [26]).

B) England Statistics

As an example, the annual report on "Fire Statistics Monitor: England April 2013 to March 2014" gives the values for England. Here, we find 223,376 false fire alarms out of a total of 393,347 (n_{FO}) fire and false alarms; 56.8%. 148,700 false alarms come from equipment. However, it shows that 66.6% of all false alarms come from equipment, which means essentially FDAS [27].

With the available data, the false alarm rates cannot be readily calculated. In each data source, at least one variable is missing. With that, there are three possible, but not unproblematic ways available to calculate the false alarm rates of FDAS in GB:

I. worst case scenario, based on an assumption that all false alarms reported in the GB statistics are from FDAS
II. assumption that 66.6% of all false alarms come from equipment (assumption is that England's statistics are representative of GB; see statistics only for England, [27] p.12) = 66.6% of 223,376 = 148,700 ($n_{FDAS,FA}$) → FA_I= 37.82%
III. we don't give any value

$FA_I = x_{FA}$ = 37.82% *(According to II, it is not recommended using this data because of uncertainties in the data.)*

4.3 Switzerland

Switzerland, with 26 cantons, lies centrally in Europe. The data in this report comes from the largest cities:-Zurich, Bern, Geneva and Basel, as well as the Canton Vaud. Fire safety is regulated at cantonal level, but highly influenced through the Association of Cantonal Building Insurers (VKF). European standards (CEN, CENELEC) apply for the products and systems deployed into the market.

4.3.1 General procedure

In Switzerland, two main data sources on false alarms are available:

a. The Swiss Association of Safety/Security System Installers (SES) collects the statistics on Fire Detection and Fire Alarm Systems and produces an annual report. The statistics and the report deal only with FDAS [33].
b. The Swiss Fire Services Coordination (FKS) collects statistics on all fire service interventions and produces an annual report. Within the report, data is available on interventions owing to fire alarm systems [34], [35].

There are notable differences between the two reports with respect to data evaluation:

a. The SES report is based on properties with FDAS that are connected to the fire services, whereas the FKS includes all fire alarm interventions.
b. The SES report provides details on the property type, location in the property and cause. The FKS report categorizes the alarms as false or real.
c. The SES report draws on data collected from 5 full-time fire services in the French and German speaking parts of the country. In the Canton of Vaud, the data are collected by non-professional fire brigades alongside the professional fire brigade of Lausanne.
d. The FKS report covers all cantons plus Liechtenstein.

For the purpose of this current analysis, the SES reports are the source of our data. The collection and reporting on false fire alarms has been conducted since the 1970s. In the 1990s, electronic evaluation of the data was introduced. The data collection is, however, still conducted on paper owing to the lack of a common reporting tool for fire services across Switzerland.

4.3.2 Some relevant standards

In Switzerland, the components of an FDAS must meet the EN 54 "Fire Detection and Fire Alarm Systems" standard series [36]. The Swiss Fire Protection Directive (VKF Brandschutzrichtlinien 2015) is an inter-cantonal standard for the planning, design, installation, operation and maintenance of active and passive fire safety measures. With respect to FDAS, this directive requires owners/operators of fire alarm systems to take measures to avoid false fire alarms and to document them [37].

In addition, in May 2016, SES published a technical bulletin for owners/operators indicating their responsibilities and providing information on how to reduce and avoid false fire alarms. This document is available in German and French [38].

4.3.3 Terminology used

Terminology and categorization are driven primarily by SES. Within this association, a dedicated committee made up of SES members and representatives from fire services and their national association plus representatives from cantonal building insurances, define and execute the program.

Switzerland categorizes alarms as "Real" or "Unwanted" (see Figure 11). In this, Switzerland deviates from other European countries using "False Alarm", but is in line with the US use of this term.

A focus area in Unwanted Alarms is "human error", as this is where changes can be applied easily and cost effectively. All other causes come under the heading "False Alarm", such as deceptive phenomena, technical defects and unknown causes.

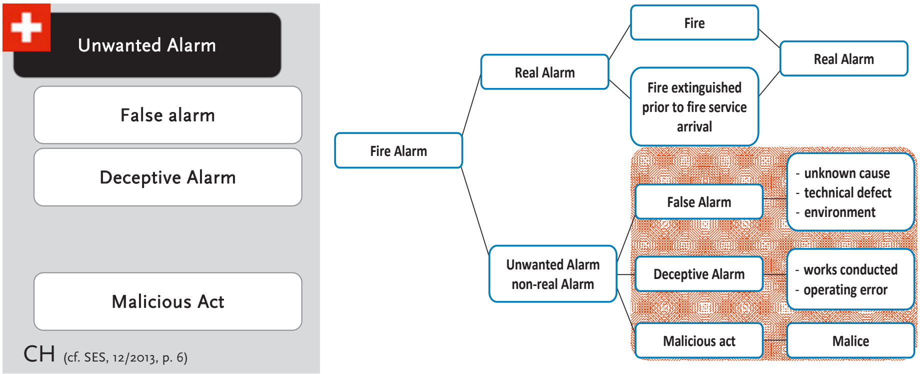

Figure 11: Definitions of false alarms in Switzerland [33]

4.3.4 Alarm Transmission Connection

The following, Figure 12, gives a functional overview of the connection between the Fire Alarm System and the Emergency Call Centers. It does not reflect the technical solution. For the purpose of this document, the technical solution is not relevant.

Where an alarm is routed first to an ARC, there would be some form of verification either by telephone or sending someone to the site prior to contacting the Emergency Call Center.

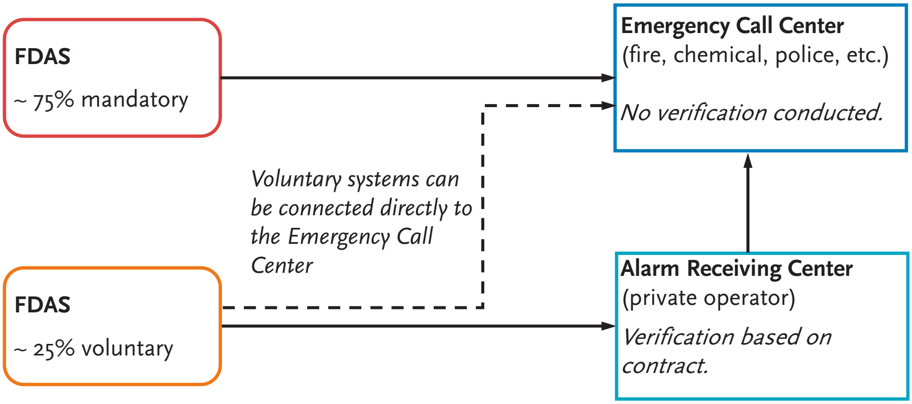

Figure 12: Alarm transmission by FDAS in Switzerland

Fire Alarm systems make use of an internal verification process that inhibits alarms from automatic detectors transmitting during “manned operation”. In all other cases the alarm is transmitted without delay.

a. During the “Manned” operating mode, if an alarm is activated, its source is located and the decision is taken as “Emergency” or “Minor incident”.
b. During “Unmanned” operating mode, all signals immediately generate a “Remote alarm”.
c. The activation of a manual call point always immediately generates a “Remote alarm”

4.3.5 False alarm ratio

The SES statistics provide detailed information about the fire alarms of FDAS from 1997 to 2015 (see Table 2). In 2015 the statistics combined the data from six fire services (Basel, Bern, Geneva, Zurich, La Chaux-de-Fonds, and from Vaud). In the geographical region covered by these fire services, the connected 7,097 FDAS transmitted 4,853 fire alarms, and 4,394 were unwanted (here: false alarms), and 459 were real fire alarms.

Table 2: Number and ratio of false alarms from FDAS in Switzerland [33]

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018	average
No. of installations	5311	4930	4897	4879	5321	4766	4942	5577	5462	5510	5631	5637	5501	6164	6186	6405	6226	7151	7097	7477	5754
Total Alarms	4066	4386	4753	4803	4901	4471	4314	4377	4404	4425	4329	4312	4237	4292	4249	4540	4073	4997	4853	3224	4400
Real Alarms	459	573	575	614	597	641	655	623	589	614	726	725	645	677	651	491	427	619	459	502	593
Unwanted Alarms	3607	3813	4178	4189	4304	3830	3659	3754	3815	3811	3603	3587	3592	3615	3598	4049	3646	4378	4394	2722	3864
Operating Error	344	381	368	351	351	298	250	227	245	209	262	266	231	228	250	243	241	202	214	216	269
Malice	222	227	231	229	211	188	165	176	174	182	124	183	192	180	162	155	153	282	255	297	199
Environment	974	1044	1191	1213	1405	1187	1198	1280	1315	1299	1182	1137	1230	1299	1255	1535	1447	1737	1795	1732	1323
Works conducted	543	515	611	644	641	557	540	629	573	561	533	532	497	519	572	608	542	749	767	573	585
Technical defect	450	632	640	698	722	623	566	557	607	601	589	518	535	452	478	510	372	545	503	456	553
Unknown	1074	1014	1137	1054	974	977	940	885	901	959	913	951	907	937	881	998	891	863	860	1036	958
FA_1	data not available																				
FA_2	data not availabe																				
FA_3	68%	77%	85%	86%	81%	80%	74%	67%	70%	69%	64%	64%	65%	59%	58%	63%	59%	61%	62%	36%	67%
FA_4	89%	87%	88%	87%	88%	86%	85%	86%	87%	86%	83%	83%	85%	84%	85%	89%	90%	88%	91%	84%	88%

From this data, we get FA_3 = 67% and FA_4 = 88%.

Detailed results

From 1997 to 2015, the number of FDAS increased. This trend can be seen, although the number of fire services involved in the statistical monitoring fluctuates. In the same period, the number of alarms from FDAS remained consistent. The number of real fire alarms from FDAS is constant at an average value of 598 alarms per year. The number of FDAS with alarm triggers decreased slightly over this time period. On average about 49% of the systems triggered an alarm. The number of false alarms from FDAS was 4,394 in 2015 and has remained on a constant level over the years. The proportion of real alarms to all alarms from FDAS fluctuated between 9.46% and 16.81% at a relatively constant level with an average of 13.44%. The false alarm ratio (FA_3), resulting from the number of false alarms from FDAS and the number of FDAS is, on average, 67.14%, and decreased slightly over the years. In 2015, the rate was 61.91% and dropped down in 2018 with 36.4%. In previous years, there was only a slight reduction. The false alarm ratio (FA_4), results from the number of false alarms from FDAS and the number of all alarms from FDAS, is, on average, 87.82%. This value varies only slightly between 83.19%, as a minimum in 2008, and 90.54%, as a maximum in 2015. The rate has stagnated over the entire period. On average, 37.83% of FDAS have one or more false alarms. This means, conversely, that approximately 62% of FDAS produce no false alarms. The percentage of installations that have caused false alarms decreased over the observation period. Since 2010, however, a slightly increasing trend can be observed. This can be a result of the shift in the database. On average, 13.40% of the alarms from FDAS are real fire alarms (see above). This is the third largest share of the alarm triggers from FDAS. Approximately 29.16% of the alarms from installed FDAS are caused by environmental conditions. In terms of the number of false alarms, this share is as high as 33.67%, making it the largest group. This group has significantly increased over the years. Operating errors are, on average, only about 6.09% of the alarms, with a significantly decreasing trend. About 4.35% of the alarms from FDAS are caused by sabotage. In the last two years, there has been a surge, although the long-term value total has stagnated. This fact is considered in the planning and placement of manual call points – especially in hospitals and care homes. Alarms that turn out to be false alarms, and are attributed to the execution of work are an average of 13.13% of all cases. Here a slight upward trend can be seen. In 12.50% of cases, technical defects in the FDAS lead to alarms. Here, a notable decrease can be observed over time. With an average of 21.37%, the alarm causes are unknown or cannot be identified. This group is the second largest group of false alarm triggers, after the group "environmental conditions". The need for further education can be seen. The analysis of the reported alarm data for the regions Basel, Bern, Geneva, Zurich and Vaud shows, in 2015, that the alarm ratio determined from the number of alarms and number of FDAS, is at a similar level of 68.40% on average. The false alarm ratio shows no large differences between the regions. On average, FA_3 is 61.81%, with a range of 56.85 and 69.00%. FA_4 has an average value of 90.38%, with only a small change from 87.95 to 92.35%. 3,817 alarms (78.65%) were reported to the fire services by automatic fire detectors in 2015, and 574 alarms (11.83%) by manual call points. 55.68% of the alarms occurred during working hours. A major focus is thus not apparent, but this can be easily explained by the aforementioned causes. Technical defects play only a subordinate role in the false alarms from FDAS. Instead, environmental conditions and poor handling of the installations during the execution of work often lead to alarms, where it is later found that there were no signs of a real fire. See Annex for detailed data. Much of this also has to do with systems not being utilized as they are intended. The introduction of fire detectors with heightened immunity to deceptive phenomena has reduced false alarms in the past 20 years, see Figure 13.

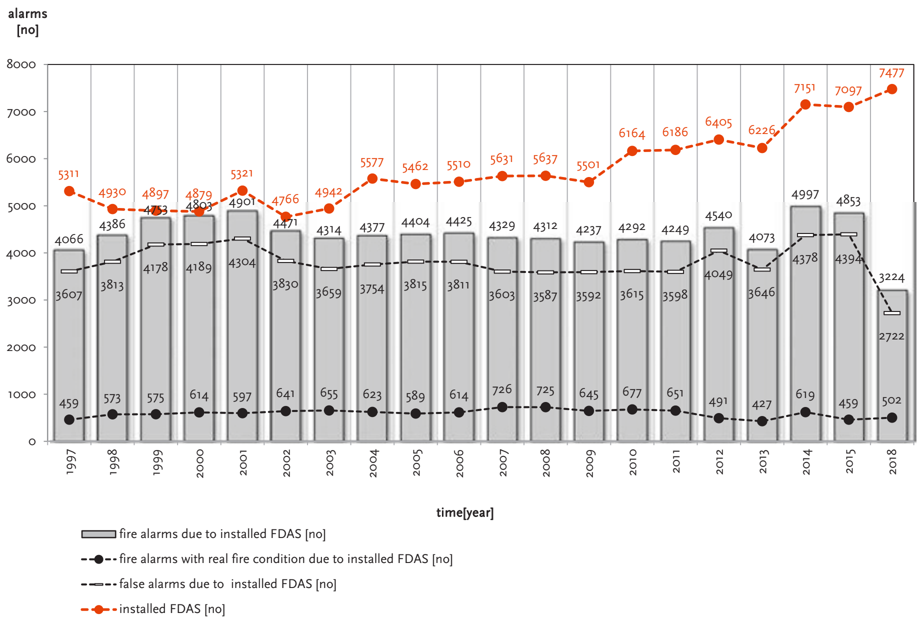

Figure 13 Development of fire alarms from FDAS in Switzerland (SES, 2018)

Since 2014, in the canton of Vaud, the data have been collected by the professional fire brigade Lausanne and new by the non-professional fire brigades (+1'170 Systems). If the number of false alarms are related to the numbers of installations it is visible that FA3 is decreasing, see Figure 14.

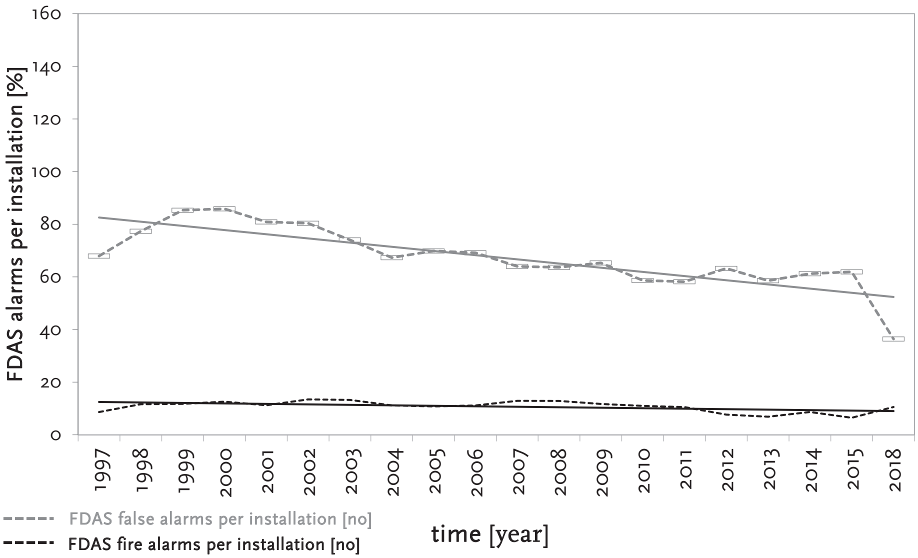

Figure 14: Real and false FDAS alarms per FDAS installation in Switzerland

4.4 Sweden

4.4.1 General procedure

Each intervention from the fire services is reported to a national database held by MSB – Swedish Civil Contingencies Agency [39]. This database includes information about the property to which the intervention was made and also information about the cause of the alarm. The information noted is from the fire services without any re-consideration after the intervention. In addition, local statistics are available [40].

In this report we are using data from MSB and from the fire services of greater Gothenburg.

4.4.2 Some relevant standards

Product standards	EN 54-series [41]
Application standards	SBF 110:7 [42]

4.4.3 Terminology used

In the statistics a false alarm is an alarm without the presence of danger from fire or gas release. The Swedish fire and rescue service have two kinds of automatic alarm systems: detecting systems for fires and detecting systems for gas leaks (chemical factories, ice rinks, hospitals etc.). In the statistics they do not differentiate between false alarms from FDAS and gas detecting systems. A study of the detailed statistics on detector type it is to observe that less than 0.25% of all false alarms come from gas leakage detectors. In the case of a false alarm, the cause is noted in each MSB report where about 25 alternative causes are listed including free text. Meanwhile, Sweden no longer differentiates between the 26 subcategories.

Table 3 shows the number of automatic fire alarms reported to the fire services without near-accident (a system triggered an alarm to the local fire brigade without there being the risk of a fire starting or a gas leak taking place) from FDAS for each reason, as an example from 2013.

4.4.4 Alarm Transmission Connection

About 90% (assumption) of the FDAS installations are connected via automatic transmission to an ARC. In case of an alarm, a direct call-out of relevant fire services will take place. For these installations there is a contractual agreement between the owner and the fire services. This contract includes the option for the fire services to charge the owner in case the alarm was caused by something else other than a fire. The cost levels are different for each fire service but typically, there is an initial administrative cost of about 600 EUR and for each non-fire intervention the cost is between 300 and 2,000 EUR.

4.4.5 False alarm ratio

The MSB database show for 2014 that, with 33,467 false versus 1,858 real alarms, the ratio is just above 18:1. The figures have been at the same level since 2005. Before that time, real alarms were reported at about 4%. The reason is, mainly, that a more precise and accurate description (real vs. false) was given in the explanation from 2005 and onwards.

In order to contrast the false alarm situation, the definition of “same values” has been agreed. The 2014 figures for Sweden and Gothenburg [40] are the following.

Table 3: Number of false alarms from FDAS in Sweden from 2013 [39]

Alarm cause	Public building	Private house	Industry	Other building	Unknown	Total	Share
Smoke from cooking	6,064	307	150	83	22	6,626	20.1%
Smoke from a work process	1,599	15	806	208	6	2,634	8.0%
Steam	1,351	21	552	97	2	2,023	6.1%
Condensation/moisture/water	656	16	293	57	7	1,029	3.1%
Intentional false alarm	838	16	12	10	1	877	2.7%
Unintentional damage	580	3	193	44	1	821	2.5%
Incorrect handling during service or inspection	531	8	206	44	1	790	2.4%
Long-term soiling	326	2	199	35	2	564	1.7%
Smoke from smokers	526	26	12	5	1	570	1.7%
Sprinkler water pressure change	181	2	237	44		464	1.4%
Other heat influence	273	3	109	25	1	411	1.2%
Smoke from smoke generators	370	3	21	12		406	1.2%
Candles or fireworks	303	9	12	2		326	1.0%
Works conducted (hot work process, e.g. welding, joining plastic floor-covering)	121	1	123	23	1	269	0.8%
Transmission fault	188		48	16	2	254	0.8%
Fault in power supply	135	3	91	20	1	250	0.8%
Smoke from a vehicle	80	8	104	27	4	223	0.7%
Smoke from a fire place	95	3	25	78		201	0.6%
Incorrect handling by the alarm receiving centre	120	2	30	4	1	157	0.5%
Lightning	61	4	27	4		96	0.3%
Sprinkler – freezing	10		64	3		77	0.2%
Animals – rodent/bird/insect	34		5	2		41	0.1%
Supposed fire	16	2	10	1		29	0.1%
Other reason	2,890	61	1,049	246	14	4,260	12.9%
Unknown	6,818	118	2,110	499	25	9,570	29.0%
Total	24,166	633	6,488	1'589	92	32,968	100%

False alarm figures based on the number of false alarms from FDAS in relation to the number of all fire services operations against fires in buildings (FA_2):

National data 66% (false alarms 33,467; operations against fires in buildings 51,029)

Gothenburg data 76% (false alarms 2,315; operations against fires in buildings 3,054)

False alarm figures based on the number of false alarms from FDAS in relation to the number of FDAS (FA_3):

National data Not available, number of installations is not included in the MSB database

Gothenburg data 57% alarm/installation/year (2,315 false alarm; 4,050 installations)

False alarm figures based on the number of false alarms from FDAS in relation to the number of all fire services operations initiated by FDAS (FA_4):

National data 95% (false alarm 33,467; operations 35,325)

Gothenburg data 90% (false alarm 2,315; operations 2,575)

Detailed results

Details of causes and percentages of the false alarms from FDAS and the data from the MSB for Sweden for 2013, are shown in Table 3. The fire services of greater Gothenburg provided operational data from FDAS from 2004 to 2014 for this report. Table 4 shows some detailed results on the development of false alarms. The data provides information on: a) the number of fire alarms from FDAS, b) the number of real fire alarms (justified alarms) from FDAS and c) the number of false alarms (unjustified alarms) from FDAS. For the year 2014, the number of installations of FDAS for the operational area of the fire services of greater Gothenburg is also available with about 4,050 installations. More data is given in Appendix A6 to A8.

Table 4: False alarm data from FDAS in greater Gothenburg [39]

	Year											
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**average**
Number of installations (FDAS)											4,050	
Number of fire alarms (FDAS)	2,472	2,556	2,672	2,736	2,652	2,462	2,632	2,799	2,678	2,685	2,575	2,629
Number of real fire alarms (FDAS)	383	383	386	354	273	306	278	259	262	257	260	309
Number of false fire alarms (FDAS)	2,089	2,173	2,286	2,382	2,379	2,156	2,354	2,540	2,416	2,428	2,315	2,320
Part of real laarms %	15.49	14.98	14.45	12.94	10.29	12.43	10.56	9.25	9.78	9.57	10.10	11.80
FA_3 [%]											57.16	
FA_4 [%]	84.51	85.02	85.55	87.06	89.71	87.57	89.44	90.75	90.22	90.43	89.90	88.24

The statements from Table 4 are:

In greater Gothenburg in the year 2014, FDAS produced 2,575 alarms. Over the years 2004 to 2014, an average of 2,626 alarms has been transmitted by FDAS. That value is relatively constant. On average, 12% of the alarms from FDAS are real fire alarms (justified). This number has decreased from 15% in 2004 to now 10%.

Over the same period, the fire services recorded an increase in false alarms (unjustified alarms) from 2,089 false alarms in 2004 to 2,315 in 2014. The maximum was found in 2011, with 2,540 false alarms.

The false alarm rate (FA_3), resulting from the number of false alarms from FDAS and the number of installations, can be determined only for 2014 (since the number of FDAS has been recorded only here) and amounts to 57%.

The false alarm rate (FA_4) results from the number of false alarms from FDAS and the number of all alarms from FDAS are on average 88%. This value varies only slightly between 85% as a minimum in 2004 and 91% as a maximum in 2011. In 2014, the rate was 90%. The rate stagnated substantially over the entire period (see above). It is not possible to translate this result to the performance per FDAS in general, because only a small number of systems were evaluated (Note: It is assumed that there has been an increase in the number of installations in Sweden, but the total number is unknown).

The data for FDAS at the fire services of greater Gothenburg is also available on a monthly basis (see Appendix A6). An analysis of the detailed data shows that the alarms from FDAS in total are equally distributed. This is also true, if the alarms are subdivided into real and false alarms. Over the months and years, no outliers are apparent, with the exception of January and December months in the case of real alarms.

Local expertise states, that the number of false alarms has been rather steady in absolute numbers in the last 15–20 years. In relation to the installed database of fire detectors, this level can be considered as an improvement, because the annual delivery of smoke detectors, as reported by the trade association SäkerhetsBranschen (earlier Swelarm), has increased from 170,000 units in 1998 to 408,000 units in 2014. In other words, the number of fire detectors has increased during the period.

4.5 Austria/Vorarlberg

Austria consists of 9 Federal States: *Vienna, Burgenland, Carinthia, Lower Austria, Upper Austria, Salzburg, Styria, Tyrol and Vorarlberg*. In this report, the data comes from Vorarlberg. The data cannot be considered as representative for the whole of Austria without deeper analysis.

4.5.1 General procedure

Every year, shared statistics are created in Austria about the occurrence of fires [43]. Information about fire detection systems and the occurrence of false alarms is not included. The information required for this report is from the Full Statistics about Fires as carried out by the Vorarlberg Fire Prevention Authority. These fire statistics contain all data required for the issues in the report at hand. The statistics cover all fires in Vorarlberg and are meaningful for the area. The results cannot readily be transferred to all of Austria. The Vorarlberg data was analyzed for the report at hand with regard to the subject discussed. Full recording of fires and collection of information about deployment of the fire brigade, criminal investigation offices and insurances can be traced back to the personal commitment of individuals. The Fire Prevention Authority looks for fire events in Vorarlberg every day/week, and receives deployment information via a standardized questionnaire from all fire brigades. Information about personal damage and the cause of a fire can be allocated using additional inquiries to the criminal investigation departments. In the same way, using additional inquiries to insurance companies, information about insured material damage is added. This approach to data acquisition is a good example of a database about the topic of fires.

4.5.2 Some relevant standards

Product standards:	EN 54 series [44]
Installation standards:	TRVB 001A [45], TRVB 123 S [46], TRVB 151 [47], TRVB S 114 [48], ÖNORM F 3051 [49], ÖNORM F 3052 [50]

4.5.3 Terminology used

In Austria, automatic alerting of the fire brigade – even though there is neither a fire nor a near-fire – is classified as a false alarm, with a near-fire that may have led to a fire with severe consequences, had it not been detected by the FDAS, being classified as an alarm [...] according to Haltmeier [51]. In Austria, false alarms are divided into false alarms and deception alarms (see Figure 15). A false alarm (equipment failure) is a fire alarm that was triggered by a technical fault in the fire detection system [45]. A deception alarm, according to is a fire alarm that was triggered by an external impact on the fire detection system that is unrelated to a fire (e.g. cigar/cigarette smoke, dust, fire activities, water vapor, heat) [45].

Figure 15: Definitions of false alarms in Austria

4.5.4 Alarm Transmission Connection

Based on the specific "Building Classe" (Gebäudeklasse) the authorities determine if an automatic fire detection and alarm system is required to have an automatic alarm transmission. Approximately 90% of these FDAS are connected directly to the fire services. Only a relative small number are voluntary FDAS and these are routed either directly to the fire services or through a private operator (ARC).

Vorarlberg has a Rescue and Fire Services Command Centre (RFL) and is the only public alarm receiving infrastructure for FDAS. Connected are mainly FDAS that are by law required to transmit alarms. Tirol has a "State Warning Centre" (Landeswarnzentrale) which receives the alarms from FDAS, Security systems, Rescue, etc. and forwards these to the appropriate responders.

4.5.5 False alarm ratio

Detailed data from Austria is not available. The statistics from Vorarlberg do provide detailed information about the fire alarms of FDAS from 2008 to 2015 (see *Table 5*).

Table 5: Number and ratio of false alarms from FDAS in Vorarlberg (vgl. [52])

	year								
false alarm ratio	2008	2009	2010	2011	2012	2013	2014	2015	average
FA_1 [%]	49,3	48,9	55,1	51,7	54,1	55,0	49,1	52,0	51,8
FA_2 [%]	77,7	80,0	83,5	85,7	85,5	87,8	78,2	88,9	83,3
FA_3 [%]	138,3	148,0	131,0	124,4	133,4	116,1	99,9	102,9	122,9
FA_4 [%]	92,5	94,5	92,7	91,6	94,6	92,0	88,5	92,4	92,4

From this data, we get FA_1 = 52%, FA_2 = 83%, FA_3 = 123% and FA_4 =92%. More data are in Appendix A9 to A17.

Detailed results

The observations of the detailed Vorarlberg results for the period 2008 to 2015 are:

11’933 interventions by fire services were recorded in Vorarlberg which averages to 1’492 per year. Of the 11’933 there are 5’196 real fires. From that we calculate a false alarm rate of 57% across all alarm paths.

Of the 11’933 fire services interventions, 7’089 alarms (real and false) in total or 866 per year came from FDAS, which is 59% of all interventions due to FDAS. The number of alarms has stagnated over the years with minimal deviations. On average 8% of the alarms were real fires and hence 92% were false alarms (average of FA_4). The number of real alarms has increased, and is explained by the increasing number of FDAS, whereas the false alarm rate FA_4 has in fact decreased. 65% of alarms are caused by deceptive phenomena with a slight decreasing trend. 25% of alarms are recorded as technical defects, but this – similar to Germany – percentage is probably too high, because false alarms with no established cause are often recorded as technical defects. The numbers for technical defects show a slight increase. Malicious acts make up for 3% of all FDAS alarms and are clearly a minority.

There were 4’580 deceptive alarms recorded, which is in average 573 alarms per year through FDAS. These alarms can be categorized into various causes. Water vapour is the predominant cause for 651 alarms (81 alarms per year) or 14%. 610 alarms were caused by kitchen vapours and kitchen apparatus, attributing to 13% of all deceptive alarms. Further causes for deceptive alarms are construction work with 53 alarms (9%) and 368 alarms (8%) due to dust.

In the observation period, 3’357 deceptive alarms were in industrial and commercial buildings. This is 73% of all deceptive alarms with a slight downwards trend. 459 alarms (10%) were in public buildings and 56 alarms in hospitals and homes for the elderly. The distribution of deceptive alarms relative to the time of day is consistent with 86% during the day and 14% during the night.

Fire service interventions with real fires

There were 5'196 fire service interventions with real fires in Vorarlberg in the period 2008 to 2015 – an average of 650 interventions per year with a slight downwards trend. Approximately half (49%) of these were notably in buildings. From 2008 to 2012 there is a small decrease whereas from 2013 to 2015 a small increase exists. Forest fires make up for 106 interventions (2%) with a decrease during the whole observation period. Waste resp. Containers contribute to 74 fire service interventions (11%) per year with a strong reduction over 50% over the years.

Fire service interventions in buildings

Fire service interventions in buildings in Vorarlberg are categorised into small, medium, large and extinguished fires with "large fires" being the smallest group (6%). 396 interventions (16%) are medium fires and 1'170 interventions (47%) make up the largest group of interventions in buildings. 564 fires (22%) were extinguished before the fire services arrived. In the observation period in Vorarlberg, 1'934 fires were detected and reported by persons, which equates to 242 interventions per year and 77% of all building fires. 538 real fires (22%) or 67 per year were detected by the FDAS with an upwards trend over the years. An increasing number of fires are detected by smoke alarm devices. This is due to the regulation "OiB-Richtlinie 2" for Vorarlberg that since Jan 1st, 2008 imposes a requirement for the installation of smoke alarm devices in new and refurbished dwellings (without a connection to the fire services).

Types of buildings

As of 2015, 751 FDAS are registered in Vorarlberg, which is an increase of 34% since 2008 with 561 FDAS. Based on the 2015 numbers, the majority of all FDAS (62%) are in commercial and industrial buildings with a 33% increase in the number of FDAS since 2008. In 2015, second place is public buildings with 135 FDAS (18%). A slight downwards trend can be observed. Over the years, 11% of all FDAS are in hospitals and homes for the elderly with a slight upwards trend. In 2015, 80 FDAS existed. Overall there are no FDAS existing in agriculture. On average, 1% of all FDAS were in dwellings and 7% in office buildings. Figure 16 shows the development of alarms in Austria/Vorarlberg.

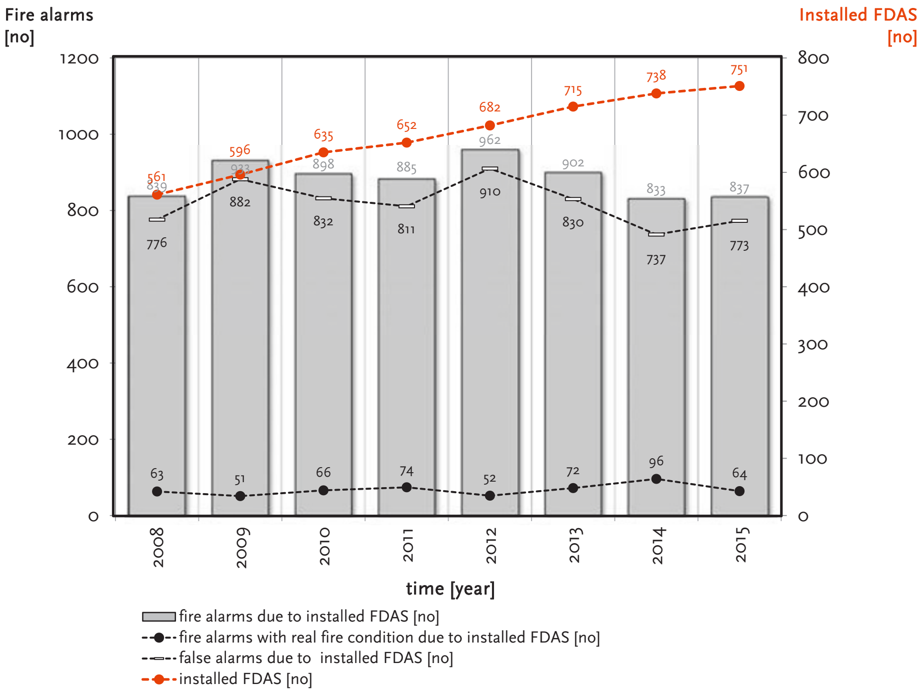

Figure 16: Development of fire alarms from FDAS in Austria/Vorarlberg (vgl. [52])

If the number of false alarms are related to the numbers of installations it is visible that FA_3 is decreasing, see Figure 17.

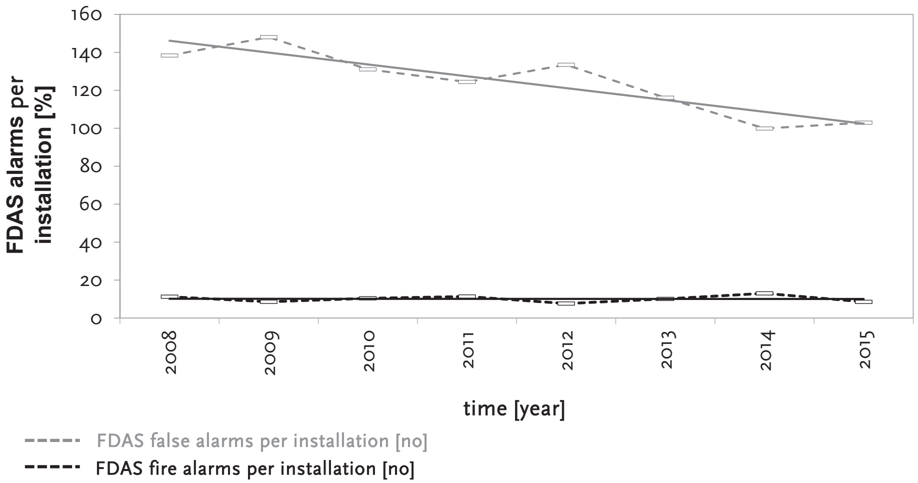

Figure 17: Real and false FDAS alarms per FDAS installation in Austria/Vorarlberg (vgl. [52])

4.6 Denmark

4.6.1 General procedure

Mandatory reporting:

Reporting of the fire services emergency responses is mandatory in Denmark. The fire services have to file notifications at latest on the 20th in the month after the emergency response. Data quality has been improved over the period. Recently, automated quality control of outliers with subsequent validation with the fire services has been implemented. Denmark has 98 municipalities and 5 regions. In 2015–2016, the municipal fire services were merged through a voluntary process reducing the number of fire brigades from 87 to 24.

4.6.2 Some relevant standards

- Only components certified according to the relevant product standard in the EN 54-series can be used.
- Minimum requirements regarding project design/engineering, installation and maintenance of fire detection and fire alarm systems are based on guideline 232 (in Danish: 'Automatiske brandalarmanlæg. Projektering, installation og vedligeholdelse'), The Danish Institute of Fire and Security Technology.
- Requirements for approval of companies, certification of systems, system parts, persons, and requirements for operation and maintenance of fire safety systems are based on guidelines 001-005, The Danish Institute of Fire and Security Technology.
- Mandatory training of the persons responsible for the fire safety systems in prevention of fire and prevention of blind/false alarms (see next section on terminology used in Denmark) is described in guideline 005, The Danish Institute of Fire and Security Technology.

4.6.3 Terminology used

In Denmark, non-fire conditions are divided into blind alarms and false alarms, based on definitions issued by the Danish Emergency Management Agency (DEMA) [53].

- Blind alarm: An alarm issued unintentional or in good faith, but without fire or risk of fire or other condition that requires or could have required fire brigade efforts.
- False alarm: An alarm issued intentional or in bad faith, but without fire or risk of fire or other condition that requires or could have required fire brigade efforts.

4.6.4 Alarm Transmission Connection

In Denmark, alarms are transmitted through a dedicated IP-based connection by default (type 1 transmission). Other options can be used, if agreed with the fire services. Type 2 transmission is also IP based, but uses an existing connection. Type 2 requires mobile back-up and that the transmissions are independent of each other. Type 3 transmission is by mobile network exclusively. The majority of FDAS is type 1 with direct transmission to the fire service. Requirements for uptime is min. 99,8% over 12 months and 98,5% over 1 month for type 1 and 2. For type 3 transmission, the uptime requirement is min. 99,9% over 12 months and 99,8 % over 7 days.

4.6.5 False alarm ratio

Statistics on fire brigade emergency responses in Denmark is registered by the fire brigades/services in ODIN, a database hosted by The Danish Emergency Management Agency. Statistics do not include Greenland and the Faroe Islands, due to self-rule on emergency management. Data were drawn on 18th October 2019.

Applying conventional detection performance parameters on FDAS gives a positive predictive value of FDAS alarms of only 7% in 2018 (real alarms (no blind and false alarms) from FDAS divided by all alarms from FDAS, 1.295/17.873).

The false alarm ratios FA_1, FA_2 and FA_4 can be calculated based on the available data from Denmark (see Table 6).

Table 6: False alarm ratios of FDAS, Denmark 2009–2018 [%]

	Year										
False alarm ratio	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Mean**
FA_1	37	47	44	47	47	51	52	54	56	52	49
FA_2	NA	NA	NA	NA	NA	NA	NA	69	71	70	70[1]
FA_3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FA_4	85	87	89	89	90	91	90	91	92	93	90

NA Not available

1 The mean for FA_2 is for 2016–2018 only

The calculations are based on the figures in table 7.

Table 7: Basic data used to calculate FA values in table Table 6 (DEMA, 2018)

	Year									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
$n_{FDAS,FA}$[1]	11.452	12.379	13.098	13.017	13.765	14.632	14.628	16.098	16.694	16.580
n_{FO}[2]	30.576	26.249	29.847	27.856	29.189	28.000	27.974	29.681	29.643	31.825
$n_{FO,B}$[3]	NA	NA	NA	NA	NA	NA	NA	23.296	23.482	23.678
n_{FDAS}[4]	13.467	14.187	14.719	14.555	15.258	16.153	16.333	17.756	18.106	17.873

NA Not available

1 No of false alarms from FDAS
2 No of all firefighting operations
3 No of all firefighting operations in buildings
4 No of all fire alarm activations caused by FDAS in the same time interval

Detailed results

The Danish Emergency Management Agency has previously looked into directly transmitted fire alarms from FDAS due to the burden on the municipal fire brigades. An analysis from 2017 of "blind alarms" (in Danish terminology) showed clearly the good effect of FDAS with early detection of fires when they are still small, but also that 91% of alarms from FDAS were unintentional or intentional false alarms ("false alarms" in Danish terminology) [54]. The fire services in Denmark can bill for the majority of false alarms from FDAS with the main exception being alarms from manual call points. In addition, there is an initial and an annual fee for FDAS to the majority of the fire services.

Looking into details of the alarms issued from different detector types showed that manual call points had a higher proportion of false alarms (Danish terminology), whereas beam detectors had a higher proportion of blind alarms (Danish terminology) compared to other detector types2. Ion smoke detectors, optimal detectors, thermo detectors, and multi-criteria detectors had very similar performance (~88–89% blind alarms (Danish terminology), ~1 % false alarms and ~10–11% real alarms). The majority of blind alarms (Danish terminology) was caused by cooking or hot works. The proportion of blind alarms (Danish terminology) per 1.000 detectors has declined from 8 to 6 alarm per 1.000 detectors during 2007–2016 as shown in Figure 18.

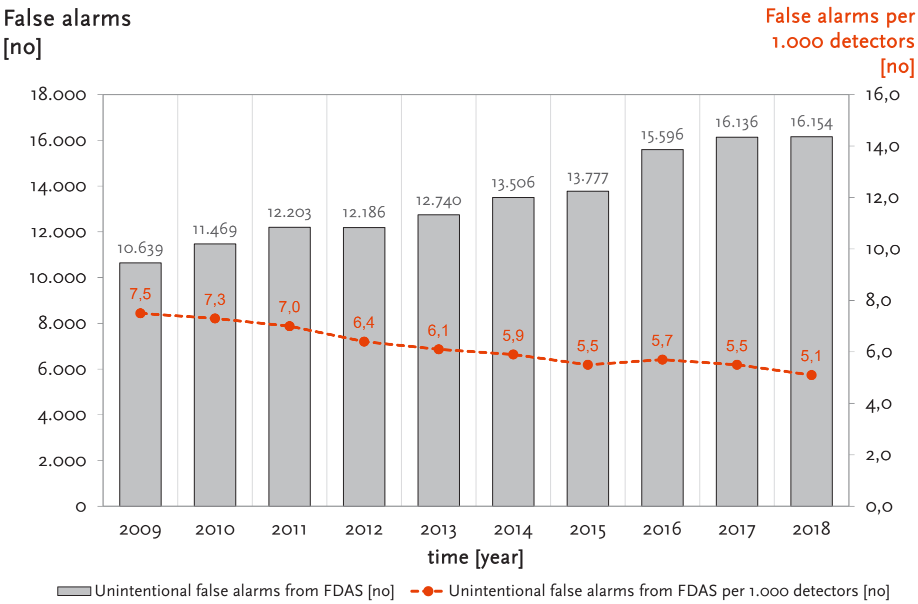

Figure 18: Blind alarms, absolute number and rate per 1.000 detectors (Denmark 2009–2018, [55])

5 Summary

In this report, the countries Germany, Switzerland, Sweden, Austria and part of Great Britain were analyzed. The situations are not directly comparable because there are a lot of differences between these countries. This begins with the fact that the term for a fire alarm without a real fire condition – at the time when the fire services arrive – varies (in detail, the situation at the time of the alarm may change until the fire services have arrived; that shows how difficult it is to assess). We call a fire alarm without a real fire-condition (from the perspective of the fire services) as *false alarm*. In some countries, it is referred to as an unwanted or unjustified alarm, although objectively the same is meant. It is even more complicated because even within the countries, standardized terms are not consequently used. Figure 19 shows the definition per country according to the country-specific terms used.

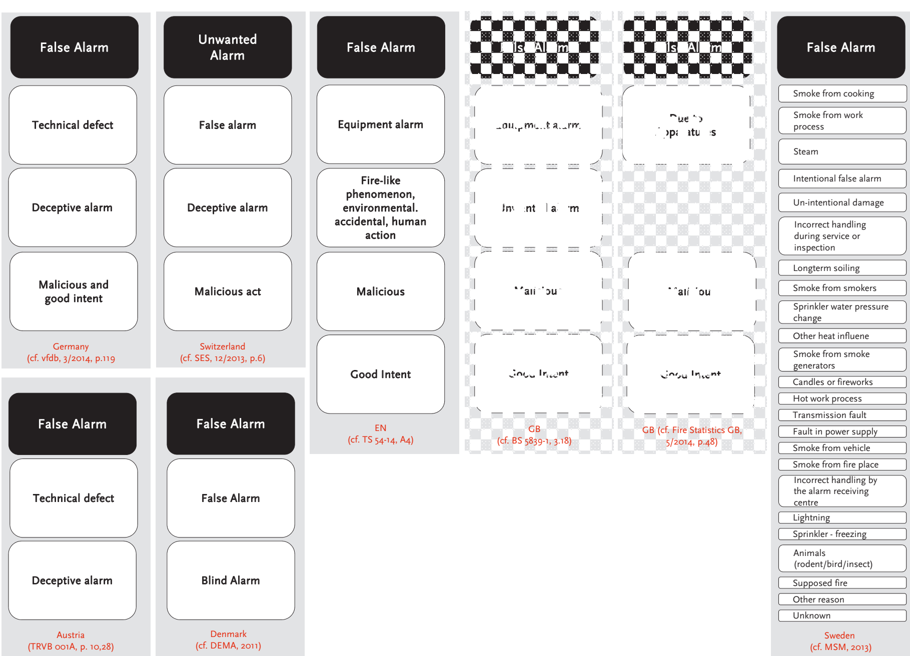

Figure 19: Overview of the definitions and terms per country

It can be seen that the definitions vary in each country, but there are some similarities. In principle, it should be possible to find a common base, without major changes. In most of the countries, a fire alarm without a real fire-condition is called a false alarm. The common basis of the categories is to distinguish equipment failures, deceptive alarms and intentional and unintentional actions by persons. The criteria in Sweden can be grouped.

In conclusion the overview of the definitions results in the following recommendation for the definition of real (fire) alarm and false (fire) alarm.

False Alarm: A fire alarm when there are no conditions that motivates a fire intervention.

Note: The alarm is not classified as a real fire alarm; a fire intervention is unjustified.

Note: In some countries the term „false (fire) alarm“ is used as unjustified, unwanted and untimely or as a subcategory (e. g. DK: false as intentional alarm and blind as unintentional alarm or CH: false as unintentional alarm).

These three following subgroups could be defined:

- ***Technical Defect/Equipment alarm:*** A false alarm has resulted from a fault in the system in the absence of an actual fire.
- ***Deceptive alarm:*** A false alarm where the technical devices are functioning properly and the sensors react to fire-like phenomena (incl. environmental influence and accidental damage) in the absence of an actual fire.
- ***Malicious and good intent:*** A false alarm triggered by human action due to malicious or good intent in the absence of an actual fire.
  - ***Malicious false alarms:*** for example, persons are activating a manual call point with the intention of doing harm
  - ***False alarms with good intent:*** in an act of good faith (mistake), in which a person operates a manual call point in the belief that there is a fire, when actually no fire exists)

In addition to the terms, the requirements/standards of FDAS vary between the countries. FDAS are used inside buildings and they must meet many requirements. The requirements are described in standards. In general, we have to differentiate between product and application standards. If the components of FDAS meet the product requirements according to EN 54-series, and this is certified by a notified body, they can be provided with a CE mark and freely traded in the European Economic Area (and EFTA). In addition to the product requirements, FDAS are subject to application requirements. These national standards represent the “state of the art” and define the minimum requirements to be met in the design and operation process of FDAS. The national requirements vary. In short: Despite using the same products or components, there is a lack of comparability between the system technologies in different EU countries owing to the various application standards and philosophies of each country [10].

Figure 20 shows the false alarm rates FA_1 to FA_4. As expected, FA_4 is higher than FA_1. In addition, a variation between the different false alarm rates in the individual countries is visible. Comparisons between FDAS from different countries are made more difficult by different ways of alarm transmission connection between the FDAS and the fire services according to the national standards. In Germany, Switzerland and Sweden, most FDAS are connected directly to the fire services. In England, most FDAS are routed to the fire services through an ARC, which verifies the alarm.

Considering all of this, of course, in the different countries, we found a different quality and quantity of data material and statistics about false alarms from FDAS. These values show similarities, but they are not suitable for a direct comparison.

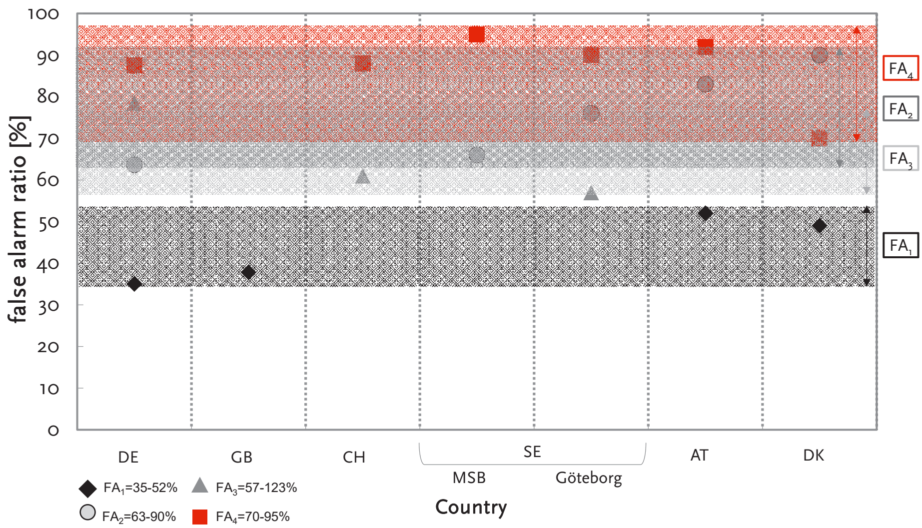

Figure 20: False alarm rates in different countries (a comparison is not reasonable)

Figure 21 shows the absolute number of false alarms per year and in average and the corresponding number of inhabitants. It can be seen that it does not make sense to derive conclusions by the absolute number of FA, as these are based on structural conditions. It cannot be used to measure whether the number is high or not.

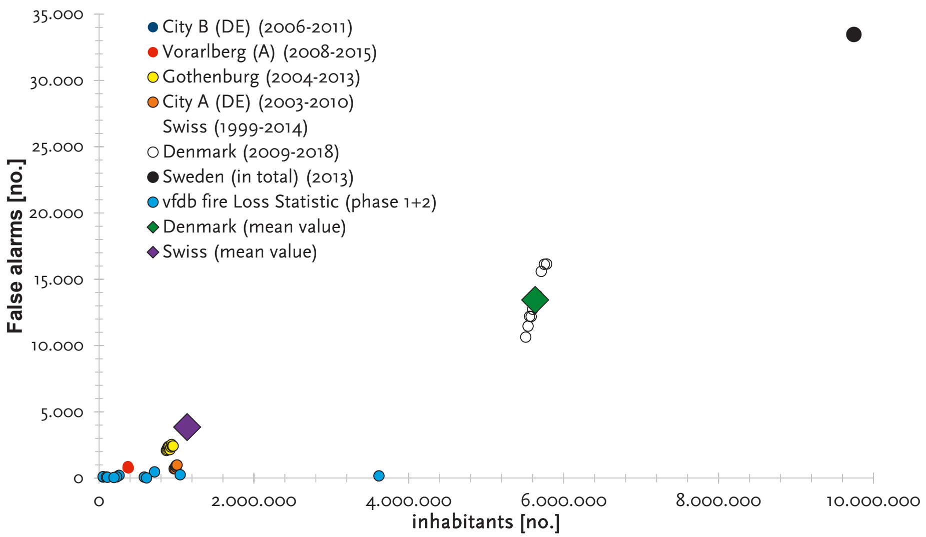

Figure 21: Absolute number of false alarms in relation to the number of inhabitants per data base

Table 8 gives a summarized overview of the false alarm situation in each country analyzed.

Table 8: Summary of the false alarm situation in countries analyzed

	Standards	Terminology	Alarm Transmission Connection	FA ratio
Germany	**Product standards:** DIN EN 54-series **Application standards:** DIN 14675, DIN VDE 0833-series, VdS 2095, VdS 3178, CPR	No standardized use; false alarm with subcategories	Most FDAS (approx. 90%) are connected automatically to fire services	FA_1 = 35% FA_2 = 64% FA_3 = 79% FA_4 = 88%
Great Britain (England)	**Product standards:** BS EN 54-series **Application standards:** BS 5839-1, (Non Domestic), BAFE 203, CPR	No standardized use; false alarm with subcategories	Mostly ARC verifies the alarm.	FA_1 = 38%
Switzerland	**Product standards:** (EN 54-series) Swiss Fire Protection Directive, Cantonal Building Insurers, Trade	Standardized use; unwanted alarm with subcategories	Most FDAS (approx. 90%) are connected automatically to fire services and approx. 10% are connected to an ARC.	FA_3 = 61% FA_4 = 88%
Sweden	**Product standards:** EN 54-series, SS3654 **Application standards:** SBF110 from Swedish Fire Protection assoc.	No standardized use; false alarm with 25 criteria	Most FDAS are connected automatically to fire services	FA_2 = 66–76% FA_3 = 57% FA_4 = 90–95%
Austria (Vorarlberg)	**Product standards:** EN 54-series, **Application standards:** TRVB 123, TRVB 151	No standardized use; False alarms are divided into equipment failures and deceptive alarms	Most FDAS are connected automatically to fire services	FA_1 = 52% FA_2 = 83% FA_3 = 123% FA_4 = 92%
Denmark	**Product standards:** EN 54-series, **Application standards:** Guideline 232 from Danish Institute of Fire and Security Technology	No standardized use; divided into false alarm and blind alarm	Most FDAS are registered to a database of fire services	FA_1 = 49% FA_2 = 90% FA_4 = 70% FA_5 = 6.2

6 Risks and Opportunities from False Alarms

False alarms are combined with risks and opportunities. Repeated false alarms can lead to a lack of response in the case of an alarm for a real fire [2], when people perceive an alarm to be false. In other words, alarms in dangerous situations may not be taken seriously.

In addition, there is the problem that false alarms consume and waste material and human resources. They also inflict economic costs. For example, in Germany the costs range between 600 and 1,200 EUR [13] per false alarm (the rules of financial support depending on the region), in Sweden it is between about 300 and 2,000 EUR and in Switzerland from 200 up to 2,000 Swiss Francs or even more.

False alarms can affect the stress and performance level of the rescue services. They may further be associated with an increased transport risk during journeys (high risk of collisions during emergency responses). Other side effects of directly transmitted fire alarms are many and include, the risk of injuries during evacuation, loss of production, delayed response to other locations, and inertia in case of repeated evacuations. For the fire brigades, false alarms cause increased expenditures for salaries and operation cost and may create challenges for recruitment and retention of fire fighters. Furthermore false alarms can also lead to a lack of acceptance of this technology.

False alarms are also combined with opportunities [2]. In relation to real fire alarms, false alarms occur relatively frequently and with little damage. These alarms can provide experience in dealing with alerting processes or the relevant properties. In this way, vulnerabilities in the technical and organizational alerting process can be established. In comparison, near misses are examined in safety science in order to gain insights into functional behaviors, without an incident having to take place.

Important knowledge can be derived from false alarms. This can be helpful in the case of a dangerous situation, for both the local stakeholders as well as for the rescue services, where the derived knowledge can reduce excessive and unfavorable (panic) stress reactions – whereby a degree of stress is important. This also applies partially to the occupants of the buildings. The rescue services gain practical objective knowledge at a relatively low cost in relation to an intervention with real fire condition.

Sebastian Festag, *False Alarm Study: Increase Fire Safety by Understanding False Alarms – Analysis of False Alarms from Fire Detection and Fire Alarm Systems in Europe*,

7 Strategies to Reduce False Alarms

As already mentioned, false alarms are not only fraught with dangers. If they are to be prevented nevertheless, some approaches are well known in the different countries analyzed. The following list shows measures to reduce or limit false alarms (see Germany [2], Great Britain [30], Switzerland [38], Sweden [42] and Austria [56]):

Products
- Usage of high quality products (e.g. CE marked and certified by a notified body, or fulfills optional and increased product requirements)
- Using optimized algorithms

Planning
- Exemption from scope of FDAS as a last resort and only after consultation with the relevant authority
- Prevention of unfavorable effects like: electromagnetic radiation, induction currents through cable lines close to conductors which carry lightning currents or close to electrical cables, air movement from e.g. air conditioners, creation of parameters of fire-like phenomena through operational processes, vibrations, weather influences like condensate formation, solar irradiation, dust, gases and water vapor, biological influences like micro-organisms and insects
- Consideration of suitable detector sensitivity settings
- Using a suitable measuring principle for the detector depending on the place of installation
- Performance monitoring of newly commissioned systems
- Positioning and selection of suitable products according to the place of installation of the detector (e.g. manual call points, automatic fire detectors)
- Further integration of the topic of false alarms into the concepts of FDAS and fire safety

Organization
- Carry out inspections after work that could cause combustion
- Comprehensive instruction of employees on the topic of fire Safety, FDAS and false alarms
- Deactivating the FDAS before work is carried out that may trigger deceptive alarms (e.g. building works, cleaning, maintenance)
- Employing at least one person on-site who is trained in handling the FDAS

- Engage well-trained and qualified (certified) providers to design, install and maintain the system
- Implementing a pre-alarm sequence
- Inform building operators and users, tenants, contractors, maintenance companies, fire services and police about the mode of operation of FDAS (raise general awareness)
- Informing external companies about the existence of fire detection equipment
- Intensify the cooperation between fire services, building owners and insurance companies to optimize the alarm process and information exchange (cf. [57])
- Provide feedback and possible corrective measures to the owner after a false alarm event
- Providing sufficient resources to organize operational fire protection
- Use of pre-transmission confirmation, which also promotes a fast, early on-site intervention against the fire
- Using the dual-detector dependency:
  - Type A; Following the first alarm signal of a fire detector, the FDAS delays the alarm condition until confirmation of an alarm signal from the same fire detector, or another detector in the same zone (In the past: “intermediate alarm storage”)
  - Type B; Following the first alarm signal of a fire detector, the FDAS delays the alarm condition until confirmation of an alarm signal from a fire detector of the same or another zone (In the past: “dual-zone dependency or two-detector dependency”)

Maintenance

- Adjustment of detectors when use changes
- Change and modernization of installations (regular check of the soiling of fire detectors)
- Consideration of additions and changes to existing standards, guidelines and recommendations as well as new regulations
- Consideration of products and application standards throughout the entire lifecycle (compliance with Fire Protection Code)
- Immediate resolution of faults in the FDAS
- Maintaining a log book with alarms, faults and operation modes for analysis of the alarm logs and to investigate the exact cause of the alarm to prevent repetition (updating the contact person in the datasheet)
- Monitor false alarms and advise on targets given the number of false alarms per 100 detectors per annum for different applications
- Owners/operators of FDAS take measures against false alarms to avoid penalties from the municipalities (charge internal and external costs to initiator)

- Regular servicing and maintenance, including the periodic check of the functionality of the FDAS
- Review detector type and settings with change of room use or geometry
- Inspection at delivery and periodic inspections thereafter, annually by trained 3rd party inspectors. This also contributes to better performing systems

8 Conclusion

It is not easy to differentiate between real and false alarms because it is not easy to say at which point we are talking about a real fire. A lot of cases are very clear, but not all. Has the situation changed between the alarm and the arrival of the fire and rescue services? As we have seen, additionally, sometimes it is not clear whether a term has the same meaning in two different countries. Even in the countries analyzed the situation is different and not directly comparable. As we have explained, the characteristic values of FDAS such as the false alarm ratio cannot simply be applied from one country to another. Among other things, a reason is that: a) a standardized European way of collecting and documenting the data does not exist – often not even in one country, b) a standardized use of terms is not given and c) the national application standards differ – and with that, the components of an alerting process.

It is important that we talk about the same things and derive conclusions from the same foundations. We need a common understanding of real and false fire alarms.

Overall, the false fire alarm ratio of FDAS (FA_4) is in a range of 87.5 to 95%, depending on the analyzed situation. The number of false alarms generally is falling, while the number of systems installed is rising, demonstrating that the technology works and that false alarm reduction strategies are effective. Often the false alarms are caused by deceptive phenomena, where the technical devices are functioning properly but their sensors respond to fire like conditions/substances (e.g. water vapor, dust, and solar radiation).

False alarms are not specific to fire. They occur in intrusion systems, airport scanner technology, even in the diagnosis of diseases. A false alarm rate of up to 95% might sound high, but it is comparable to other industries and technologies. But false alarms are not exclusively negative they can also identify vulnerabilities in detection or alerting systems and provide risk-free practise for emergency services in responding to incidents and in the specific alerting procedures of the properties where they occur. However, the discussion about which false alarm rate is tolerable has not even started yet. When answering this question, it should be kept in mind that a false alarm can cause costs of up to 2´000€, while a real fire can lead to up to 500,000€, depending on the circumstances.

More fundamental research activities are needed to get reliable facts. There are a lot of questions considering that real and false alarms are not on a same quality level: How many false alarms do we have? How can this be assessed quantitatively and qualitatively? When will we have more false alarms than we want to accept?

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Are false alarms in principle a side-effect of fire detection? How many real alarms do we have from FDAS? What are the effects of real and false alarms? Which technical approaches are helpful for a reliable and fast fire alarm combined with a view to false alarms? Looking at these questions this report provides some answers, but the picture remains incomplete.

Basically, we see that the subject of false alarms must be increasingly implemented and integrated into the fire protection and fire alarm strategies. Handling false alarms is an active part of the management of a site.

References

[1] DIN VDE 0833-1:2009-09. Gefahrenmeldeanlagen für Brand, Einbruch und Überfall – Teil 1: Allgemeine Festlegungen [Alarm systems for fire, intrusion and hold-up Part 1: General requirements]. Beuth publishing house: Berlin.

[2] Festag, S. & Döbbeling, E.P. (2020). vfdb-Brandschadenstatistik: Untersuchung der Wirksamkeit (anlagentechnischer) Brandschutzmaßnahmen. Technischer Bericht TB 14-01, Münster: vfdb..

[3] Bukowski R. & Mulholland, G. (1978). Bukowski &Istvan, 1980; Drouin, Arthur & Cote, 1984; Dätwyler, 1985; Teupser et al., 1987; Détriché et al., 1989.

[4] Bukowski, R. & Istvan, S. (1980). A survey of field experience with smoke detectors in health care facilities. Prepared for: U.S. Department of Health and Human Services. U.S. National Bureau of Standards: Washington, DC.

[5] Bukowski R. & Mulholland, G. (1978).Smoke Detector Design and Smoke Properties. U.S. Department of commerce. Washington, DC: National Bureau of Standards.

[6] Drouin, J., Arthur, E. & Cote, P. (1984). Smoke and Heat Detector Performance: Field Demonstration Test Results. National Fire Protection Association: Quincy.

[7] Dätwyler, F. (1985). False alarm reduction programme. CERBERUS: Männedorf.

[8] Teupser, (1987).Measures for Reducing the Level of Unwanted Alarms arising from Fire Detection and Alarm Systems. Final Document, Association of European Manufactures of Fire and Intruder Alarm Systems. Working Group 1.

[9] Détriché, Ph., Gately, B., Hertel, C., Hopf, K., Kunz, F., Teupser, R. &Wollin, G. (1989). Study of Efficiency of Fire Detection and alarm Systems. Final Document, Association of European Manufactures of Fire and Intruder Alarm Systems.

[10] Festag, S. & Staimer, A. (8/2012). Unterschiedliches Verhalten gleicher Anlagentechnik: Erläuterung am Beispiel der Gegenüberstellung von deutschen und britischen automatischen Brandmeldeanlagen, [Different Behaviour of Similar Industrial and Building Systems: Comments with an Example of Contrasting German and British Automated Fire Alarm Systems]., VFDB, 3/2012, pp. 128–134.

[11] Festag, S. & Schmitz, D. (8/2014). Bestimmung der Falschalarmrate von Brandmeldeanlagen [Determination of the Rate of False Alarms by Automated Fire Alarm Systems]. VFDB, 3/2014, pp. 134–141.

[12] Festag, S. (01/2016). False Alarm ratio of Fire Detection and Fire Alarm Systems in Germany – A Meta Analysis. Fire Safety Journal, Volume 79, Elsevier, pp. 119–126 (DOI: 10.1016/j.firesaf.2015.11.010).

[13] Döbbeling, E.P., Festag, S. & Witzigmann, M. (8/2012). Brandschadenstatistik zur Wirksamkeit anlagentechnischer Brandschutzmaßnahmen [Fire Damage Statistics for the Effectiveness of Fire Prevention Installations]. VFDB, edition 3/2012, pp. 123–127.

Sebastian Festag, *False Alarm Study: Increase Fire Safety by Understanding False Alarms – Analysis of False Alarms from Fire Detection and Fire Alarm Systems in Europe*,
DOI 10.5822/ 978-3-503-20969-9, © 2022, Erich Schmidt Verlag GmbH & Co. KG, Berlin.

[14] Festag, S. (05/2016). Brandschadenstatistik – Der Wert für die Wissenschaft. In vfdb (Hrsg.), vfdb-Jahresfachtagung 2016 (S. 209–226), Stuttgart: vfdb.

[15] Döbbeling, E.P. (05/2016). Brandschadenstatistik – Der Wert für die Feuerwehrpraxis. In vfdb (Hrsg.), vfdb-Jahresfachtagung 2016 (S. 227–xyz), Stuttgart: vfdb.

[16] Festag, S. (5/2017). Brandalarm, aber hat es auch gebrannt (?) – Herausforderungen für eine sichere Branderkennung. In vfdb (Hrsg.), vfdb-Jahresfachtagung 2017 (S. 73–90) in Bremen, Köln: VdS, SchadenverhütungGmbH Verlag.

[17] DIN EN 54-series. Brandmeldeanlagen [Fire detection and fire alarm systems]. Beuth publishing house: Berlin.

[18] DIN 14675:2012-04. Brandmeldeanlagen – Aufbau und Betrieb [Fire detection and fire alarm systems – Design and operation]. Beuth publishing house: Berlin.

[19] DIN VDE 0833-series. Gefahrenmeldeanlagen für Brand, Einbruch und Überfall [Alarm systems for fire, intrusion and hold up] Beuth publishing house: Berlin.

[20] VdS 2095:2010-05. VdS-Richtlinien für automatische Brandmeldeanlagen – Planung und Einbau [VdS Guidelines for automatic fire detection and fire alarm systems – Planning and Installation]. VdS Schadenverhütung GmbH: Köln.

[21] VdS 3178:2014-03. VdS-Richtlinien für automatische Brandmeldeanlagen – Brandgasmelder mit optionalem Temperatursensor – Anforderungen und Prüfmethoden [VdS Guidelines for automatic fire detection and fire alarm systems, fire gas detectors with optional temperature sensor – Requirements and test methods]. VdS Schadenverhütung GmbH: Köln.

[22] CPR – Construction Products Regulation. Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, Text with EEA relevance. European Union.

[23] Schmitz, D. & Festag, S. (10/2014). Estimating the magnitude of the false alarm ratio generated from installed fire detection and fire alarm systems in Germany based on fire brigades data. 15th International Conference on Automatic Fire Detection, 14.–16.

[24] Festag, S. & Herbster, H. (2012). Anlagentechnische Beiträge zur Unterstützung der Evakuierung von Gebäuden im Brandfall, [Fie system technologies for evacuation of buildings in case of fire]. In: DietmarHosser (Edt.).Braunschweiger Brandschutz-Tage 2012. 26th Symposium on Fire Protection of Special Buildings., September, 19.–20, 2012, Braunschweig, p. 41–60.

[25] Festag, S. & Meinert, M. (2019). Falschalarme als Phänomen: Chancen, Risiken und Gegenmaßnahmen. In Braunschweiger Brandschutztage, Braunschweig.

[26] Department for Communities and Local Government (11–12/2015)., Fire Statistics: Great Britain/April 2013 toMarch 2014. URL: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456652/Fire_Statistics_Great_Britain_2013-14___PDF_Version_.pdf.

[27] Department for Communities and Local Government (11–12/2015). Fire Statistics: England/April 2013 toMarch 2014., URL: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456623/Fire_Statistics_Monitor_April_2014_to_March_2015_Updated260815.pdf.

[28] Scottish Fire and Rescue Service (12/2014). Statistical Bulletin – Crime and Justice Series. Fire and rescueStatistics 2013–14: Scotland. URL: http://www.gov.scot/Resource/0046/00466202.pdf.

[29] BS EN 54-series. Fire detection and fire alarm systems. British Standards Institution: London.

[30] BS 5839-1:2013 Fire detection and fire alarm systems for buildings – Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises. British Standards Institution: London.

[31] BS 5839-6:2004. Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings. British Standards Institution: London.

[32] BAFE Scheme: SP203-1. For the Design, Installation, Commissioning & Maintenance of Fire Detection and Fire Alarm Systems. BAFE – British Approvals for Fire Equipment: Gloucestershire.

[33] SES – Swiss Association of Installers of Security Systems (06/2016). Alarmstatistik Brandmeldeanlagen [alarm statistics of installed FDAS]. Joint effort of the professional fire brigades Basle, Bern, Geneva, Vaud, Zurich, und La Chaux-de-Fonds,, the Swiss Association of Fire Fighters (SFV) and Swiss Association of Installers of Security Systems (SES): Zollikofen.

[34] FKS – Swiss Fire Brigade Coordination. Downloads of Fire Brigade statistics. URL: http://www.feukos.ch/de/downloads/.

[35] SVF – Swiss Fire Brigade Association. Annual statistics. URL: http://www.swissfire.ch/fileadmin/swissfire/Der%20SFV/FKS-Statistik_2015_d.pdf.

[36] SN EN 54-series. Brandmeldeanlagen [Fire Detection and Fire Alarm Systems]. SNV Schweizerische Normen-Vereinigung: Winterthur.

[37] VKF – Vereinigung Kantonaler Feuerversicherungen (01/2015), Brandschutznorm [fireprotection standard]: Bern.

[38] SES – Swiss Association of Installers od Security Systems (05/2008). Merkblatt für Betreiber von Brandmeldeanlagen zur Vermeidung von ungewollten Alarmen [SES Technical Bulletins for operators of FDAS on how to avoid false alarms]., URL: https://www.sicher-ses.ch/de/dokumente/technische-dokumente/ftw-simplelayout-filelistingblock/merkblatt-bm-de-02-20080524-v1.pdf/download.

[39] Mc Inyre, C. (04/2015). Data from the MSB. MSB – SwedishCivilContingencies Agency. Table 1.8, Presentation EURALARM TG False Fire Alarm meeting in Gothenburg. URL: www.msb.se/en/.

[40] Paulusson, B. (04/2015). Göteborg Mölndal Kungsbacka Härryda Partille Lerum. Presentation EURALARM TG False Fire Alarm meeting in Gothenburg. Gothenburg fire brigade. URL: www.rsgbg.se/.

[41] SS-EN 54-series. Branddetekterings- och brandlarmsystem [Fire Detection and Fire Alarm Systems]. SIS – Swedish Standards Institute: Stockholm.

[42] SBF 110:7, October 2014. Regler för brandlarmanläggning [Rules for Automatic Fire Alarm]. Swedish Fire Protection association: Stockholm.

[43] Statistik des ÖBFV – Österreichischer Bundesfeuerwehrverband, Wien. URL: http://www.bundesfeuerwehrverband.at/downloads/statistiken-des-oebfv/.

[44] OENORM EN 54-series. Brandmeldeanlagen [Fire Detection and Fire Alarm Systems]. Austrian Standards Institute: Wien.

[45] TRVB 001 A (2017). Definitionen [Definition]. Technische Richtlinien vorbeugender Brandschutz, Österreichischer Bundesfeuerwehrverband. Die österreichischen Brandverhütungsstellen: Wien.

[46] TRVB 123 S (2011).Brandmeldeanlagen [Fire Detection and Fire Alarm Systems]. Technische Richtlinien vorbeugender Brandschutz, Österreichischer Bundesfeuerwehrverband. Die österreichischen Brandverhütungsstellen: Wien.

[47] TRVB 151 S (2015). Brandfallsteuerungen – Ansteuerung von automatischen Brandschutzeinrichtungen durch automatische Brandmeldeanlagen gemäß TRVB 123 S [Actuation of automatic fire protection devices]., Technische Richtlinien vorbeugender Brandschutz, Österreichischer Bundesfeuerwehrverband. Die österreichischen Brandverhütungsstellen: Wien.

[48] TRVB 114 S (2015). Anschaltebedingungen von Brandmeldeanlagen an öffentliche Feuerwehren. Technische Richtlinien vorbeugender Brandschutz, Österreichischer Bundesfeuerwehrverband. Die österreichischen Brandverhütungsstellen: Wien.

[49] OENORM F 3051:2011-08-15. Automatische Brandschutzanlagen – Auswertezentrale für Alarmübertragungssysteme [Fire detection and fire alarm systems – Receiving center transceiver for alarm transmission systems]. Austrian Standards Institute: Wien.

[50] OENORM F 3052:2012-03-01. Brandmeldeanlagen – Alarmübertragungssysteme [Fire detection and fire alarm systems – Alarm transmission systems]. Austrian Standards Institute: Wien.

[51] Haltmeier, M. (2014). Reduktion der Feuerwehreinsätze durch die Verringerung von Täuschungsalarmen automatischer Brandmeldeanlagen [Reduction of the fire brigades' operational commands by diminishing spurious alarms of automatic fire detection systems]., Master Thesis, Zentrum für Infrastrukturelle Sicherheit der Donau-Universität Krems: Krems.

[52] Giselbrecht, K. (2015). Fires in buildings with fatal consequences – attempt to make an analysis in Austria. EUSAS / EURALARM Conference on "Fire Detection in private Homes", Freiburg, Germany, May 12–13, 2015.

[53] The Danish Emergency Management Agency [2011]. Note on blind, false and real alarms (in Danish 'Notat om blinde, falske og reelle alarmer').

[54] The Danish Emergency Management Agency [2017]. Analysis: Automatic Fire Alarm Systems (in Danish: Analyse: Automatiske brandalarmanlæg).

[55] The Danish Emergency Management Agency. The estimated numbers of detectors was kindly provided by SikkerhedsBranchen – The Danish Trade Organization for Safety and Security.

[56] Brand Verhütungsstelle Vorarlberg (2014). Falsche Alarme sind teuer! Fehlalarmierungen durch Brandmeldeanlagen können teuer werden: Bregenz.

[57] Insurance company Göta Lejon. URL: www.gotalejon.goteborg.se/wps/portal/gotal/in-english/.

[58] Giselbrecht, K. (2018). Datenbank der Brandverhütungsstelle Vorarlberg.

Appendix

Table A1: Fires, building fires and false alarms (Great Britain/England) [27]

criteria / year	England		Great Britain
	2013–14		**2013–14**
Total (fires and false alarms)	505'600	**Total (fires and false alarms)**	393'300
Building fires – other	21'700	**Fires in primary buildings, Others (not dwellings)** *we dont know the number of false alarms in building*	16'200
False alarms	293'100	**Fire alarms due to apparatus** *but apparatus are more then FDAS*	148'700

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Table A2: FDAS-Installations, fire alarms, false alarms and false alarm ratio (Switzerland) [33]

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018	Avg.
Anzahl Anlagen *Number of installations* *Nombre d'installations*	5'311	4'930	4'897	4'879	5'321	4'766	4'942	5'577	5'462	5'510	5'631	5'637	5'501	6'164	6'186	6'405	6'226	7'151	7'097	7'477	5'663
Anzahl Alarmmeldungen *Number of fire alarms* *Nombre des alarmes*	4'066	4'386	4'753	4'803	4'901	4'471	4'314	4'377	4'404	4'425	4'329	4'312	4'237	4'292	4'249	4'540	4'073	4'997	4'853	3'224	4'462
Anzahl Echte Alarme *Number of real fire alarms* *Nombre des alarmes justifiées*	459	573	575	614	597	641	655	623	589	614	726	725	645	677	651	491	427	619	459	502	598
Anzahl Anlagen mit Auslösungen *Number of installations with activations / alarms* *Nombre d'installations avec déclenchements*	3'385	3'071	2'968	2'965	3'101	2'787	2'704	2'722	2'823	2'859	2'684	2'606	2'672	2'688	2'614	2'494	2'236	2'817	2'812	2'722	2'790
Anzahl Ungewollte Alarme *Number of false alarms* *Nombre des alarmes injustifiées*	3'607	3'813	4'178	4'189	4'304	3'830	3'659	3'754	3'815	3'811	3'603	3'587	3'592	3'615	3'598	4'049	3'646	4'378	4'394	4'310	3'864
Anteil echte Alarme % *Part of real alarms %* *Part des alarmes justifiées %*	11.29	13.06	12.10	12.78	12.18	14.34	15.18	14.23	13.37	13.88	16.77	16.81	15.22	15.77	15.32	10.81	10.48	12.39	9.46	15,6	13.44
FA_3 [%]	**67.92**	**77.34**	**85.32**	**85.86**	**80.89**	**80.36**	**74.04**	**67.31**	**69.85**	**69.17**	**63.99**	**63.63**	**65.30**	**58.65**	**58.16**	**63.22**	**58.56**	**61.22**	**61.91**	**36,40**	**68.24**
FA_4 [%]	**88.71**	**86.94**	**87.90**	**87.22**	**87.82**	**85.66**	**84.82**	**85.77**	**86.63**	**86.12**	**83.23**	**83.19**	**84.78**	**84.23**	**84.68**	**89.19**	**89.52**	**87.61**	**90.54**	**84,43**	**86.60**

Table A3: FDAS-Installations with false alarms (Switzerland) [33]

Anzahl Anlagen mit ungewollten Alarmen *Number of installations with false alarms* *Nombre d'installations avec des alarmes injustifiées*	1'746	2'000	2'152	2'196	2'158	2'061	2'048	2'018	2'142	2'072	2'077	2'036	2'055	1'958	2'046	2'284	2'055	2'482	2'467	–	2'108
Anteil der Anlagen mit ungewollten Alarmen % *Part of installations with false alarms %* *Part d'installations avec des alarmes injustifiées %*	32.88	40.57	43.95	45.01	40.56	43.24	41.44	36.18	39.22	37.60	36.89	36.12	37.36	31.77	33.07	35.66	33.01	34.71	34.76	–	37.58

Table A4: Cause of FDAS alarms (Switzerland) [33]

Ursache der Alarmierung [Anzahl] / *cause of alarms [number] / causes des alarmes [nombre]*	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2018**	**Avg.**	**part [%]**
Echter Alarm *Real fire alarms Alarmes justifiée*	459	573	575	614	597	641	655	623	589	614	726	725	645	677	651	491	427	619	459	502	593	13.47
Bedienungsfehler *Handling/operationg error Fausse manipulation*	344	381	368	351	351	298	250	227	245	209	262	266	231	228	250	243	241	202	214	216	269	6.10
Unfug *Sabotage Sabotage*	222	227	231	229	211	188	165	176	174	182	124	183	192	180	162	155	153	282	255	297	199	4.53
Umgebung, Betrieb *Environment, operation Environnement, activité*	974	1'044	1'191	1'213	1'405	1'187	1'198	1'280	1'315	1'299	1'182	1'137	1'230	1'299	1'255	1'535	1'447	1'737	1'795	1'732	1'323	30.06
Arbeiten ausgeführt *Carried out work Travaux exécutés*	543	515	611	644	641	557	540	629	573	561	533	532	497	519	572	608	542	749	767	573	585	13.30
Technische Defekte *Technical fault Défaults techniques*	450	632	640	698	722	623	566	557	607	601	589	518	535	452	478	510	372	545	503	456	553	12.56
Unbekannte Ursachen *Cause unknwon Causes inconnues*	1'074	1'014	1'137	1'054	974	977	940	885	901	959	913	951	907	937	881	998	891	863	860	1'036	958	21.76

Table A5: FDAS-Installations, fire alarms, false alarms and false alarm ratio in 2015 per fire brigade (Switzerland) [33]

2015	Basel	Bern	Genève	Zürich	Vaud	Tot.
Anzahl Anlagen *Number of installations* *Nombre d'installations*	1'168	967	1'484	1'247	2'231	7'097
Anzahl Alarmmeldungen *Number of fire alarms* *Nombre des alarmes*	719	693	1'117	830	1'494	4'853
Alarmrate je Anlage % *Alarm rate per Installation %* *Quote-part des alarmes par installa-tion %*	61.56	71.66	75.27	66.56	66.97	68.38
Anzahl Echte Alarme *Number of real fire alarms* *Nombre des alarmes justifiées*	55	77	93	100	134	459
Anzahl Ungewollte Alarme *Number of false alarms* *Nombre des alarmes injustifiées*	664	616	1'024	730	1'360	4'394
FA_3 [%]	**56.85**	**63.70**	**69.00**	**58.54**	**60.96**	**61.91**
FA_4 [%]	**92.35**	**88.89**	**91.67**	**87.95**	**91.03**	**90.54**

Table A6: FDAS fire alarms per month and year (Sweden/Gothenburg) [39]

Anzahl Alarmmeldungen Number of fire alarms Nombre des alarmes	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	average	part [%]
Jan	208	233	210	251	224	193	263	234	209	238	190	223	8.48
Feb	194	197	156	204	163	199	216	196	222	173	142	187	7.13
Mar	207	184	234	192	193	199	223	189	207	191	197	201	7.66
Apr	172	181	163	194	221	206	179	205	201	203	175	191	7.26
Maj	169	197	191	236	217	166	193	220	200	226	204	202	7.67
Jun	193	178	224	222	213	171	151	197	212	232	207	200	7.61
Jul	197	249	248	253	221	234	217	283	254	255	248	242	9.19
Aug	238	224	268	280	253	241	256	301	223	247	247	253	9.61
Sep	200	236	220	218	242	214	189	271	213	244	219	224	8.53
Okt	223	210	277	245	246	193	253	240	245	224	267	238	9.07
Nov	224	242	219	219	231	198	216	234	213	203	237	221	8.42
Dec	247	225	262	222	228	248	276	229	279	249	242	246	9.36
Total	2'472	2'556	2'672	2'736	2'652	2'462	2'632	2'799	2'678	2'685	2'575	2'629	100.00

Table A7: FDAS real fire alarms per month and year (Sweden/Gothenburg) [39]

Anzahl Echte Alarme Number of real fire alarms Nombre des alarmes justifiées	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	average	part [%]
Jan	39	40	43	39	20	32	38	24	28	36	28	33	1.27
Feb	29	30	27	36	19	22	27	19	15	19	15	23	0.89
Mar	29	32	30	28	15	27	22	23	24	15	20	24	0.92
Apr	25	32	30	32	20	32	20	29	26	24	25	27	1.02
Maj	39	39	32	39	23	23	28	21	16	17	17	27	1.02
Jun	32	23	28	25	22	23	18	16	15	19	23	22	0.84
Jul	24	28	22	19	15	19	14	20	25	10	27	20	0.77
Aug	21	27	34	24	19	17	20	18	17	19	24	22	0.83
Sep	25	31	29	22	35	19	14	19	13	22	25	23	0.88
Okt	39	24	26	30	24	28	25	11	28	25	16	25	0.95
Nov	31	30	22	25	23	29	11	24	19	26	17	23	0.89
Dec	50	47	63	35	38	35	41	35	36	25	23	39	1.48
Total	383	383	386	354	273	306	278	259	262	257	260	309	11.76

Table A8: FDAS false alarms per month and year (Sweden/Gothenburg) [39]

Anzahl Ungewollte Alarme Number of false alarms Nombre des alarmes injustifiées	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	average	part [%]
Jan	169	193	167	212	204	161	225	210	181	202	162	190	7.21
Feb	165	167	129	168	144	177	189	177	207	154	127	164	6.24
Mar	178	152	204	164	178	172	201	166	183	176	177	177	6.75
Apr	147	149	133	162	201	174	159	176	175	179	150	164	6.24
Maj	130	158	159	197	194	143	165	199	184	209	187	175	6.66
Jun	161	155	196	197	191	148	133	181	197	213	184	178	6.76
Jul	173	221	226	234	206	215	203	263	229	245	221	221	8.42
Aug	217	197	234	256	234	224	236	283	206	228	223	231	8.78
Sep	175	205	191	196	207	195	175	252	200	222	194	201	7.65
Okt	184	186	251	215	222	165	228	229	217	199	251	213	8.12
Nov	193	212	197	194	208	169	205	210	194	177	220	198	7.53
Dec	197	178	199	187	190	213	235	194	243	224	219	207	7.88
Total	2'089	2'173	2'286	2'382	2'379	2'156	2'354	2'540	2'416	2'428	2'315	2'320	88.24

Table A9: Fire alarms, false alarms and false alarm ratio per year (Austria/Vorarlberg) [58]

Jahr *year*	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**avg.**
BMA-RFL Falschalarme *FDAS false alarms*	776	882	832	811	910	830	737	773	819
Alle echten Brandeinsätze *All real fire-fighting operations*	706	738	600	655	637	584	636	640	650
BMA-RFL Falschalarme *FDAS false alarms*	776	882	832	811	910	830	737	773	819
Alle FA-Einsätze **(Telefon, Mobil und Gebäude.., Flure, Wiesen)** *All false fire-fighting operations* *(phone, mobilephone an buildings, fields*	92	185	78	104	135	94	129	74	111
FA_1	**49.3**	**48.9**	**55.1**	**51.7**	**54.1**	**55.0**	**49.1**	**52.0**	**51.8**
BMA-RFL Falschalarme *FDAS false alarms*	776	882	832	811	910	830	737	773	819
Alle echten Brandeinsätze in Gebäuden *All real fire-fighting operations in buildings*	368	331	301	289	282	296	317	332	315
Gebäude Einsätze – BMA Täuschungsalarme *fire-fighting operations in buildings – deceptive alarms with FDAS*	555	599	623	567	657	568	511	500	573
Alle FA-Einsätze in Gebäuden (Telefon, Mobil,..) *All false fire-fighting operations in buildings*	76	173	73	90	125	81	114	38	96
FA_2	**77.7**	**80.0**	**83.5**	**85.7**	**85.5**	**87.8**	**78.2**	**88.9**	**83.3**
BMA-RFL Falschalarme *FDAS false alarms*	776	882	832	811	910	830	737	773	819
Anzahl der aufgeschalteten BMA's *Number of installed FDAS*	561	596	635	652	682	715	738	751	666
FA_3	**138.3**	**148.0**	**131.0**	**124.4**	**133.4**	**116.1**	**99.9**	**102.9**	**122.9**
BMA-RFL Falschalarme *FDAS false alarms*	776	882	832	811	910	830	737	773	819
BMA-RFL Gesamtalarme *All FDAS alarms*	839	933	898	885	962	902	833	837	886
FA_4	**92.5**	**94.5**	**92.7**	**91.6**	**94.6**	**92.0**	**88.5**	**92.4**	**92.4**

Table A10: Fire-fighting operations per year (Austria/Vorarlberg) [58]

Feuerwehr-einsätze *fire-fighting operations*	**Jahr** *year*	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**total**	**aver-age**
Gebäude *buildings*	**Number**	368	331	301	289	282	296	317	332	2'516	315
	previous year %		–10.1	–9.1	–4.0	–2.4	5.0	7.1	4.7		–1.2
	%	52.1	44.9	50.2	44.1	44.3	50.7	49.8	51.9		48.5
Rauchfang *chimney*	**Number**	65	48	60	52	54	60	60	46	445	56
	previous year %		–26.2	25.0	–13.3	3.8	11.1	0.0	–23.3		–3,3
	%	9.2	6.5	10.0	7.9	8.5	10.3	9.4	7.2		8,6
Wald *forest*	**Number**	18	24	9	22	6	4	12	11	106	13
	previous year %		33.3	–62.5	144.4	–72.7	–33.3	200.0	–8.3		28,7
	%	2.5	3.3	1.5	3.4	0.9	0.7	1.9	1.7		2,0
Wiesen, Flure *grassland*	**Number**	36	47	41	63	46	33	44	44	354	44
	previous year %		30.6	–12.8	53.7	–27.0	–28.3	33.3	0.0		7,1
	%	5.1	6.4	6.8	9.6	7.2	5.7	6.9	6.9		6,8
Müll, Container *waste, container*	**Number**	102	100	90	66	83	62	46	44	593	74
	previous year %		–2.0	–10.0	–26.7	25.8	–25.3	–25.8	–4.3		–9,8
	%	14.4	13.6	15,0	10.1	13.0	10.6	7.2	6.9		11,4
Fahrzeuge *vehicles*	**Number**	70	63	47	76	57	56	47	61	477	60
	previous year %		–10.0	–25.4	61.7	–25.0	–1.8	–16.1	29.8		1,9
	%	9.9	8.5	7.8	11.6	8.9	9.6	7.4	9.5		9,2
Sonstige *other*	**Number**	47	125	52	87	109	73	110	102	705	88
	previous year %		166.0	–58.4	67.3	25.3	–33.0	50.7	–7.3		30,1
	%	6.7	16.9	8.7	13.3	17.1	12.5	17.3	15.9		13,5
Gesamt *Total*	**Number**	706	738	600	655	637	584	636	640	5'196	650
	previous year %		4.5	–18.7	9.2	–2.7	–8.3	8.9	0.6		–0,9

Table A11: Fire-fighting operations: fire size and fire detection per year (Austria/ Vorarlberg) [58]

Feuerwehreinsätze: Gesamtgebäude nach Brandausmaß und Brandentdeckung *fire-fighting operations: fire size and fire detection*	**Jahr** *year*	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**total**	**average**
Groß *large*	**Number**	39	23	23	13	18	9	22	18	165	21
	%	10.6	6.9	7.6	4.5	6.4	3.0	6.9	5.4		6.4
Mittel *medium*	**Number**	46	56	44	42	50	51	48	59	396	50
	%	12.5	16.9	14.6	14.5	17.7	17.2	15.1	17.8		15.8
Klein *small*	**Number**	160	170	155	147	128	125	136	149	1'170	146
	%	43.5	51.4	51,5	50.9	45.4	42.2	42.9	44.9		46.6
Gelöscht *extinguished*	**Number**	119	78	54	62	54	70	68	59	564	71
	%	32.3	23.6	17.9	21.5	19.1	23.6	21.5	17.8		22.2
Kein – Gesamt *non – total*	**Number**	4	4	25	25	32	41	43	47	221	28
	%	1.1	1.2	8.3	8.7	11.3	13.9	13.6	14.2		9.0
Kein – davon Beinahebrand *non – nearly fire*	**Number**	2	3	20	11	29	38	36	47	186	23
	%	50.0	75.0	80.0	44.0	90.6	92.7	83.7	100.0		77.0
Gesamt *total*	**Number**	368	331	301	289	282	296	317	332	2'516	315
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0
Entdeckung Personen *detection by persons*	**Number**	301	278	232	210	228	213	212	260	1'934	242
	%	81.8	84.0	77.1	72.7	80.9	72.0	66.9	78.3		76.7
Entdeckung BMA *detection by installed FDAS*	**Number**	63	51	66	74	52	72	96	64	538	67
	%	17.1	15.4	21.9	25.6	18.4	24.3	30.3	19.3		21.5
Entdeckung Wohn. Melder *detection by smoke detector*	**Number**	4	2	3	5	2	11	9	8	44	6
	%	1.1	0.6	1.0	1.7	0.7	3.7	2.8	2.4		1.8
Gesamt *total*	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0

Table A12: FDAS-Installations per operation area and year (Austria/Vorarlberg) [58]

Aufgeschaltete Brandmeldeanlagen und Einsatzgebiete *Installed FDAS and operation area*		**Jahr** *year*	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**aver-age**
Gesamt *total*		**Number**	561	596	635	652	682	715	738	751	666
		%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Wohngebäude *residential buildings*		**Number**	7	7	8	10	11	11	11	12	10
		%	1.2	1.2	1.3	1.5	1.6	1.5	1.5	1.6	1.4
Gewerbe + Industrie *trade + industry*		**Number**	350	375	396	402	421	441	455	464	413
		%	62.4	62.9	62.4	61.7	61.7	61.7	61.7	61.8	62.0
Landwirtschaft *agriculture*		**Number**	0	0	0	0	0	0	0	0	0
		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sonstige Gebäude *Other buildings*	**öffentliche Gebäude** *public buildings*	**Number**	100	107	114	119	124	132	137	135	121
		%	17.8	18.0	18.0	18.3	18.2	18.5	18.6	18.0	18.1
	Bürogebäude *offices*	**Number**	40	41	45	46	48	51	53	55	47
		%	7.1	6.9	7.1	7.1	7.0	7.1	7.2	7.3	7.1
	Krankenhäuser, Altenheime *Hospitals, retirement homes*	**Number**	64	64	69	73	75	76	78	80	72
		%	11.4	10.7	10.9	11.2	11.0	10.6	10.6	10.7	10.9
	Sonstige *other*	**Number**	0	2	3	2	3	4	4	5	3
		%	0.0	0.3	0.5	0.3	0.4	0.6	0.5	0.7	0.4
	Gesamt Sonstige Gebäude *total other buildings*	**Number**	204	214	231	240	250	263	272	275	244
		%	36.4	35.9	36.4	36.8	36.7	36.8	36.9	36.6	36.5

Table A13: FDAS real fire alarms and causes for false alarms per year I (Austria/ Vorarlberg) [58]

Jahr *year*		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**aver- age**
BMA-RFL Echtalarme *FDAS real fire*	**Total Number**	63	51	66	74	52	72	96	64	67
	% an Gesamtalarmen *% of total alarms*	7.5	5.5	7.3	8.4	5.4	8.0	11.5	7.6	7.7
BMA RFL Täuschungsalarme mit BMA Beinahebränden (bereinigt um Sybos-Doppelzählungen) *FDAS deceptive alarms with FDAS nearly fire (adjusted by Sybos-double counts)*	**BMA Beinahe Zahl** *FDAS nearly fire number*	11	22	22	25	61	44	31	23	30
	BMA Täusch. Ohne Beinahe Zahl *FDAS deceptive alarm without nearly fire number*	544	577	601	542	596	524	480	477	543
	BMA Täusch. + Beinahe Zahl *FDAS deceptive alarm with nearly fire number*	555	599	623	567	657	568	511	500	573
	BMA Beinahe % an Täusch. *FDAS nearly fire % of deceptive alarm*	2.0	3.7	3.5	4.4	9.3	7.7	6.1	4.6	5.2
	% Beinahe an Gesamtalarmen *% nearly fire of total alarms*	1.3	2.4	2.4	2.8	6.3	4.9	3.7	2.7	3.3
	% Täusch. an Gesamtalarmen *% deceptive alarm of total alarms*	64.8	61.8	66.9	61.2	62.0	58.1	57.6	57.0	61.2
	% Täuschung + Beinahe an Gesamtalarmen *% deceptive alarm + nearly fire of total alarms*	66.2	64.2	69.4	64.1	68.3	63.0	61.3	59.7	64.5
BMA-RFL Fehlalarme (bereinigt um Doppel- zählungen) *FDAS technical defects (adjusted by double counts)*	**Number**	200	256	189	216	221	240	200	252	222
	% Fehlalarme an Gesamtalarmen *% technical defect of total alarms*	23.8	27.4	21.0	24.4	23.0	26.6	24.0	30.1	25.1
BMA-RFL Böswillige Alarme *FDAS malicious alarms*	**Number**	21	27	20	28	32	22	26	21	25
	% Bösw. an Gesamtalarmen *% malicious alarms of total alarms*	2.5	2.9	2.2	3.2	3.3	2.4	3.1	2.5	2.8
BMA-RFL Gesamt- alarme *FDAS total alarms*	**Number**	839	933	898	885	962	902	833	837	886
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A14: FDAS real fire alarms and causes for false alarms per year II (Austria/ Vorarlberg) [58]

Jahr *year*		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**aver-age**
BMA RFL *FDAS*	**Number**	561	596	635	652	682	716	738	751	666
BMA-RFL Echtalarme *FDAS real fire*	**Number**	63	51	66	74	52	72	93	64	67
	Alarme pro BMA *Alarms per FDAS*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	% aller BMA *% all FDAS*	11.2	8.6	10.4	11.3	7.6	10.1	12.6	8.5	10.0
BMA-RFL Täuschungsalarme Beinahebrände *FDAS deceptive alarm with nearly fire*	**Number**	11	22	22	25	61	44	31	23	30
	Alarme pro BMA *Alarms per FDAS*	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
	% aller BMA *% all FDAS*	2.0	3.7	3.5	3.8	8.9	6.1	4.2	3.1	4.4
BMA-RFL Täuschungsalarme ohne Beinahebrände (bereinigt um Sybos-Doppelzählungen) *FDAS deceptive alarm without nearly fire (adjusted by Sybos-double counts)*	**Number**	544	577	601	542	596	524	480	477	543
	Alarme pro BMA *Alarms per FDAS*	1.0	1.0	0.9	0.9	0.9	0.8	0.7	0.7	0.9
	% aller BMA *% all FDAS*	97.0	96.8	94.6	83.1	87.4	73.2	65.0	63.5	82.6
BMA-RFL Fehlalarme (bereinigt um Sybos-Doppelzählungen) *FDAS technical defects (adjusted by Sybos-double counts)*	**Number**	200	256	189	216	221	240	200	252	222
	Alarme pro BMA *Alarms per FDAS*	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	% aller BMA *% all FDAS*	35.7	43.0	29.8	33.1	32.4	33.5	27.1	33.6	33.5
BMA-RFL Böswillige Alarme (bereinigt um Sybos-Doppelzählungen) *FDAS malicious alarms (adjusted by Sybos-double counts)*	**Number**	21	27	20	28	32	22	26	21	25
	Alarme pro BMA *Alarms per FDAS*	0.04	0.05	0.03	0.04	0.05	0.03	0.04	0.03	0.04
	% aller BMA *% all FDAS*	3.7	4.5	3.1	4.3	4.7	3.1	3.5	2.8	3.7
BMA-RFL Gesamtalarme *FDAS total alarms*	**Number**	839	933	898	885	962	902	833	837	886
	Alarme pro BMA *Alarms per FDAS*	1.5	1.6	1.4	1.4	1.4	1.3	1.1	1.1	1.3
	% aller BMA *% all FDAS*	149.6	156.5	141.4	135.7	141.1	126.0	112.9	111.5	134.3

Table A15: Fire-fighting operations: FDAS – deceptive alarm and causes per year (Austria/Vorarlberg) [58]

Feuerwehreinsätze: BMA-RFL Täuschungsalarme und Ursachen *fire-fighting operations: FDAS – deceptive alarm and causes*	**Jahr** *year*	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**total**	**aver-age**
Staub *dust*	**Number**	42	36	32	64	54	40	47	53	368	46
	%	7.6	6.0	5.1	11.3	8.2	7.0	9.2	10.6		8,1
Küchendunst, Kochgeräte *kitchen dust, cooking appliances*	**Number**	64	72	79	69	99	82	72	73	610	76
	%	11.5	12.0	12.7	12.2	15.1	14.4	14.1	14.6		13,3
Bau- und Schleifarbeiten *construction and grinding work*	**Number**	46	56	50	55	55	60	60	44	426	53
	%	8.3	9.3	8.0	9.7	8.4	10.6	11.7	8.8		9,4
Wasserdampf *steam*	**Number**	63	77	87	87	100	88	80	69	651	81
	%	11.4	12.9	14.0	15.3	15.2	15.5	15.7	13.8		14,2
Rauchwaren *smoked foods*	**Number**	23	28	18	25	20	29	13	11	167	21
	%	4.1	4.7	2.9	4.4	3.0	5.1	2.5	2.2		3,6
Abgase, Feuerstätten, Fahrzeuge, Maschinen, Geräten *exhaust, fireplace, vehicle, machines, equipment*	**Number**	17	27	25	19	51	43	61	58	301	38
	%	3.1	4.5	4.0	3.4	7.8	7.6	11.9	11.6		6,7
Schweißen, Flexen, Löten *welding, flexing, brazing*	**Number**	30	30	37	27	21	21	18	15	199	25
	%	5.4	5.0	5.9	4.8	3.2	3.7	3.5	3.0		4,3
Wassereintritt *water ingress*	**Number**	13	15	18	12	16	16	10	13	113	14
	%	2.3	2.5	2.9	2.1	2.4	2.8	2.0	2.6		2,5
Reinigung, Wartung *cleaning, maintenance*	**Number**	24	34	29	35	50	31	21	40	264	33
	%	4.3	5.7	4.7	6.2	7.6	5.5	4.1	8.0		5,8
Arbeiten BMA *working at FDAS*	**Number**	21	26	40	29	29	33	33	24	235	29
	%	3.8	4.3	6.4	5.1	4.4	5.8	6.5	4.8		5,1
Sonstige *other*	**Number**	87	86	92	79	100	78	65	61	648	81
	%	15.7	14.4	14.8	13.9	15.2	13.7	12.7	12.2		14,1
Unbekannte *unknown*	**Number**	125	112	116	66	62	47	31	39	598	75
	%	22.5	18.7	18.6	11.6	9.4	8.3	6.1	7.8		12,9
Gesamt BMA *total FDAS*	**Number**	555	599	623	567	657	568	511	500	4'580	573
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100,0

Table A16: Fire-fighting operations: FDAS – deceptive alarm, objects and time per year (Austria/Vorarlberg) [58]

Feuerwehreinsätze: BMA-RFL Täuschungsalarme und Objekthauptgruppen sowie Tageszeit *fire-fighting operations: FDAS – deceptive alarm, objects and time*		**Jahr** *year*	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**total**	**average**
Wohngebäude *residential buildings*		Number	4	10	17	21	20	33	12	17	134	17
		%	0.7	1.7	2.7	3.7	3.0	5.8	2.3	3.4		2.9
Sonstige Gebäude	**Öffentl. Gebäuden** *public buildings*	Number	38	55	43	53	78	65	70	57	459	57
		%	6.8	9.2	6.9	9.3	11.9	11.4	13.7	11.4		10.1
	Bürogebäude *office buildings*	Number	17	37	29	10	12	14	17	9	145	18
		%	3.1	6.2	4.7	1.8	1.8	2.5	3.3	1.8		3.1
	Krankenhäuser, Altenheime *hospitals, retirement homes*	Number	55	68	69	62	67	43	48	33	445	56
		%	9.9	11.4	11.1	10.9	10.2	7.6	9.4	6.6		9.6
	Sonstige *other*	Number	0	1	0	1	2	8	13	15	40	5
		%	0.0	0.2	0.0	0.2	0.3	1.4	2.5	3.0		1.0
	Gesamt Sonstige *total other*	Number	110	161	141	126	159	130	148	114	1’089	136
		%	19.8	26.9	22.6	22.2	24.2	22.9	29.0	22.8		23.8
Industrie und Gewerbe *industry and trade*		Number	441	428	465	420	478	405	351	369	3’357	420
		%	79.5	71.5	74.6	74.1	72.8	71.3	68.7	73.8		73.3
Landwirtschaft *agriculture*		Number	0	0	0	0	0	0	0	0	0	0
		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Gebäude Einsätze BMA Täuschungsalarme (mit Beinahebränden) *building operations with FDAS deceptive alarms (including nearly fire)*		Number	555	599	623	567	657	568	511	500	4’580	573
		%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0
Tag *day*		Number	480	514	538	491	571	487	431	424	3’936	492
		%	86.5	85.8	86.4	86.6	86.9	85.7	84.3	84.8		85.9
Nacht *night*		Number	75	85	85	76	86	81	80	76	644	81
		%	13.5	14.2	13.6	13.4	13.1	14.3	15.7	15.2		14.1

Table A17: All real fires per year (Austria/Vorarlberg) [58]

Jahr *year*		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**total**	**aver-age**
Alle echten Brandeinsätze Gebäudebrände *All real fires Fire in buildings*	**Number**	368	331	301	289	282	296	317	332	2'516	315
	%	24.1	19.7	20.6	19.5	17.9	20.6	22.8	24.0		21.2
Alle echten Brandeinsätze Sonstige (z.B. Wald, Wiesen, Flur, Müll, Container, Kfz) *All real fires, other (e.g. forest, waste, container Vehicles)*	**Number**	226	234	187	227	192	155	149	160	1'530	191
	%	14.8	13.9	12.8	15.3	12.2	10.8	10.7	11.6		12.8
Rauchfangbrände mit Beschränkung auf das Rauchfanginnere *chimney fire (inside)*	**Number**	65	48	60	52	54	60	60	46	445	56
	%	4.3	2.9	4.1	3.5	3.4	4.2	4.3	3.3		3.7
Alle echten Brandeinsätze Gebäude + Sonstige + Rauchfangbrände *All real fires Buildings + other + chimney fire*	**Number**	659	613	548	568	528	511	526	538	4'491	561
	%	43.2	36.5	37.6	38.3	33.6	35.6	37.8	38.8		37.7
Falschalarme Gebäude ohne BMA-RFL (z.B. Feuerscheine, unklare Rauchentwicklung) *False alarms Buildings without FDAS, unknown smoke generation)*	**Number**	76	173	73	90	125	81	114	38	770	96
	%	5.0	10.3	5.0	6.1	7.9	5.6	8.2	2.7		6.4
Falschalarme Sonstige *False alarms other*	**Number**	16	12	5	14	10	13	15	36	121	15
	%	1.0	0.7	0.3	0.9	0.6	0.9	1.1	2.6		1.0
Falschalarme Gebäude ohne BMA-RFL + Falschalarme Sonstige *False alarms buildings without FDAS + False alarms other*	**Number**	92	185	78	104	135	94	129	74	891	111
	%	6.0	11.0	5.3	7.0	8.6	6.6	9.3	5.3		7.4
Falschalarme BMA-RFL *False alarms FDAS*	**Number**	776	882	832	811	910	830	737	773	6'551	819
	%	50.8	52.5	57.1	54.7	57.9	57.8	52.9	55.8		54.9
Gesamt Feuerwehr-Einsätze *Total Fire-fighting operations*	**Number**	1'527	1'680	1'458	1'483	1'573	1'435	1'392	1'385	11'933	1.492
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0

In hazardous situations, alerting those affected and intervention services is crucial. In several cases, there is however a lack of evidence of any hazard at the location of the incident. In such cases we are talking about false alarms. There are many different causes for false alarms and the phenomenon is widespread. They exist for example in alarm and early warning systems, people screeners, in the diagnosis of diseases, in journalism and in politics.

This False Alarm Study is the result of the work of the Euralarm Task Group on False Alarms. The Task Group investigated the false alarm issue of fire detection and fire alarm systems in several European countries. The material was carefully collected and objectively processed using a comprehensible basis to achieve comparable calculations and identify trends and risk priorities. The study provides approaches towards reducing false alarms and discusses the opportunities and risks. The work is currently unique.

Facts and trends on the false alarm issue of fire detection and fire alarm systems with a view of several European countries are presented and made available to an international audience. The study provides basics relevant to the fire safety industry concerned, but also to fire departments, associations, insurance companies, testing facilities, planners and installers, building operators and science.

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