Learning from fires in Norway
Preconditions, barriers and enabling factors
Abstract

Fires are devastating events that may harm humans, properties and the environment. Authorities, organizations, companies and societies should be able to learn from fire incidents to reduce the probability and impact of future fires. To achieve a reduction in fires and their consequences, an effort is needed from multiple actors and both technical, organizational and individual changes would be necessary. Importantly, we therefore consider change as a prerequisite for learning. So how can we as a society change or modify our efforts for prevention and mitigation of fires?

A learning approach often starts with some form of inquiry about the occurred accidents – an investigation. This investigation can take many forms: the fire services’ own evaluations of the response to a fire, an authority’s assessments of the compliance and fit of their regulations, a company’s analysis of internal rules and organisation, and the police’s investigation of criminal issues. Investigations require highly skilled professionals using often multidisciplinary skills such as knowledge in human behaviour, fire dynamics, electrical systems, mechanical processes and many more. A fire investigator may use many different techniques and tactics, to figure out how the fire started, what fault led to the fire, what made the fire develop the way it did and, also what factors and measures that worked well in the fire. The investigator can work for the fire service, the police, insurance companies, hired private fire investigators or in larger companies, to mention a few. However, not all fires are investigated in Norway, and there is also a large number of incidents that is concluded with an unknown fire cause.

The aim of our research has been to increase the society’s capacity to learn from fires. We have two main objectives contributing to the aim:

1. Obtain knowledge on the preconditions for learning from fires in Norway.
2. Provide recommendations to increase learning from fires in Norway.

Leading to these main objectives, we shed light on investigations, examinations, databases and routines related to the different actors, and importantly, the actors’ beliefs, collaboration and practices related to fire prevention and learning. The main corpus of material in this study is interviews with actors relevant for learning from fires in Norway. The informants were from the fire service, the police, educational system, insurance, authorities and organisations with interest in fire safety. The interviews were related to themes like cooperation inside and outside the organisation, resources and databases, how the interviewees see the fire investigation area today and how it should be improved. The findings were then divided into the Pentagon model’s five categories:

- formal structure
- technology and infrastructure
- culture
- interaction
- relations and network

The findings from the interviews and the reasons behind them are extensive and are elaborated upon in the report, but the main points are summarised here. Generally, we see clearly that learning from fires is a complex issue. It does not only encompass obtaining the correct technical
insights from a fire scene, but also informal aspects like the personal relations and how the fire services are organised.

Further, we see that fire investigation in Norway lack both the quality and quantity needed to obtain sufficient knowledge on fires that occur. The approaches, mandates and focus vary greatly with each actor, and this affects the coordination, cooperation, and systematic work of learning from investigations. High variation can also be found in the fire services’ own evaluations of their own fire-fighting efforts, which leads to regionally different methodology and terminology. This has an additional negative impact on the cooperative work even between fire departments. The cooperation is also varying when it comes to the sharing of knowledge which is prevalent between all actors involved in fire investigation. Little cooperation is formalised and therefore most cooperation on investigation and learning, as well as the sharing of knowledge and experiences, are done through individual and personal relations. This is also true inside the fire services where personal experiences and social learning is preferred to more systematic evaluation of fires and formal education. This creates a potential conflict with efforts of standardising work and learning processes. Lastly the lack of resources in preventive work in fire and rescue services and the police, especially in the investigation phase, hinders the possibility to learn effectively from fires and to convey the experiences from them. The difference in status between preventive and preparedness efforts in these public services is still relevant today.

Recommendations

Six areas are recommended as the most important for further work to improve the learning from fire investigations in Norway:

1. **Resources and prioritisation of fire prevention work**
   Resources for fire investigation and the status for fire prevention work must be increased to enable going from information to implementation of change. This is a matter of prioritisation and will require substantial work on several levels of authority.

2. **Organised investigation commission(s) for serious accidents involving fire**
   a. The establishment of a centrally organised investigation commission for fire accidents should be considered through a specific assessment. It should be considered if this commission could be organised as a part of the Norwegian Safety Investigation Authority.
   b. The formalisation of regional investigation groups should again be considered. This should be pursued as a potential way of increasing collaboration and quality, dedicated personnel with multidisciplinary competencies and increase the quality of the investigation.

3. **Education, training and competence**
   a. Education, training and competence related to fire investigations should be increased for both the police and fire- and rescue services.
b. Requirements for a minimum level of competence for private fire investigators and for fire expert witnesses should be developed and implemented. A certification system could be considered.

4. **Increase collaboration for learning**
   a. Guidelines for a process of collaboration across fire departments and municipalities with the aim of obtaining increased learning should be developed.
   b. Guidelines for a process of collaboration between fire preventive and fire preparedness sections within fire- and rescue services should be developed.

   These guidelines should be tested in practise.

5. **Establishing a common terminology and methodology for evaluation of fires in the fire and rescue services**

   Reducing the large local variations in terminology and methodology for evaluations could improve systematic learning activities across fire departments and other actors. It is important to balance standardisation by at the same time giving room for development of local best practises in the fire departments.

6. **Evaluation of the use of fire databases**

   Regular evaluation of the use of databases and follow-up of necessary changes based on the findings would ensure their relevance. Including aspects of “what went well?” would be beneficial.

Proposals for further work connected to these recommendations are described in the report. The Norwegian Fire Academy, that will implement a new educational structure in 2024, would serve as a perfect platform to set the stage for a better sharing culture between emergency services. This will bridge the many gaps between preparedness and preventive work mentioned in this report.
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Preface

This report presents results from a project that has been performed in the Norwegian Fire Research and Innovation Centre FRIC from 2020 to 2022.

We would like to extend our thanks to all fire related personnel in Norway giving their opinions in interviews on how Norway should learn better from fires. Their input is what makes this project unique, and their contributions give this project the relevance it needs to further improve Norwegian fire safety. We would also thank the experts from abroad that have contributed with valuable information to our work.

The Fire Research and Innovation Centre (FRIC) commenced in the spring of 2019. The aim is to increase the knowledge within fire safety to make optimal decisions and develop better solutions that provide increased fire safety in buildings. FRIC is led by RISE Fire Research in Trondheim, with NTNU and SINTEF as research partners. FRIC has partners from public organisations, fire safety consultants, producers and suppliers of building products and building installations, and property development and management. The research center is funded by all partners, in addition to funding from the Research Council of Norway, program BRANSIKKERHET, project number 294649. (www.fric.no)

Trondheim, 11-03-2022

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1 Introduction

The term “fire investigation” may have different meanings depending on the purpose of the analysis. In this report the term is used with a broader perspective than in a criminal investigation, where the goal is to reveal if any criminal act has been performed. The goal of fire investigations – or analyses of fire incidents - can be focused on different aspects, like the fire development, function of fire safety measures, human behaviour, the organisational safety culture, fire service intervention, fire behaviour of construction elements and materials etc.

Different perspectives of a fire incident can be used with the aim of revealing different pieces of the puzzle that could be of interest to different target groups. Thus, for this English report, the word “investigation” is used to cover the different words in Norwegian including “undersøkelse”, “granskning”, “etterforskning”, “evaluering” and “analyse”.

Information about how the fire started may indicate if the fire was ignited intentionally as a criminal act, or if there could have been some other fire cause, like e.g., a fault in the electrical system or accidental open flames. Information about the fire development can indicate if the construction materials and building elements had the intended behaviour according to fire regulations. Studying information on peoples’ behaviour in the fire situation may tell if the installed fire safety measures and evacuation routes worked as intended. The organisational culture perspective may reveal a discrepancy between procedures and practice, or how the communication works between different actors.

In Norway there are several institutions that investigate fires. According to the Norwegian prosecution instructions § 7-4 [1] the police shall investigate all fires to find a probable fire cause, even though there is no suspicion of a criminal act.

§ 20 in the Norwegian regulation on fire prevention requires that the municipality shall evaluate fires that had, or could have had, serious consequences for life, health, environment or material assets with regard to the effect of their fire preventive work [2]. The municipality is also obliged to implement routines that will ensure that knowledge from incidents is useful for the future preventive work. Based on this requirement the fire services evaluate fires with the purpose of evaluating the efficiency of the fire preventive work and improving their own efforts.

Insurance companies examine fires in connection with insurance cases, while the authorities evaluate the fires with the purpose to learn and get input for possible revisions of fire regulations.

Supervisory authorities and agencies examine fires within their subject area, e.g., the Petroleum Safety Authority Norway examines fires in the oil and gas industry, the Norwegian Safety Investigation Board (Statens Havarikommisjon) investigates fires in the areas of air, sea, railway and road traffic in addition to incidents in the Norwegian defence sector, and the Norwegian Armed Forces investigates incidents relevant for the military. Other organisations and private companies can also perform fire investigations and examinations in their areas of interests, or if requested to do so by parties with a stake or interest in the fire.
Despite all these institutions’ investigations and examinations, it is far from all fires that are investigated, and consequently there is a large number of fires with an unknown cause [3], [4]. It also seems to be challenges and gaps related to systematic collection of learning points from fires that can be transferred back to the authorities, fire services, educational establishments, fire consultants and manufacturers.

Furthermore, as we will explain more in detail, we argue that when seeking to learn from fires, obtaining knowledge through investigations is only the first step – the knowledge needs to be transferred and put in to concrete measures and practice before we can say that learning has taken place. Merely a change in the process or number of investigations does not change behaviour and practice without continuous efforts.

1.1 Aim and objectives

The aim of our research has been to increase the society’s capacity to learn from fires. We have two main objectives contributing to the aim:

(1) Obtain knowledge on the preconditions for learning from fires in Norway.

(2) Provide recommendations to increase learning from fires in Norway.

Leading to these main objectives, we shed light on investigations, examinations, databases and routines related to the different actors, and importantly, the actors’ beliefs, collaboration and practices involved with prevention and learning. To provide recommendations, we conducted a preliminary study using documents and nine interviews to provide a basis rooted within a variety of domain experts’ perceptions and experiences. These preliminary findings will subsequently lead to a more in-depth study of selected topics and issues in the second phase of the project.

1.2 Structure of the report

The report is structured as follows:

• A basic introduction is presented in Chapter 1.
• Chapter 2 presents the background of the theoretical frameworks of the study, and a summary of knowledge of fire investigations in Norway.
• Chapter 3 gives an overview of methods used in this project.
• Chapter 4 goes in-depth on the results from our qualitative interviews with different experts. To provide a more condensed set of findings.
• Chapter 5 presents the main findings and recommendations.
• Proposals for further work are presented in Chapter 6.
2 Background

In this section we provide some background information on learning from accidents and fires, including accident investigations. The term organisational learning is elaborated, and the Pentagon model of organisational safety by Schiefloe [5] is presented.

2.1 Accident investigations in general

Accident investigations can be organised in different ways, both with regard to the structure of the analysis itself and with regard to the mandate of the investigation. These choices will influence the results of the investigation, and thus the possibilities of learning from the accidents investigated [6]. The structure of the analysis can be said to be based on accident models, which are the ways we think that the accidents happen. Accident models help create a mental picture – or mental models – of causal factors for the accident. The use of accident models can be explicit, or it can be implicit. In both cases accident models are relevant, as they are a way of describing the assumptions we have about the society, organisation, and technical parts of the system in which an accident occurs.

A common way of thinking about accidents is that they happen in a particular temporal order – one initial (and unexpected) event triggers a new event, and so on. Sequential accident models assume that accidents happen in a linear and deterministic manner. The focus in these accident models is thus often on the actors, and the time aspect of the events leading to the accident. A second group of accident models are epidemiological models, where accidents can be seen as analogue to the spreading of disease – an accident is the outcome of a combination of manifest and latent factors that happen to exist together in space and time [7]. These models are, however, often portrayed in a linear way, such as the famous "Swiss cheese" model developed by James Reason [8]. In this model, there can be several layers of obstacles, both organisational and technical, where manifest and latent flaws in the different layers of obstacles lead to an accident. The advantage with these models is that they are often simple and easy to understand.

However, a characteristic of major accidents is that they are often complex events with several underlaying and contextual factors interacting, and if not seen in relation to each other, learning from unwanted events is made difficult. Accident models which facilitate this level of understanding are the systemic models where accidents are seen as emerging phenomena. Interactions between the technical aspects, actors, organisations and regulations lay the foundation for a safe or an "unsafe" system [9]. The systems focus is also important as a way to avoid blame on specific actors. In safety research, there has generally been a shift from thinking about accidents as linear events where "human error" of specific actors have been in focus, toward the systems perspective where long term learning is made. This learning is made possible by identifying inadequate systemic structures and interactions, which definitely includes a focus on both technical, human and organisational aspects.
2.2 Learning from fire incidents

2.2.1 How can studies of fire incidents be valuable?

Real fires are valuable objects for case studies in the fire community. Investigation of fires and analyses of information from fires are useful tools for gathering experience and knowledge of characteristics of fires, how fires occur and why they develop as they do. Through investigation of fires important data and information can be collected and analysed. Such information can be used for assessment and revision of regulations, it can be applied by insurance companies in risk assessments, be used by manufacturers of different kinds of building products and installations for product evaluation and development and can be useful for fire safety engineers when analysing fire risk in e.g., a building design project. This information will be a good complement to today's established fire statistics and is necessary for understanding the fire safety challenges of the modern society. Research projects are often developed based on findings from fire investigations to study details and solve revealed problems.

The frequency of fatal fires could be regarded as an indicator of fire safety in the society. Reducing the number of fatalities in fires would imply an overall increase in the fire safety level of the area in question. Fires that cause loss of lives are normally thoroughly investigated by the police to reveal if there was any criminal act behind the incident, and this means that details describing these incidents are very often well documented. Getting access to the police report and approaching other sources of information make the potential of learning large. Studies of fatal fires have been performed in many countries worldwide and the results have provided a good base for sharing of common knowledge.

However, since countries can be very different regarding e.g., social traditions, living conditions, building- and fire regulations, climatic conditions, fire service intervention etc. there are many factors that will affect the fire safety level in a specific country. Therefore, statistical results should not be adapted uncritically from one country to another without making assumptions regarding the possible effect of specific national conditions. This is obviously a very difficult task. Results from studies of fire fatalities in a country will therefore be a very valuable input to the country's national fire safety strategy. Differences in terminology may also make comparison of fire statistics from different countries difficult.

2.2.2 Fire investigation

Fire investigation is a highly multidisciplinary activity and can require expertise in many fields in addition to expertise on fire dynamics and fire development. The required expertise depends on the case, and can include e.g. knowledge on human behaviour in fire, sociodemographic gradients, firefighting, electric systems, industrial processes, constructions and infrastructure of different kinds, transportation etc. It is also worth noticing that risk and safety analysis is one of
the expert areas that needs to be covered. There are no formal requirements for documentation of fire competence for private fire investigators in Norway, this is also the case for fire expert witnesses in court cases. As described in the articles from J. Munday and Mick Gardiner [10] and J. J Lentini [11] the UK and the US, respectively, have certification systems for private fire investigators, although this is not a formal requirement. However, some states in the US for example, according to J. J Lentini, exclude the testimony of an expert witness that is not certified. There are no regulation specific to fire investigators, but in practice lawyers and insurance companies generally prefer to hire certified people [12]. Introduction of this type of formal requirement has also been discussed in Norway [13]. We see formal competence requirements as an important measure to ensure a sufficient level of quality in analyses of fires. Documentation of relevant fire competence should be required for private investigators (i.e., not employed by the police and fire and rescue service), and a certification system could be one solution to this.

The information gathered from analyses of fire incidents will depend on the objectives and scope of the analysis, the available resources (time, involved persons, funding), and on the specific competence of the investigators. This will naturally constitute some limitations on the potential cross-disciplinary learning from a fire incident.

Different strategies and methods are used in analysis of fires depending on the objectives of the analysis. Some guidelines for the work are given in the following documents:

- A comprehensive fire investigation handbook - *Håndbok i brannetterforskning* - was published by the Norwegian Fire Protection Association in 2012 [14]. The handbook is targeted at fire investigators from the police, fire service, the Local Electricity Inspectorate (DLE), insurance companies and any other persons with an interest in fire investigation.

- The *Nordic Fire Manual* was developed through a collaboration of experienced fire investigators from the national forensic units in Finland, Iceland, Sweden, Denmark and Norway [15]. This document is targeted at fire investigators and specialists, and is used in forensic work by e.g., investigators from the police and insurance companies.

- The report *Veiledning for brannutredere* is specifically targeted at electrotechnical investigators from the Local Electricity Inspectorate (DLE) [16].

- The report *Metode for evaluering av branner* describes a methodology for analysis of “smaller” fire accidents, and is primarily targeted at investigators from the fire service [17]. The report was prepared after an amendment of §9 in the *Fire and Explosion Prevention Act* [18], that requires the local authority to evaluate incidents to ensure continuous learning and improvement of the work within fire prevention- and preparedness.

In addition to these documents, fire investigation guidelines and handbooks from other countries can be used by some investigators, like NFPA 921 Guide for Fire and Explosion Investigations [19] and Kirk’s Fire Investigation [20]. Articles in scientific journals, reports and textbooks can also contain relevant information for the fire investigation.
2.2.3 Regional fire investigation groups

One way of learning from others’ competence and experience is through participation in multidisciplinary investigation groups, i.e., groups where the investigators have different background relevant for fire investigation. Such competence can be in fire science, forensics, electrotechnical science, different engineering disciplines, accident investigation etc., and will depend on the specific incident. As an example: Investigation of a railway fire may require specific knowledge on railway transportation and trains, while knowledge of constructions and building materials may be important when investigating a building fire.

In 1997, a working group on quality assurance of fire investigations was appointed by the Norwegian Ministry of Justice [21]. A part of the mandate was to prepare a proposal on how regional fire investigation groups should be organised. A proposal on a binding cooperation between the fire service, the police and the Local Electricity Inspectorate (DLE) in regional fire investigation groups was proposed by a working group in a report from 2002. In 2006-2007 three pilot projects with regional fire investigation groups were performed [9]. A working group evaluating the pilot projects recommended that such groups should be organised in all police districts in Norway [23]. However, the National Police Directorate decided not to make this mandatory, and the organisation model is therefore now only implemented on a voluntary basis. According to a bachelor thesis from 2019, regional fire investigation groups were established in 10 out of the 12 police regions in Norway, only one of these groups was formally established through a written agreement [24]. Five of the groups include all three professions: the fire service, the police and the Local Electricity Inspectorate (DLE), while five groups have members from two of the professions. Two of the Norwegian police districts did not respond to the survey in the bachelor project.

This is an indication that the model is implemented to some degree in Norway, but the implementation is based on voluntary engagement. Lack of funding to establish such multidisciplinary cooperation is also an obstacle.

2.2.4 Professional networks

There are several networks and forums where experiences and information from analyses of fire incidents can be exchanged. Some networks are connected to a specific profession (e.g., insurance, police, and fire service), while others are open to several professions.

- **Nordic Fire Group (Nordisk branngruppe)** is a network for forensic fire investigation with representatives mainly from the police in the five Nordic countries: Norway, Sweden, Denmark, Finland and Iceland.

- **Midt-Norsk forum for brannsikkerhet**\(^1\) is a network in the Trøndelag region for different disciplines within the fire area, e.g., fire consultants, fire service, police, research,

\(^1\) https://www.facebook.com/Brannsikkerhet/
education and local authorities. Investigation of recent fires is one of the topics that can be presented and discussed at the member meetings.

- **Forum for bygningsmessig brannvern** is located in the Oslo region and is similar to *Midt-Norsk forum for brannsikkerhet* but is focused on fire safety in buildings.
- **BFO - Brannfaglig Fellesorganisasjon**[^2] is a member organisation for suppliers of products and services within fire safety, and for public and private purchasers who also have personnel working within fire prevention. BFO arranges regular conferences where investigation and analyses of recent fires can be one of the topics on the program.
- **The Norwegian Association of Fire Officers (Norsk brannbefals landsforbund)**[^3] has an open webpage that contains different information on fire safety that can be of interest to several parties. Under the tag “Solskinshistorier” (“stories with a happy ending”) experiences from fires where e.g., safety measures have prevented a fire development are shared.

### 2.2.5 Fire databases

Data from fire investigations can be shared through databases. The Norwegian databases related to fire safety are described below.

- **Brannstatistikk.no**[^4] is a national database containing information from all callouts from the Norwegian fire services registered by the emergency call number 110 from 2016. The information is imported directly from the fire services’ reporting system *BRIS*.
- **BRASK – Brannskadestatistikk**[^5] (Fire damage statistics) contains data from fires that were reported to the Norwegian insurance companies. The database was established in 1985 and the information covers more than 90% of the Norwegian market. One fire can have several claims for compensation, which means that the number of cases in BRASK is higher than the number of call-outs in the database at Brannstatistikk.no.
- **Knitre** (“crackle”) is the name of a database that was launched in November 2020. Knitre was developed by the Norwegian Fire Protection Association (Norsk brannvernforening) and the National Criminal Investigation Service (Kripos). The database contains data related to fire cause, and the data are based on experiences from fire investigations, in addition to information from research and literature. The database is available on demand for the police, insurance companies, fire service, research and education.
- **Ulme** (“smoulder”) is the name of a database that is developed in a collaboration between several parties led by the Norwegian Fire Protection Association (Norsk brannvernforening). The database will contain information that goes beyond the cause

[^2]: [https://www.bfobrann.no/](https://www.bfobrann.no/)
[^3]: [https://www.nblf.no/](https://www.nblf.no/)
[^4]: [https://www.brannstatistikk.no/brus-ui/](https://www.brannstatistikk.no/brus-ui/)
[^5]: [https://brask.finansnorge.no/OmBrask.aspx](https://brask.finansnorge.no/OmBrask.aspx)
of fire, e.g., how the fire developed, the function of fire safety measures, human behaviour etc. The database was launched in January 2022.

2.2.6 Dissemination

Dissemination of the knowledge and experiences obtained through analyses of fires is an activity that promotes learning between disciplines in the field of fire. Since the target groups for the information are so diverse, a diversity of channels for communication are used.

- **Scientists:**
  - **Scientific journals** are targeted at the scientific community. However, since there are different target groups and readers for different journals, it is not guaranteed that the information reaches the most relevant audience.
  - The considerations above can to a large part also be relevant for publication on **Scientific conferences**.

- **Fire professionals:**
  - There are **Professional journals** targeted towards specific professions (e.g. Bevis⁶, Brann & redning⁷, Byggeindustrien⁸, Teknisk Ukeblad⁹...).
  - **Professional conferences**, both national and international are also arenas for dissemination of this type of knowledge.
  - **General fire safety journals** with broad target groups, are channels for publication of articles from fire investigations (e.g. Brann & Sikkerhet¹⁰, Brandposten¹¹, Brennaktuelt¹²).
  - **Other channels for dissemination** of knowledge are also used, like groups and discussion forums on social media (Facebook, LinkedIn). One example is the private company KOMBRA that regularly dispatches photos and results from fire experiments connected to fire investigation to a large mailing list¹³.

Reports publicly available on the web are also an important dissemination channel. The reports need to get publicity through other channels to reach their audience, e.g., through conferences, social media, articles etc.

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⁶ [http://bevis.no/](http://bevis.no/)
⁷ [https://www.brannredning.com/](https://www.brannredning.com/)
⁸ [https://www.bygg.no/](https://www.bygg.no/)
⁹ [https://www.tu.no/](https://www.tu.no/)
¹⁰ [https://brannvernforeningen.no/brann-og-sikkerhet/](https://brannvernforeningen.no/brann-og-sikkerhet/)
¹¹ [https://www.ri.se/en/brandposten](https://www.ri.se/en/brandposten)
¹² [https://brennaktuelt.no/](https://brennaktuelt.no/)
2.2.7 Who should learn – and why?

Different organisations have different perspectives and goals for investigation of fires and can thereby have different needs for information and the learning process. Actors who would have interest in this topic are:

- Criminal investigators
- Fire Service (both in connection with fire preventive work and firefighting)
- Fire investigators from insurance companies
- Fire investigators from the Local Electricity Inspectorate (DLE)
- Private fire investigators
- Accident investigators in general
- Governmental authorities
- Local authorities, including health and social service etc.
- Educational institutions
- Fire researchers
- Fire safety engineers
- Organisations engaged in fire preventive work
- Manufacturers of building products and installations
- Manufacturers of fire safety measures
- Expert witnesses engaged in court cases
- ... and probably several other actors in different fields

Many actors will have a need for individual learning connected to fire as a phenomenon, including both general and specific knowledge. Such knowledge is important to be able to interpret information from the fire scene and assess factors like the location of the fire origin, the possible source of fire and the most likely fire development.

Governmental authorities need information that is relevant for amendments and development of regulations. This could e.g., be data connected to behaviour of construction products and fire safety measures in real fires, and information about human behaviour and firefighting efforts.

Communicating the stories of the important fires is important to ensure that the knowledge once obtained does not disappear. There are many fires that have been thoroughly analysed and investigated in the past, and where important findings still are relevant and need to be shared. The stories must be included in lectures and presentations and used to highlight and illustrate topics in fire dynamics and fire safety. Indeed, photos and stories from the large fire in the Lærdal village in 2014 or from the disaster on the passenger ferry Scandinavian Star in 1990 will certainly contribute to that these fires remain as flashbulb memories in our society.
2.2.8 International experiences

How one country investigates fires, gathers and evaluates the knowledge and implements it into learning is varying widely. Therefore, this project started with a brief exchange of experiences from five countries (UK, Sweden, Denmark, New Zealand and the US).

The findings suggest that not all countries have a database or central reporting system for collecting data from fire investigations. However, having a database for reporting from investigations is not synonymous with having a perfect tool to collect and analyse data. Having a continuous process of assessing what and how much data are to be collected in the database and having investigators that take the job of registration of data in the database seriously, are some of the potential needed improvements. For instance, information on how a fire department performed in an extinguishing effort may be sensitive and may therefore not be reported in fear of consequences.

In one of the countries mentioned above the fire service writes public reports from fire incidents, but these were assessed by our contact to be of low quality. Restricted access to the information is also a problem, as many reports from the police and insurance companies are confidential and therefore never shared. This data cannot be utilised for improvements of fire safety in the society. Therefore, many countries experience stand-alone initiatives, from private companies, interest organisations etc., for spreading information on fire safety. Although directed towards fire safety, these initiatives are generally regarded as of questionable motivation.

Some contact persons expressed that the level of fire education and fire research in their country could improve. Getting the same level of education for fire investigators as for crime scene investigators was pointed out as a good place to start. The fire research is generally fragmented. Research should also focus more on residences rather than larger office buildings, as the highest numbers of fire fatalities are registered in buildings where people live.
2.3 Learning in organisations

2.3.1 Organisational learning

When speaking of learning from fires in Norway, the emphasis is generally on the organisations and their interfaces, rather than the mere individuals. This calls for the theoretical basis of organisational learning. Theories on organisational learning are multifaceted and a vast majority of theories are overlapping and are probably more suitable for some domains than others. We will not make an extensive review in this chapter, but rather extract theories and research that fit our research focus.

Two main areas of organisational learning theories are presented by Rossnes et al. [25]:

- A change in organisational knowledge, as presented by Schulz [26].
- A process where organisations and subunits change as a result of experience, which was introduced by Argote & Ophir [27].

The first definition is focusing on the change in organisational knowledge, which can be both positive and negative. Learning can expand, change or reduce organisational knowledge [25]. The change in knowledge can manifest itself in changed procedures or work methods, or in the collective consciousness of the persons in the organisation. The second definition emphasise the process in which the change is occurring. This process, which can be less tangible than the resulting changes, can take place both on an individual level, a group level, and the organisational level. The learning process can be carried out through methods such as collection and systematisation of knowledge to dissemination and implementing lessons learned into real practice. Thus, organisational learning can be seen both as manifested change in an organisation and the process towards the change. In line with most theories, we understand learning as a manifested change in behaviour (individual or group level) or organisational if this change is somehow shared/collective. This also means that merely changing a procedure, or obtaining knowledge from an investigation, without a change in behaviour, is not considered learning in this view.

The literature on organisational learning is vast, and in the following we will only introduce some core concepts which are important in the context of this project, namely levels of learning and promoters and obstacles for learning.

2.3.2 Levels of learning

Several theories and models of organisational learning defines some levels. One of the most used is the distinction between single-loop and double-loop learning [28]. Single-loop learning describes an organisation's ability to detect and correct errors to "keep up normal production". Double-loop learning is related to the degree of an organisation’s ability to question underlying policies, objectives and culture – e.g., a learning process which reveals whether future
production should be fundamentally different than production of today. Both these types of learning are important in relation to organisational safety. Detecting and correcting disturbances in normal operations are necessary, but also being able to change and introduce new work practices on a higher level to cope with changing conditions.

As an example, consider this hypothetical case: The firefighting team arrived too late to a fire scene compared to internal requirements and expectations. Earlier events have also shown that the response was too slow. The organisation should learn from these events. A single-loop learning approach can be to train personnel to respond faster by doubling the amount of emergency response exercises. A double-loop learning approach can be that the fire services ask the question "are we doing the right things?", and the result is implementation of measures such as installing automated fire-fighting systems or restructuring the organisation or locations of the fire brigades, so that more personnel can respond to a fire. The point here is that the organisation questions its underlying assumptions instead of optimising existing ways of working.

A third level of the “loop-learning” theory is the deutero learning level. This level essentially consists of efforts that lead to measures that enhance the capabilities of the organisation to leverage both single- and double-loop learning - or “learning to learn”. Continuing the aforementioned example, one could for example envision that the fire service implements new ways of learning what to learn through regular focus groups across fire rescue services – a structured approach to how we should learn.

Thus, one takeaway from the theory of loops in learning is that in order to learn, the organisation challenges established notions, practices and beliefs. However, this is not easy as such knowledge often is taken as granted and is predominantly “tacit” (understood or implied without being stated) and rooted in the year-long practice of the workers.

Another example of a level-based model is the is the 4I model by Crossans et al. [29] in Schilling and Kluge [30]. The model consists of four different processes of learning, which can be linked to the different organisational levels, from the individual level to the organisational level:

1. **Intuition (individual level)** – the process of developing new insight and ideas based on personal experience, e.g., the individual understanding of how to perform a job based on experience.

2. **Interpretation (individual and group level)** – explaining insights through words and/or actions to oneself and others, e.g., sharing of experience in a debrief after an operation.

3. **Integration (group level)** – shared understanding in a group which allows for coherent, collective actions, e.g., dissemination and implementation of lessons learned on a group level.

4. **Institutionalising (organisational level)** – shared understanding is implemented in systems, structures, procedures, rules, and strategies, as well as common norms and practise, thereby becoming independent of individuals, e.g., change in procedures and practices.
Learning in an organisation is however not regarded as only a linear stepwise process developed from individual to institutionalised learning. The process can be initiated at different levels with feed-back and feed-forward from and to the individual level and the organisational level. An example: A change in procedures can be initiated by an employee who sees discrepancy between real work practice, but also from a company review of the document management system. It can also be managed (initiated and led by managers) or spontaneous (originating from individuals or groups). However, learning which has reached (not necessarily originated from) the highest levels in the organisation are in most cases the most impactful. This, however, requires a holistic approach to a managed change process. An important factor for management in an organisation will thus be to prepare the grounds for these learning processes to take place, and in this process also make sure that the acquired knowledge is stored, communicated and implemented in an adequate manner. Managed mechanisms for learning include, for example, reporting systems, debrief sessions and workshops [31]. The antithesis of managed learning is spontaneous learning – which is informal and without a real intention to learn, but rather the knowledge and understanding that emerges when actors collaborate. Managed learning efforts to lay the ground for spontaneous learning can be an effective combination, for example through appointing a structured exercise regime with cross-organisational attendance (managed learning), but where the individuals and departments involved for example discover new ways of working, new reflections that they bring back to their own organisation and pursues a change process. This is in line with creating a good learning culture.

Lastly, considering that this study encompasses a variety of organisations, a perspective that is valuable is learning from others – spreading knowledge and practice. This is important to consider, for example, given that one fire department successfully exerts double-loop learning, this cannot be spread or manifested in other fire departments.

To sum up:

1) A core idea of organisational learning is that individuals and organisations challenge existing beliefs and practice
2) Merely constructing knowledge or information is not considered "real" learning – a change is needed
3) There are various levels that could be defined for degrees and aspects of organisational learning

2.3.3 Barriers and enablers for learning

In addition to knowing about the preconditions for learning in an organisation, it is useful to know what can restrain organisations from learning. In fact, according to Weick and Westley [32], organisational learning can actually be an oxymoron - contradictory, since organisations as a phenomenon in a nutshell is about structuring and aligning towards a stable state. Moreover, as stated by Czarniawaska in Handbook of Organizational Learning and Knowledge, “most learning (individual) aims to protect and revitalise institutional order rather than change it” [33].
I.e. there can be an inherent aspect of organisations that counteracts “double-loop” learning. We essentially have to fight against something that works against us. Also, within psychological research, a lot of emphasis has been made on individual's resistance to change as a personality trait. In line with these notions, institutional theory emphasises the processes by which structures, including schemes, rules, norms, and routines, become established as authoritative guidelines for social behaviour [34], and therefore practice also needs to be understood as context-dependent on these factors. For example, that we have to consider that Norwegian firefighters are educated from only one fire academy (as opposed to other professions, that are educated from various schools offering variants of the same education). These firefighters operate within a long-lasting tradition of small fire services – these are mechanisms that lead to structure and stability. Notably, however, as the students must spend two years training in their respective fire departments before schooling introduces some variation to the education.

Schilling and Kluge [30] have identified some general barriers to learning in the literature and categorised them according to the four different learning processes. Barriers to learning within topics such as employees' mindsets, skills and motivation, group dynamics, leadership, organisational structure, and culture are found. Some examples of the learning barriers presented by Schilling and Kluge are listed in the second column of Table 2-1, in the third column some corresponding promoters for learning are listed. The existence and strength of each learning barriers and promoter will vary across organisations.
Table 2-1: Learning barriers in the different learning processes, adapted from Schilling and Kluge [30].

<table>
<thead>
<tr>
<th>Learning process</th>
<th>Learning barriers</th>
<th>Enablers for learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intuition</td>
<td>Monolithic corporate culture</td>
<td>A common set of norms and understanding of reality will facilitate implementation of measures that support the goal of the organisation.</td>
</tr>
<tr>
<td></td>
<td>Implicitness, ambiguity and/or extraneousness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High degree of labour division and standardisation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blame culture, lack of psychological safety</td>
<td></td>
</tr>
<tr>
<td>Interpretation</td>
<td>Organisational silence and fear of ridicule</td>
<td>A culture which promotes openness and a will to evaluate itself will contribute to a judgement free interpretation process</td>
</tr>
<tr>
<td></td>
<td>Hierarchical culture leading to lack of status of the innovator</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failure avoidance in the group</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>Ineffective allocation of resources</td>
<td>Drive and capacity to implement are positive aspects of power in an organisation.</td>
</tr>
<tr>
<td></td>
<td>Lack of trust between units leads to little sharing of knowledge</td>
<td>Political abilities and the use of techniques for influence will increase likelihood for implementation of measures</td>
</tr>
<tr>
<td></td>
<td>Lack of top management attention</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rigid and outdated beliefs, values, and assumptions of senior management</td>
<td></td>
</tr>
<tr>
<td>Institutionalising</td>
<td>Rapid technological changes in the organisational environment</td>
<td>Considerations of the learning processes must be included in the design of the formal organisation.</td>
</tr>
<tr>
<td></td>
<td>A lack of organisational resources for the implementation process, poor communication methodologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low levels of trust in the willingness and skills of employees and laissez-faire leadership style</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High levels of decentralisation in the organisation, inconsistencies in the implementation</td>
<td></td>
</tr>
</tbody>
</table>
2.3.4 Learning from incidents and accidents

Now we have presented some aspects of levels of learning, and barrier/enablers for it to happen – it is time to turn to learning from incidents in particular. There are several different models of learning from incidents. The model of Drupsteen et al. [35], Figure 2-1, highlights the phases involving

1. Investigation/analysis
2. Planning interventions
3. Intervening, and
4. Evaluating – which eventually leads back to the previous phases in a feedback loop.

![Figure 2-1: The phases defined in organisational learning from incidents by Drupsteen et al. [35].](image)

When comparing this model with theories of organisational learning, a review by Drupsteen & Guldenmund [36] found that most safety-related research has been focusing on the first phase, i.e. getting adequate knowledge about occurred incidents, and less on the phase that in most definitions is where the “real” learning take place. It is the measure phase (or intervention phase) that is also the most difficult to successfully accomplish, which is manifested by the many major and severe incidents that have had the tendency to re-occur within organisations and sectors despite efforts to learn.

So, how can negative and positive aspects for learning from incidents or accidents be characterised? Størseth and Tinmannsvik [37] identify important promoters of learning after accidents based on interviews with personnel from the railway sector (the “Åsta Train Crash accident”) and marine sector (the "Sleipner catamaran accident"). The interviews focused on changes after accidents and conditions for learning from accidents. Promoters identified were:

1. dismissing the question of blame and aim for understanding
2. not forgetting the accident and keeping the history alive
3. accepting learning as a skill which must be maintained
4. curbing the urge for procedures
Learning from fires in Norway – Preconditions, barriers and enabling factors

The barriers, or inhibiting factors, were:

1. remote controlling – to be controlled from external parties, like authorities, for a quick response on concrete single tasks rather than changing organisational culture
2. catastrophic journalism – media directs the focus after an accident for commercial purposes
3. expectations of quick responses like “rituals”
4. that the safety discourse was academic and without operative relevance
5. procedurability – the tendency to develop new procedures as a “cheap” way of demonstrating action capacity after accidents

In conclusion, from the literature on promoters and barriers to learning it is easier to find inhibiting factors rather than promoting factors. We find that a balance between applying the right structural efforts such as implementation of new procedures, equipment or organisational structures, and making sure that the human aspect is taken into consideration, is important to prepare the grounds for the learning organisation. In the organisations that values aspects such as psychological safety, openness to evaluate itself and high trust will be in a better position to learn, than the organisations which promote a hierarchical and monolithic culture where blame and lack of trust constitute a part.
2.4 The Pentagon model

In order to shed light on our focus on learning from fires from an organisational learning and organisational safety perspective, we needed a sound tool. Several tools and models are available for guiding an analytical process related to technological, human and organisational aspects of safety-related issues. One model that is often used is the Pentagon model [5], which describes a holistic organisational analysis, consisting of five dimensions with implications for safety of a system. The model is particularly useful to analyse the performance of complex organisations and was developed considering the gas blow-out at the Snorre A offshore platform on the Norwegian Continental Shelf in 2004. The idea behind the model is that the whole is greater than merely the sum of its parts, meaning that each dimension can have an impact on safety, and the combination of dimensions has impact as well. It is an analytical model, often used to categorise factors influencing the performance of the object under study. The model is shown in Figure 2-2.

![Figure 2-2: The Pentagon model by Shiefloe [5].](image-url)

The upper part of the model (Formal structure and Technology and infrastructure) shows formal qualities, whereas the lower part (Culture, Relations and network, Interaction) presents informal qualities of the system. An extension of the Pentagon model can include External relations...
(Stakeholder influence) and External context (Frame conditions), that influence the five dimensions. The external aspects are not modifiable of the organisation/object under study.

**Formal structure and organisation.** This dimension consists of leadership, organisation charts, reporting systems, formal lines to official government agencies, and procedures.

**Technology and infrastructure.** Relates to the organisations’ technologies, equipment and ICT systems.

**Culture.** Consists of safety culture, communication climate, experience as well as formal competence. Covers elements like language/concepts, established expectations concerning “ways of working”.

**Relations and network.** Represents the informal structure and the social capital of the organisations: trust, friendship, access to knowledge and experiences, informal power, alliances, competition, conflicts. Network across disciplines.

**Interaction.** This dimension covers communication, cooperation, coordination, and emphasises that individual and collective behaviour never occur in a vacuum – acknowledging for example management practices, work processes, information flow.

In this first phase of the project, we consider the model to grasp all major actors involved, and their relations, i.e., making one model for the analysis and not one for each organisation involved in the study.
2.5 Summary of background

- For organisations to have learned, we consider a change in behaviour, not merely changing a procedure or obtaining a new insight. Various theories conceptualise different levels of learning.
- Organisational learning is rooted in challenging established beliefs and notions.
- Learning from accidents and incidents is often considered as a stepwise process from investigation to intervening and evaluating changes – but focus on the latter parts are often lacking.
- Accident investigations are of varied focus and methodology, where a holistic man, technology and organisation (MTO) focus is proposed as best practice.
- Research has identified several somewhat generalised promoters for learning after accidents such as
  - dismissing the blame question
  - curbing the urge for new procedures
  - enhancing psychological safety
- Identified barriers for learning are
  - being remote controlled by external parties
  - advancing too fast to “quick” measures
  - high levels of decentralisation
- Fire investigation is a highly multidisciplinary activity and can require expertise in many fields. One example of a model to accommodate this is the regional fire groups pilots, including the fire service, the police and the Local Electricity Inspectorate (DLE).
- Several means of dissemination and collaboration with regard to transferring knowledge on fires exist today, including networks like the Nordic Fire Group, and databases like BRIS, Knitre and Ulme.
- Several organisations in Norway are involved in learning from fires, from companies, researchers, and fire services to authorities and educational institutions.
- The Pentagon model is useful to analyse the performance of complex organisations and can be used as a tool to systematise factors important for learning from fires.
3 Method

3.1 Interviews

When seeking to understand a human or organisational phenomenon like “learning” with a rich level of details, the preferred methodology is qualitative. The goal of a qualitative inquiry is understanding and capturing different aspects of the research questions, rather than making a generalisable finding. In the first phase of our study, we wanted to gain an initial understanding of opinions and formal and informal practices from the different stakeholders, which fits very well with the notions of qualitative interviews.

The interviews were conducted in a semi-structured way in a combination of group interviews and single interviews. In all interviews, one was assigned as main interviewer, and a second researcher took notes (“human recorder”).

The agencies to be interviewed were chosen after collecting input from the Norwegian Directorate for Civil Protection and Norwegian Fire Protection Association. The organisations that were interviewed in this project was:

- The police (one representative)
- The local fire service (eight representatives)
- The National Criminal Investigation Service (Kripos) (one representative)
- Norwegian Safety Investigation Authority (SHK) (one representative)
- Insurance (one representative)
- Finance Norway (one representative)
- Norwegian Directorate for Civil Protection (DSB) (one representative)
- Norwegian Building Authority (DiBK) (one representative)
- Norwegian Fire Protection Association (one representative)
- The Local Electricity Inspectorate (DLE) (one representative)
- The Norwegian Police University College (PHS) (one representative)
- The Norwegian Fire Academy (NBSK) (one representative)

These twelve organisations were then distributed on nine interviews, which were conducted by SINTEF and RISE Fire Research.

For the interviews to be relevant some main topics were discussed. An interview guide was developed, including the following topics:

- Information about the organisation and its motivation to investigate fires.
  - Background
  - Responsibilities related to a fire investigation
- How the organisation learns from fire investigation internally.
  - Practice for extracting knowledge from investigations
  - Mechanisms for transfer of knowledge
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- Use of knowledge for internal training and education
- Methodology used in investigations

- Cooperation and networks.
  - Cooperation in the investigation phase
  - Cooperation for obtaining learning
  - Cooperation with authorities

- Learning after fires in Norway.
  - Learning outcome from large fire accidents in Norway
  - Norwegian overall efficiency in learning from fires
  - Barriers and enablers for learning from fires in Norway
  - Authorities’ handling of newly acquired knowledge

- The databases “Knitre” and “Ulme”.
  - Opinions about the databases
  - Input on important information these databases should contain
  - Thoughts and desires for the user interface and daily operation

At the end of the sessions the interviewees were asked if there were some questions they were missing, and if they had a main message they wanted to express.

In addition, a brief exchange of experiences was conducted through email on how some countries work with their learning outcome from fires and what they think should improve. Chapter 2.2.8 gives a condensed version of the experiences shared from New Zealand, Sweden, Denmark, England and the US.

3.2 Analysis

The assessment of the information was based on a simplified thematic analysis (see V. Braun and V. Clarke [38]) with the following steps:

- Immediately after each interview, the findings were summarised, and categorised as either descriptive data or theoretical and analytical findings and ideas
- Each researcher individually read all summaries and emerged their own main findings
- Through an analysis workshop, all researchers presented their findings and got supporting, falsifying and/or nuancing remarks from the other researchers, and a more holistic set of topics was formed
- The topics were categorised according to the Pentagon model
- The findings are presented integrated with the authors’ analytical perspective in this report
4 Findings from interviews

The findings from the interviews will now be presented according to the Pentagon model, which was described in chapter 2.3.4. Figure 4-1 shows the Pentagon model with the categorised findings added. The Pentagon model is used not as a scientifically absolute definition of our findings, but rather as a convenient, simple and logical way of presenting the results.

![Figure 4-1: The Pentagon model, by Schiefloe [5] with systematisation of the findings from this study.](image)

### 4.1 Formal structure

This dimension consists of leadership, organisation charts, reporting systems, formal lines to official government agencies, and procedures. From the interviews, four topics have been identified:

- *Size and organisation of fire departments*
- *Authorities, rules and regulations*
- *Resources and prioritisations*
- *Commission for investigating fires*
4.1.1 Size and organisation of fire departments

Organisation and dimensioning of fire rescue services are defined in regulations by the Directorate for Civil Protection, but duty of the regulations is situated in municipalities. Although there are general requirements, there are quite different approaches to fulfilling them, and the different municipalities find various ways of organising. The municipal responsibility also led to the different sizes of fire rescue services’ organisations – small municipalities generally have small fire rescue service organisations. Regulations ensures that the fire service keeps a minimum standard of preventers and firefighters. To do this, demographic requirements demand a minimum number of both preventive and responding professionals. Beyond this, the fire department is required to organise and keep enough personnel to match the risk and vulnerability analysis of the municipality.

Interviews with fire departments in both small and larger municipalities were conducted, and these showed that the size and organisation of the fire and rescue services matter for learning. A distinction between the fire departments in the larger cities in Norway and the departments in smaller, more rural areas was accentuated. The resources of the fire departments are allocated through the budgets of the municipalities. As Norway is a country with many small municipalities, there are many small and scattered fire departments, while larger cities and municipalities have more resources available. However, some smaller fire departments have formed inter-municipal collaborations. In the smaller municipalities, the fire chief in most cases only has a part time engagement, and the firefighters are part-time employees, only called upon in case of fires. The larger municipalities have more resources, with employees working full time both on emergency preparedness, but also strategically related to prevention of fires. In these larger fire departments, the roles seem to be more structured, while in the smaller fire departments it is probably easier to internally adapt and change structures, procedures and work practices, but more difficult to standardise and learn from other departments. Smaller departments tends to have more part time firefighters which on average get 40 hours of training per year, compared to the full time employed having 40 hours of training monthly.

In the largest fires departments, two main groups of employees were interviewed; one group with people working in the fire prevention division; and one group engaged in fire preparedness. The main task for the prevention division is to supervise preventing measures, in order to protect lives, health, assets and environment. The duty of the fire preparedness division is to respond and cope with all types of fires. There are variations within the fire departments related to the size and the scope of work for these groups, and how they interact with each other. Some fire departments reported a clear division between the fire prevention group and the emergency preparedness group, with little communication between the groups, especially in larger organisations. This division was explained by historic differences in culture, different work hours and work tasks. In one fire department in a larger municipality this division was less prominent as employees had responsibilities within both prevention and preparedness, but this is considered uncommon.
4.1.2 Authorities, rules and regulations

In the interviews, fire safety regulations related to technical requirements of buildings, and the operation and management of these were discussed, in addition to regulations giving requirements to the organisation of fire departments. These regulations are given and followed up on by the Norwegian Building Authority (DiBK) and the Directorate for Civil Protection (DSB).

In general, the regulations given by the Norwegian Building Authority related to fire safety for buildings in Norway are perceived as well-working. These regulations are function based, in contrast to prescriptive, which means that requirements are formulated in a general way, often based on required risk analysis. In the technical building regulations, some pre-accepted requirements are given as the minimum level to be in accordance with the regulation. The guidelines to the regulations give a set of pre-accepted performance levels that will fulfil the function-based regulations.

Some challenges with the regulations were mentioned, such that there is a large emphasis on trust in regulations, and less focus on physical controls of the fire safety system design in buildings during construction and when the buildings are completed. The interviews also indicate that it varies between the different municipalities how they follow up the regulations and how much the regional building departments work together with the fire departments. The regulation on organisation and dimensioning of the fire services gives requirements to the municipalities on how to organise, equip and staff the fire departments so that tasks required in law and regulations are performed satisfactorily. The DSB is responsible for this regulation. This regulation has been revised and was sent for a public hearing, which was closed in January 2021. The fire departments we have interviewed state that the old regulation was somewhat unclear with regard to how it should be interpreted, which lead to different ways of dimensioning the fire departments across different municipalities. Beyond following up on this regulation, the possibility of the DSB to govern the organisation and work processes in the municipalities is low. DSB does not have authority to instruct how the municipalities structure their work, e.g., with regard to how to extinguish fires or what equipment to use. A comparison was made with the National Police Directorate, which is given more control over the processes in the regional police departments.

4.1.3 Resources and prioritisations

This topic relates especially to the notions of interviewees concerning prioritisation of preventive efforts in the fire services. In general, the tasks related to emergency preparedness and response seem to be prioritised over preventive efforts due to the emergent characteristics of these tasks and the large workload related to them. Traditionally, preventive safety-related efforts exceeding the minimum requirements are also often difficult to argue for, due to the lack of clarity in how to measure a successful outcome (i.e., absence of negative events) - and when something (a fire) does not happen, the pressure towards cutting effort often comes along. However, the need to work on preventive efforts is emphasised, and one of the interviewees
mentioned that even when having more than the minimum requirements of staff working with preventative efforts, they are not able to reach over all tasks. Other aspects mentioned in the interviews, that influence the prioritisation of these tasks, are the local economy in the municipalities and local politics.

One issue regards the police and what resources and capacity they can bring with them to a fire incident. Lack of resources and capacity may set the bar too low for when the police consider a fire investigation finished. It was also reported that often the forensic fire technician does not get the chance of investigating at all, instead a quick glance at the fire scene returns some electrical fault-conclusion, and “that is it”. The case is then taken over by the insurance company that has the resources to do a proper investigation. This difference in resources has given way to a statement put forth by several interviewees: “Fires are mostly an insurance issue”. This statement points out that it is not until you have great material losses or losses of life in a fire, that resources are put into the investigation.

It was reported that the demand for DLE-inspectors in fire investigations had dramatically decreased over the last years. This is due to that fire incidents do not get the priority they need. This in turn gives problems for the DLE-inspectors who do not get the chance to sustain and improve their competency and makes it harder to argument for maintaining the number of inspectors who are financed by the Directorate for Civil Protection.

4.1.4 A central commission for investigating fires

The importance of having a centrally based investigation commission for fires in Norway is one of the main conclusions in a study in FRIC from 2020 [3]. This finding prompted questions given in these interviews but were also commented on by some of the interviewees in this study without being asked. The idea received positive comments from the interviewees as “this commission can fill the increasing gap in frequency of the police investigations”. The already existing Norwegian Safety Investigation Authority (HKS) were proposed as host institution for this, as the investigative work could really benefit from its established investigation methodology. As HKS is dependent on hiring external fire competence in many of their involvements in fire related matters, this hiring often depends on personal relations. The inclusion of competency on fire investigation into the organisation could aid in the reliability of comprehensive fire investigations in Norway, when HKS have their own fire experts. Some interviewees expressed concerns with the probability of this idea becoming reality, due to the matter of financing such a commission, when the area of fire investigation is already given a minimum of resources.
4.2 Technology and infrastructure

The dimension Technology and infrastructure relates to the organisations’ technologies, equipment and ICT systems. Two main topics from the interviews related to this category are:

- **Fire knowledge databases**
- **Use of technology to facilitate learning processes**

4.2.1 Fire knowledge databases

There are several databases applied by various actors in Norway related to learning from fires. see chapter 2.2.5 for more information.

In general, our findings show that today, the content of the databases are of varying quality and quantity. Moreover, the distinction between intended use and actual use becomes apparent when synthesising the interviewees' experiences. In smaller organisations, the perceived usefulness is low. It is also evident that the different databases are developed for certain purposes and actors along with different mandates, that can hinder others' use. On the other hand, most of the interviewees were positive to the intentions of the databases, and that given sufficient resources, standardisation and maturity, they noted that we are going in the right direction.

**BRIS/Brannstatistikk.no - Fire and rescue services’ reporting system**

Varying quality as well as quantity is a problem for this database according to the interviewees:

“Police officers and fire service investigators do not always have time to do a proper reporting of the findings from the investigation, and especially the analysis of the findings in the investigation”.

There is a lack of resources from authorities to provide the grounds for good analysis locally and regionally of the statistics put into the database. A reoccurring problem, according to one interviewee, is that a lot of the investigation done by the police ends up with unknown fire cause, due to their conclusions being legally binding and therefore caution is taken when an investigator is not 100 % sure. The Norwegian version of “Nordic Fire Manual. A practical guide for fire investigations” refers to the use of graded conclusions [39]. The grades range from 1 to 6, where grade 1 means that the conclusion is indisputable, and grade 6 means that it is not possible to draw any conclusion based on the investigation [14, pp. 233–235]. One interviewee also pointed out that the questions in the BRIS database were often irrelevant or the right questions were not there. In smaller fire rescue services, the perceived usefulness of BRIS was lower than in the larger organisations. This was related to that in the smaller municipalities and regions, the risk picture is easier to grasp. That means that descriptive statistics on fires in these regions are of less value because the number of fires is generally lower.
BRIS is also a fairly new tool being established in 2016, and it was commented that the amount of data is restricted because of the short registration period.

**KNITRE (“crackle”) and ULME (“smoulder”)**

The concerns with BRIS were extended to the newly established databases Ulme and Knitre. These new initiatives were discussed in the interviews, but not many of the interviewees had heard about them at all. When they were informed through the interviews, the feedback was positive, but cautious. The interviewees who were new to the databases underlined the importance that the difficulty of the user interface will decide if the databases will be used by “regular police and fire constables”. Moreover, one interviewee stated that openness is key:

“Everyone that needs the information stored there must get access, not only the police and fire service, but the ones making laws and regulations”.

Furthermore, interviewees noted that these databases would be a great tool in educational situations, i.e. for lectures and students writing their reports.

**BRASK**

Some interviewees pointed to the lack of collaboration between fire service and the insurance companies, to get more detailed information from insurance cases. One of the ways to gather some of this data is through the insurance industry driven database BRASK. Especially small fires that are not reported to the authorities could be gathered here. The problem, some interviewees reported, are that only fires that result in a compensation from the insurance company are registered in the database and there can be several insurance claims connected to a single fire incident. All of this makes the statistical data in the database inaccurate. It was also reported that the statistics in this database was difficult to apply locally.

### 4.2.2 Technology to facilitate learning processes

One of the fire- and rescue services highly valued the adoption of technology to obtain objective knowledge on how their missions were carried out in terms of decisions, management, procedures and general work practice. The technology mentioned was a camera attached to the helmet of certain firefighters and/or as dash cameras mounted on the fire trucks. The recorded data was then analysed as part of the internal evaluations within the fire department. According to the interviewee the data from the cameras was impactful:

“From only one event we got enough material to learn from and work with for five years”.

and
“This information is 100% objective, which rids the information of subjective viewpoints and interpretations”.

Others of the interviewed fire and rescue services had equipped cameras in vehicles. These cameras were, however, not utilised explicitly for learning purposes but for identification of specific information on demand from for example the police investigation.

The introduction of technological equipment like helmet cameras can be an example of an aspect that is triple loop or deutero learning (see section 2.3). By using this technology, the fire services are learning to learn in different ways. It provides better grounds for challenging underlying assumptions on how to conduct a response.

In one interview it was commented on the potential to use social media to broaden the reach and intrigue the younger population in society. The spread of information about fire safety to the general population is not good enough, and one way of getting a more effective spread of awareness is through newer virtual platforms where people spend their time.

4.3 Culture

The dimension Culture consists of safety culture, communication climate, experience as well as formal competence. It covers elements like language/concepts, established expectations concerning “ways of working”. From our findings, three main topics emerged to this dimension:

- Cultural characteristics of the fire rescue services
- Competence to learn effectively
- Actors’ different goals of obtaining and sharing knowledge

4.3.1 Cultural characteristics of the fire rescue services

“The fire is mine – keep away”

Several of the interviewees from different actors highlighted cultural characteristics of fire services in Norway. Working within fire services was characterised primarily as an experience-based profession, where firefighters’ learning is predominantly based on their own individual experience of firefighting in real fires, and many feel a personal ownership of the events (hence the quote “the fire is mine – keep away”). The fire services have a long tradition of individualised competence and experience of leaders as well as of employees of fire brigades. The descriptions of the firefighter culture are related to the nature of the work a firefighter conduct. A firefighter in urban areas uses approximately one minute to board the fire truck, and perhaps two minutes to drive to the designated area. This has implications for how well you can structure and plan a response. One of the interviewees implied that the preoccupation with improvisation and individual intuition has led to some conflicts when referring to distinguishing between planned and immediate responses, and training as a mechanism for learning:
“One cannot read how to act [they say]. But we are trying to say that there’s no harm in training”.

In line with these notions, interviewees underlined the intuition as an important role in conducting work. Intuition as an approach to decision-making, is based on the demand that even complex and novel fires and accident scenarios require coping under pressure. This approach, improvising based on experience, is a part of the culture of the brigades. The effect of these elements as a profession identity implies less emphasis on systematic evaluation of the work, where the firefighters rather value the individuals’ or brigade’s own experiences. The somewhat individualistic nature that is described relates to the potential collaboration of the fire departments in Norway. From the interviews we have also found good examples of regional collaboration, but the general impression is that each fire department is autonomous and, in this sense, individualistic.

Some noted, however, that although the traditional focus of the firefighters was as previously described, things had changed:

“I think it has become better. I mean there’s a change. People have different experience from schools, and they want to focus on training and exercises”.

The learning within the fire and rescue services seems to be based on an imitation method, which works very well in this practical profession. This method is heavily based on experience transfer, almost exclusively. The problem is that when this method is allowed to dominate alone, it becomes a vulnerable form of learning. Acquired knowledge becomes a storytelling, which has no (scientific) knowledge-based reference points or measuring points. The only points of reference are the storyteller’s preferences, and thus make this a vulnerable system for learning.

In a way, the challenge indicates a conflict between two different views on work; one predominantly oriented towards systematic standardisation (more functionalist view), and one more oriented towards individualism, intuition, practice and experience. These potential differences could be related to the profession identity of the firefighter, and established conventions of what is proper work as a firefighter. One concern with the individualistic and experience-based notions is the potential lack of systematic structures to contain important organisational knowledge, especially when key personnel retire or leave the job.

From the authorities’ perspective, there was impressions that the fire services’ culture is characterised with little sharing and learning. As one informant said:

“My impression is that there is a gap between words and action. They are willing to share what has gone well, but not what has gone bad. It is related to openness and culture where it is a learning potential. This encompasses recognising that something has not been good”.

This is a notion that also Sanne [40] highlights in studies of the Swedish fire rescue services - that the services do not always “allow” questions – especially if the rescue operation has not gone according to the plan. Other interviews also indicate that the sharing of knowledge and practice between fire and rescue services is limited.
It could be argued that, historically, the fire and rescue services has not had the culture to have “real” debriefs or evaluations of itself as an organisation. Many believe this is due to the valuing of the relationships within the organisation. When participating in a debrief, the firefighter knows that they will work closely together on a new assignment. In this situation it is understandable that it is not desirable to just recently having "criticised" the colleague. Therefore, evaluations have mostly been about sharing good experiences. The fear of showing "bad sides" of fire rescue services also relates to what Schilling & Kluge highlights as “Organisational silence and fear of ridicule”, as a barrier, including also blame culture, lack of psychological safety outside their own fire brigade, and fear of exposing weaknesses in media or to authorities [30].

4.3.2 Competence to learn effectively

Several aspects related to different actors and roles’ competence and skills were identified in the interviews.

According to some interviewees, there is a lack of competence regarding what evaluation really is in the fire services:

“The fire and rescue services are good at assessments. But they stop when it is done. Evaluations should start with an assessment. The fire rescue services do not have good enough knowledge on what an evaluation is. And how it should be done”.

This also points to the notions of most researchers regarding learning after incidents – most focus is directed to acquiring knowledge, and less in the subsequent phases of learning.

An interviewee from a prevention role highlighted that the courses and education efforts towards firefighters on prevention-related aspects were of a low quality. This was exemplified with that an increase in firefighters’ knowledge on modern building materials and construction techniques will be relevant both in a prevention and preparedness effort.

Basic level of fire competence within many investigation units of the police and fire services was considered as too low among several interviewees as this quote illustrate:

“The basic level of competence, especially in the police, but also in the fire service needs to be increased”.

This also relates to section 4.3.1 where resources and prioritisation were discussed. To have formal policies on the lift of competence the necessary resources must be allocated.

In one interview it was expressed a need to have better practical training grounds for fire investigators from the police. This should be equipped to handle real fire scenarios with solutions to increase the experience of the students.
4.3.3 Actors’ different goals of obtaining and sharing knowledge

One of the most important findings of the learning process from fires in Norway is the challenges arising when different actors are having differing motives and goals for obtaining and sharing the knowledge through investigation and analysis. This problem lies in the very different mandate of the actors and therefore it was indirectly reported as an issue by almost all interviewees. The main focus areas (as analysed from interviews) of the actors are briefly described below:

- The insurance companies and the police are predominantly motivated for finding any potential violation of laws and regulations, as to pursue recourse or legal aspects of the incident. Police can even, as one interviewee said, “sort of lock themselves onto a specific lead or theory and therefore only follow this forward, disregarding evidence worth noting, not relevant to the theory”. The fact that the police must produce legally binding conclusions to their investigations gives little room for speculation when a fire cause is not obvious and could be a barrier to the cooperation with fire service on site.
- The fire service investigates to evaluate their own work and build their experience-based knowledge base for their own organisation. This implies more focus on root causes and, especially for prevention efforts, informing how they should pursue findings to prevent similar fires later.
- The authorities have their own investigative methodology to learn across sectors and organisations. This is where DiBK and DSB comes in, as they are motivated towards gaining new insight into the rules and regulations, and therefore investigates leads towards this goal.
- The media and journalists are motivated towards publishing important findings that will reach the publicity and, in this way, make the foundation for enlightenment and democracy. It is although reported that information that ends up in the media is not always beneficial for the public, but something that gives the article attention.

4.4 Interaction

The dimension of Interaction covers communication, cooperation and coordination, and emphasises that individual and collective behaviour never occur in a vacuum - acknowledging for example management practices, work processes and information flow. Four main topics emerged to this dimension:

- Collaboration and interface between municipality and the fire services
- Collaboration and interface between the fire service and the police
- Sharing between the municipalities, the Norwegian Building Authority and the Directorate for Civil Protection
- Sharing of best practices and lessons learned among fire departments
4.4.1 Collaboration and interface between municipality and the fire services

Overall, it seems like the fire and rescue services vary in how and to what extent they collaborate with municipalities. Fire services in the larger cities reported about initiatives where presentations on fire safety were given for the different city district boards. These initiatives created a lot of positive feedback. They reported that the meetings had increased the overall focus of the inhabitants on fire safety as indicated by receiving increased amounts of messages of concern. One fire department reported that they had dedicated representatives for each city district and especially for vulnerable groups, and another fire department reported that they had generally good experiences with collaborating with the municipality compared to cases where the building was privately owned.

One interviewee highlighted that the regulations now are more facilitating advice instead of mere audits and inspections from a prevention perspective. This had acted as a catalyst for using more time on various prevention and learning efforts, for example collaborating with the municipalities' health services on training health care workers on fire safety.

Based on the comparison of small and larger fire rescue services, it seems as if the collaboration with the municipality is easier the smaller the municipality is. However, it is also less formalised. One example was given from an interviewee working with prevention. The fire and rescue service wanted the home care services to notify in case of insufficient fire safety in the homes of people regarded as vulnerable in a fire situation. The interviewee's experience was that establishing this collaboration with the municipality was no problem in smaller municipalities but hit a more rigid system in a bit larger municipality. The barrier was related to that collaboration that increased the workload should be formalised via union representatives.

4.4.2 Collaboration and interface between the fire service and the police

Representatives from the fire service reported in the interviews that they have had some challenges when collaborating with the police. The first being that the different mandates and focus areas for the investigation give a distinct difference in what is being investigated. As one interviewee said:

“The fire service is investigating everything, and the police are being narrower”.

The sharing of information between them are dialogue-based when on scene, which is to a large extent not formalised. This is also harder to accomplish when a crime has been committed. The police receive help from the fire service to evaluate each case, which supports the preventive work in general. There is no money from the municipalities to fund this collaboration and it is difficult to assure that persons with the right competence are involved.
4.4.3 Sharing between the municipalities, the Norwegian Building Authority and the Directorate for Civil Protection

DSB is regulating what the municipalities should be doing in the preventive work, but also in the preparedness work, through supervision and regulations. The directorate is also giving departmental training to municipalities and is involved in courses related to fire management and emergency response at the National Fire Academy. These seem to be central contact points between the authorities and the local municipalities and fire services.

The Norwegian Building Authority receives audit reports from the municipalities on deviations found in local building audits performed by independent companies. This is a communication channel that according to the interviewees could be more exploited. However, the deviations reported are focused on the planned design and building concepts, and not on the final construction.

With regard to learning from incidents, the two directorates can commission investigations on fire incidents. There are no set criteria for which fire incidents that should be investigated, but serious fires with large consequences and public and political interests are often investigated. The directorates are also particularly interested in fires indicating that changes to regulations could be necessary.

4.4.4 Sharing of best practices and lessons learned among fire departments

According to our interviewees, there is a general need of improvement in sharing of knowledge between the various fire and rescue service organisations. One interviewee meant that it existed a fear in the fire service of exposing weaknesses in their own work routines and evaluation capabilities if information and lessons learned were shared with other departments. This aspect could be associated with the finding commented in chapter 4.3.1 on firefighter culture, but also the fact that interviewees reported great regional variations in quality of investigational work and information gathering. It is important to underline that examples of the contrary exist, and that some regions have done improvements on this particular point, especially through regional collaborations.
4.5 Relations and network

Maybe quite overlapping with the previous section on Interaction; Relations and Network represent the informal structure and the social capital of the organisations: trust, friendship, access to knowledge and experiences, informal power, alliances, competition, conflicts, and network across expert areas. Within Relations and network, we formed three topics, all related to the fire services:

- Preparedness and prevention - collaboration and differences
- Personal relations as determinants for collaborations
- The Norwegian Fire Protection Association - the spider in the web of fire safety

4.5.1 Preparedness and prevention in the fire and rescue services - Collaboration and differences

A reoccurring topic in the interviews was the distinction between preparedness (or response) efforts and departments and the preventive efforts and departments. The prevention departments have, according to some interviewees, historically had a lower status in the fire services. Earlier, firefighters with health problems or of a higher age would be transferred to the fire preventive department, and that led to the slang “geriatric department”. Based on the interviews, these notions and clear distinctions in terms of status have changed – but there are still differences between the two types of departments. This can also relate to several other notions regarding the prioritisation of prevention efforts in general (see chapter 4.1.3).

The prevention departments are characterised with a different set of backgrounds and competencies than the preparedness departments. Personnel working with prevention efforts are of a more heterogenous background and are also often more of an academic and/or knowledge-based nature. The background and competence differences manifest themselves with different language and terminology that by itself can be a challenge when collaborating with other parts of the fire service. The preparedness departments seem to be more practice-oriented towards the response. One interviewee noted that the fact that employees in the prevention departments work at a different shift schedule (daytime) than employees in preparedness departments is relevant in this regard. The notions of differences in cultural aspects between the two departments echoes quite well with previous findings in the police, where response-related efforts exhibit a higher status than prevention or more knowledge-based work, and the personnel with highest informal power is the first responders out in the field [41].

Experiences from a smaller fire and rescue service indicate that perhaps the cultural and structural differences between the two departments are smaller in small organisations. In the organisation part of our study, prevention-related roles also had fire-fighting competence, so they could be part of response efforts. Similarly, some firefighters from the preparedness
department were utilised for prevention efforts. One example was that a fire brigade visited an underground parking lot to inspect fire safety. Two additional effects by using the fire brigade were identified. The first was that using uniformed firefighters and fire trucks can increase the symbolic effect of the inspection. The second was that the crew also could test e.g., the radio signal status in the area, which enabled them to be better prepared if a real event should occur.

4.5.2 Personal relations as determinants for collaborations

During the interviews it was discovered that when a formal framework for collaboration does not exist between actors on investigation and sharing of knowledge, personal relations dictate instead. This could be between the fire service and the police, between the authorities and the fire service and so on. This reliance on individuals was commented to be a vulnerability, as organisations can lose key personnel, e.g., when experienced officers retire and take with them their personal contacts and relations. It is important to underline that the interviews also uncovered great contradictory stories where some sort of agreed collaboration has proved successful. Furthermore, the personal relations are even more apparent in smaller fire and rescue services. One example was that a fire and rescue service department was generally collaborating with an investigator from the police. They had annual meetings to discuss fires that had happened, in order to learn more about general findings and causes. The collaboration ended when the police investigator retired. A new police investigator was employed in the position, and the collaboration was (unintentionally) not continued.

4.5.3 The Norwegian Fire Protection Association - The spider in the web of fire safety

Considering that the Norwegian Fire Protection Association is a non-governmental organisation (NGO) without formal responsibilities, their role in learning from fires is quite distributed across a vast number of activities and actors. They have a vital role in the development of the experience-sharing databases Knitre and Ulme, administer certifications for various aspects like hot works, they are sharing knowledge through their magazine Brann og Sikkerhet (Fire and Safety), and develop several guidelines for investigation. They also collaborate with most actors within fire safety related work. Lastly, they conduct their own analytical inquiries regarding fires. Most of their collaborations are, according to an interviewee, relation-based and not formalised. Thus, it seems like the Norwegian Fire Protection Association acts as a spider in the web of fire safety in Norway and provides an important ground for learning.
5 Main findings and recommendations

The objective of this study has been to investigate preconditions for learning from fires in Norway. Various investigations, analyses and evaluations are made by different actors such as the fire departments, the police, insurance companies, and investigations commissioned by the authorities. Information from these efforts form a basis of knowledge that would be valuable for different actors working with fire safety.

5.1 Main findings

The main finding from the project work can be summarised as follows:

1. Too few fires in Norway are analysed or investigated. If fires are investigated, the mandate, approach and focus vary. A lack of a common, systematic, and holistic approach to fire investigations impairs the quantity and quality. An independent central investigation commission could have a unifying role.

2. Databases with information from fires seem to have potential for improvement both regarding better quality of input data and regarding adequate analyses of the data, both at a regional and a national level. Some of the databases are rather new or in the making, and it will probably take some time to develop robust routines, competence, and data material.

3. Lack of resources, both in the fire and rescue services and in the police sector, impairs the possibility of learning from fires and for disseminating lessons learned from fires.

4. Sharing of knowledge and experience within and between organisations seems to be very varied in both amount and form and is often dependent on individual efforts and personal relations.

5. In some of the larger fire departments there is a drive towards more systematic efforts connected to facilitating evaluations and learning.

6. Collaborations in fire investigations are generally based on personal relations and not on formalised agreements.

5.2 Remarks on preconditions for learning

Some interesting remarks could be made from our findings. If we consider the phases proposed by Drupsteen, it is clear that the findings show that most emphasis is made on the first phase of learning from incidents - obtaining knowledge - thus being in line with previous findings [36]. Although most emphasis is made on this information phase, the interviewees also pointed towards clear weaknesses within this phase - especially in terms of the number and the quality
of investigations. Further, the ecosystem consists of several databases, but the resources and practices around them seems to hinder their application to their full potential, although improvements are underway.

A further insight is that fires are quite special types of incidents, as they transcend sectors and actors, whilst being a subject of specific expertise at the same time. This creates a complex network of organisations that could or should learn from incidents some way or another, and our findings show that the centralised bodies for coordinating are somewhat diffuse in this regard.

We see that the size of organisations matter in how and to what extent learning within and between entities takes place. Based on the findings, we see for example clear differences between fire rescue services of different sizes regarding informality versus formality in the learning processes.

The structure and culture of organisations involved, especially for the fire and rescue services, are important for if and how there will be learning from fires, and what type of learning this could be. The findings show that preconditions for learning from incidents is not primarily a technical or procedural issue, but rather of an interrelated complex nature, with both informal and formal factors. This also implies that interventions and measures for improving the learning must acknowledge that this is a complex man, technology and organisation issue (MTO).

5.3 Recommendations

Based on the findings, we recommend the following to increase the quantity and quality of fire evaluations, and to improve preconditions to learn from fires in Norway:

1. **Resources and prioritisation of fire prevention work**
   Resources for investigation of fires and the status for fire prevention work must be increased to enable going from information to implementation of change. This is a matter of prioritisation and will require substantial work on several levels of authority.

2. **Organised investigation commission(s) for serious accidents involving fire**
   a. The establishment of a centrally organised investigation commission for fire accidents should be considered through a specific assessment. It should be considered if this commission could be organised as a part of the Norwegian Safety Investigation Authority.
   b. The formalisation of regional investigation groups should again be considered. This should be pursued as a potential way of increasing collaboration and quality, dedicated personnel with multidisciplinary competencies and increase the quality of the investigation.

3. **Education, training and competence**
   a. Education, training and competence related to fire investigations should be increased for both the police and fire and rescue services.
b. Requirements for a minimum level of competence for private fire investigators and for fire expert witnesses should be developed and implemented. A certification system could be considered.

4. **Increase collaboration for learning**
   a. Guidelines for a process of collaboration across fire departments and municipalities with the aim of obtaining increased learning should be developed.
   b. Guidelines for a process of collaboration between fire preventive and fire preparedness sections within fire- and rescue services should be developed.

These guidelines should be tested in practice.

5. **Establishing a common terminology and methodology for evaluation of fires in the fire and rescue services**
   Reducing the large local variations in terminology and methodology for evaluations could improve systematic learning activities across fire departments and other actors. It is important to balance standardisation by at the same time giving room for development of local best practises in the fire departments.

6. **Evaluation of the use of fire databases**
   Regular evaluation of the use of databases and follow-up of necessary changes based on the findings would ensure their relevance. Including aspects of “what went well?” would be beneficial.
6 Proposal for further work

When suggesting further work the recommendations from chapter 5.3 are critical as to further assess how they could be operationalised. This project report is meant as a brief mapping of challenges and possible solutions to a complicated issue on learning from fires in Norway. Therefore, further work needs to be attributed to the findings and recommendations so that solutions can be drawn from this work.

Firstly, the results from interviews with relevant actors are not to be underestimated. The feedback given to this project from people that work with this on a daily basis is critical in finding good solutions to the problems. That is why we suggest that further interviews into one or more of the recommendations are needed. For example, the work to assess establishment of a national investigation commission for fires must start with gathering opinions and experiences from stakeholders like the fire investigators in the fire service, police, insurance etc. that are directly involved with investigative work, regulations and procedures on this specific topic. The findings here should then be directed back to the responsible authorities.

Secondly, a study on the economic consequences of limited resources on fire investigation in Norway could be considered, through for example cost-benefit analyses. This will be a good leverage point when discussing how and why prioritise preventive work in the fire service and the police. It has become apparent that lack of resources is a fundamental cause of the low quality and quantity of fire investigations in Norway.

For the further work directly linked with the objectives in this project there are some topics to consider. Interviews with private fire safety engineers can give valuable insight into how learning from fires could benefit the fire safety engineering area of expertise.

For the work on strengthening the competency in the investigative work in Norway the mapping of knowledge gaps is a good place to start. This can also be done by interviews and workshops that specifically focus on the fire service and police investigations. It was commented through the report that it is here that the pressure lies. This can have a direct implication on the change of educational structure the Norwegian Fire Academy will implement as they move to the new fire academy premises in 2024. The academy, which are targeted mainly at the fire service, serves as a perfect platform to set the stage for a better sharing culture. This will bridge the many gaps between preparedness and preventive work mentioned in this report.
References


Learning from fires in Norway – Preconditions, barriers and enabling factors


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