

# PRECONDITIONS FOR LEARNING FROM FIRES IN NORWAY – STRUCTURAL, CULTURAL, TECHNOLOGICAL, INTERACTIONAL AND RELATIONAL ASPECTS

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Learning from incidents is widely accepted as a core part of safety management. This is also true for fires – however few fires in Norway are investigated. Fires are interesting incidents conceptually due to their potential of devastating outcomes on material and human lives and because they happen across all sectors and industries, businesses, and homes. In Norway, several different actors play a role in investigating and learning from fires, from the fire rescue services to directorates and Non-Governmental Organisations. The present study seeks to understand the preconditions for learning from fires in Norway, with emphasis on the formal actors that play a role in preventing and mitigating fires. Methodologically, the study is based on qualitative interviews conducted with relevant actors from first responders, authorities, and other sectors. We found that there are structural, cultural, technological, and relational aspects that seem to influence learning from fires in Norway. The results were analyzed using thematic analysis and the Pentagon model framework. The findings are discussed in relation to theories from organisational learning and learning from incidents.

*Keywords:* organisational learning, fire safety, fire and rescue services, pentagon model.

## 1. Introduction & research question

A pinnacle of safety management is to learn from incidents and accidents to obtain knowledge and to adapt structures and practices to avoid future events. Fires are quite frequent incidents with high potential for loss of human lives and material damage. A goal for the systematic management of fire safety within a society should thus include committing to knowledge-based change and learning, so that structures and practices will be adapted for appropriate risk-reduction.

The objective of this study has been to investigate the organisational preconditions for learning from fires in Norway, emphasising the formal actors involved, and their perceptions and knowledge on the subject. Our overall research question is *What are the preconditions of learning from fires in Norway?*

The paper is structured to first provide a theoretical basis for our study, methodological aspects, then describing the findings from qualitative interviews. Then, these results are discussed in relation to a model of learning from incidents. Lastly, conclusions and practical implications are presented.

## 2. Background - Organisational learning and safety

The theoretical foundation of our work is situated within three domains; organisational learning, learning from incidents and accidents, and organisational safety including the Pentagon model framework (Schieffloe, 2011).

### 2.1. Learning in organisations

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. Two main definitions of organisational learning are presented in Rosness et al. (2013): a *change* in organisational knowledge (Schulz, 2001) and a *process* where organisations and subunits change because of experience (Argote & Ophir, 2002). One prerequisite for organisational learning is related to the organisations ability to challenge established notions, practices, and beliefs. However, this is not easy, as such knowledge often

is tacit, meaning that it is difficult to capture in structural plans and procedures.

Several models of organisational learning are oriented towards levels of learning. One model describing this is presented in Schilling and Kluge, (2009). The model consists of four different processes of learning, which may be linked to the different organisational levels (individual, groups and organizational). The processes of learning are in this model *intuiting* (individual level), *interpreting* (individual to others), *integrating* (group level) and *institutionalising* (shared knowledge implemented at organisational level).

Another aspect of levels of learning is the concept of single-loop and double-loop learning, which are well-known terms in the literature on organisational learning (Argyris, 1977). 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. A third level of the "loop-learning" theory is the deutero learning level (Visser, 2007). This level is essentially efforts that lead to the measures that enhance the capabilities of the organisation to leverage both single- and double-loop learning - or "learning to learn".

We consider that learning in an organisation is not a linear process where learning is formed at an individual level and then develops into institutionalised learning. The process may be initiated at different levels with feed-back and feed-forward from and to the individual level and the organisational level. For example, a change in procedures may be initiated both by an employee who sees discrepancy between real work practice and work as planned, and from a company review e.g., of the document management system. Learning may also be both *managed* and *spontaneous* (Rosness et al, 2013).

## 2.2. Learning from incidents

An area close to, and overlapping with, organisational learning – is learning from incidents. There are several different models of learning from incidents. The model of Drupsteen et al. (2013), see Figure 1, highlights steps in learning from incidents, including 1. Investigation/analysis, 2. Intervention, 3. Intervening, and 4. Evaluating – which eventually leads back to the previous steps in a feedback loop. The model could be primarily considered reflecting a *managed* learning process, however, we also assume that spontaneous learning processes are involved when learning from incidents.

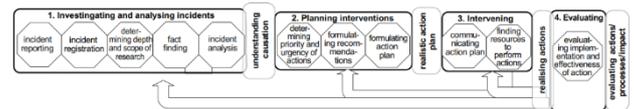


Figure 1. Learning from incidents (Drupsteen et al., 2013)

When comparing this model with theories of organisational learning, a review (Drupsteen & Guldemund, 2014) 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. This is the measure phase (or intervention phase - phase 3) 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.

Whereas the model of learning from incidents is a step-wise, cyclic and "linear" process, we can regard the organisational learning terms and theoretical frameworks as underpinning mechanisms and a broader context.

## 2.3. Organisational safety - The Pentagon model

Several tools and models are available for guiding an analytical process related to technological, human and organisational aspects of safety-related issues. One recognised model is the Pentagon model (Schiefloe, 2011), which is a holistic organisational analysis model, consisting of five dimensions, all related to safety of a system. The model is particularly useful to analyse the performance of complex organisations and was developed when considering the gas blow-out at the Snorre A offshore platform in 2004. The model consists of five dimensions. **Formal structure and organisation** dimension consists of leadership, organisation charts, reporting systems, formal lines to official government agencies, and procedures. **Technology and infrastructure** relate 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** represent 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. **Interactions** covers communication, cooperation, coordination and emphasises that individual and collective behaviour never occurs in

a vacuum – acknowledging for example management practices, work processes, information flow.

### 3. Method

#### 3.1 Research approach

The paper is part of a research project related to learning from fire investigations, as part of the Fire Research and Innovation Centre (FRIC). In the first phase of our project (study I), we focus on preconditions for learning, by using a broad thematic guidance and data gathering to gain an initial understanding of the issue, followed by in-depth studies (study II-III) on particular areas of interest later in the project. For study I, we conducted semi-structured interviews with representatives from important actors in the fire community.

#### 3.2. Semi-structured interviews

A goal of qualitative inquiry is understanding and capturing rich descriptions of a phenomenon, rather than making representative and generalisable findings. A suitable method in this regard is the semi-structured interview. To investigate the research questions of the study, we conducted 14 individual and group interviews with 11 actors and 17 informants. The interviews were based on a thematic semi-structured interview technique and guide. The organisations interviewed in this project were (number of informants):

- The Police (1)
- The fire services (8)
- The National Criminal Investigation Service (Kripos) (1)
- Norwegian Safety Investigation Authority (SHK) (1)
- Insurance (1)
- Finance Norway (1)
- Norwegian Directorate for Civil Protection (DSB) (1)
- Norwegian Building Authority (DiBK) (1)
- Norwegian Fire Protection Association (1)
- The Norwegian Police University College (1)
- The Local Electricity Inspectorate (DLE) (1)

The analysis of the data was based on a simplified Thematic Analysis (Braun & Clarke, 2008), combining descriptive and analytical summarising/coding (individually, then collaboratively), and developing overarching themes. Then, the themes were categorised according to the Pentagon model through a collaborative analytical process with the researchers involved.

### 4. Findings – Pentagon model of preconditions for learning from fires in Norway

In the following, we will elaborate on the main findings of the qualitative interviews relating to preconditions for learning from fires in Norway.

#### 4.1. Formal structure and organisation

##### 4.1.1 Size and organisation of fire and rescue services

The fire and rescue services in Norway are locally organised, where each municipality is responsible for the fire services. The organisation and dimensioning of fire rescue services in Norway is defined by regulations enforced by the Directorate of Civil Protection. The interviews showed that there are quite different approaches to fulfilling them in each municipality due to different interpretations of the regulation and local needs and context. As Norway is a country with many small municipalities (in population especially), this leads to many small and scattered fire rescue services. Beyond the regulations, the national governance is quite limited, and the municipal units are seen as autonomous organisations.

Some smaller fire rescue services have formed inter-municipal organisations to collaborate across fire departments. In the smaller municipalities, the fire chief in most cases only has a part time engagement, and the fire fighters are often part-time employees, only called upon in case of fires. The larger municipalities accordingly have more resources, with employees working full time both on emergency preparedness, but also strategically related to prevention of fires and more knowledge-oriented work. In these larger fire departments, the roles seem to be more structured, while within the smaller fire departments, it is probably easier to internally adapt and change structures, procedures and work practices, but more difficult to standardise and organise learning across departments in other municipalities. In smaller fire and rescue services, the knowledge and learning might thus be more tacit than in the larger organisations.

Although there are good examples of regional collaboration, the general impression is that each fire and rescue service is primarily autonomous.

##### 4.1.2. Resources and prioritisations

This topic relates especially to the prioritisation of preventive efforts in the fire services. In general, the tasks related to emergency preparedness seem to be prioritised over preventive efforts due to the emergent characteristics of these tasks and their large workload. Traditionally, preventive safety-related efforts exceeding the minimum requirements are also often difficult to argue for, due to the difficulties in how to measure a successful outcome (i.e. absence of events). Other aspects mentioned in the interviews that influence the prioritisation of these tasks, are the local economy in the municipalities and local political decisions.

Similarly, in the police departments, the lack of resources is influencing the quality of investigations that are performed after a fire, according to the informants. Often, just a superficial evaluation is made, before the case is turned over to insurance companies that have more resources for investigation.

In addition to these topics, the informants highlighted that responsibility for investigating fires were scattered across actors and lacking a central/official fire investigation commission. Such a commission would be beneficial as actors with technical knowledge of fires and competence in investigations would be united and could play a central role in uncovering and sharing important learning from fires. One option that was mentioned was to place this responsibility with the Norwegian Safety Investigation Authority. However, there were also expressed concerns about how such a central investigation should be organised especially with regards to resources.

#### **4.2. Technology and infrastructure.**

##### **4.2.1 Use of databases capturing knowledge on fires**

In Norway there are four main databases that gather information about fires, Bris (2021), Brask (2021), Knitre (2021), launched in 2020 and Ulme (2020), to be launched. In general, our findings show that today, the contents of the databases are of varied quality and quantity. For example, the type of data and parameters that the databases ask for as insufficient and there is also a challenge with regards to lack of authority resources to follow up and analyse the data. Moreover, the distinction between imagined use and actual use becomes apparent when synthesising the informants' experiences.

In smaller organisations, it seems like the perceived usefulness is lower than in larger, due to that the workers have a simpler risk picture where "we know what the causes and the risks are". It is also evident that the different databases are developed for certain purposes and user groups with different mandates, that may hinder others' usability. Most of the informants were positive to the intentions of the databases, and that given sufficient resources, standardisation, and maturity, informant noted that 'it is going in the right direction'.

##### **4.2.2. Use of technology to aid learning.**

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 central technology mentioned was a camera attached to the helmet of certain firefighters

and/or as dashboard cameras mounted on the fire trucks. The recorded data were then analysed as part of the internal evaluations within the fire department. According to the informant, the data it gave was impactful: "*from only one event we got material to learn from and work with for 5 years*", and "*this information is 100% objective, which rids the information of subjective viewpoints and interpretations*". Other fire and rescue services interviewed had equipped cameras in vehicles, but they were not utilized explicitly for learning purposes.

#### **4.3. Culture**

##### **4.3.1. Cultural characteristics of the fire rescue services**

Being a firefighter within fire and rescue services is in the interviews characterised primarily as an experience-based profession, where the fire fighters' learning predominantly is based on their own individual experience of firefighting in real fires and a feeling of personal ownership of the event. This was characterised with the expression "*the fire is mine – keep away*", which also is symbolic for the individualism of the fire services themselves. The fire services have a long tradition and experience that associates the competence of leaders and workers based on individual experience. One informant stated that "*I quite often hear here that fire officer is an experience-based profession, with pride*". In line with these notions, informants also underlined intuition as an important factor in conducting work. An effect of the profession identity is less emphasis on systematic evaluation, where fire fighters rather value the individuals' or brigades' or departments' own experiences.

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*". In some of the larger fire departments, there were also a focus with the managers to counteract the individualistic thinking with actively changing the way systematic evaluations were performed.

Also from the national authorities' perspective, the impressions expressed in the interviews were that the fire services' culture is characterised by little sharing and learning. "*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 for where it is a learning potential. This encompasses recognising that something has not been good.*".

### 4.3.2 Competence to learn effectively

As mentioned, the fire departments are autonomous entities, and there is little coordination across the department on how to effectively learn from incidents, and evaluations are performed to varying degrees. In addition, there is a lack of competence regarding what an evaluation should be within the fire and rescue 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 and rescue services do not have good enough knowledge on what an evaluation is neither.”*

An informant working with fire prevention highlighted that the courses and education efforts towards fire fighters on prevention-related aspects are inadequate. This was exemplified with firefighters’ lack of knowledge on modern construction material and techniques, which is relevant both in prevention and preparedness efforts.

### 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 reported as a problem by almost all informants.

The insurance and police are predominantly motivated for finding the potential violation of laws and regulations, as to pursue the legal aspects of the incident. One informant noted that *“Another challenge is the differences between fire and police evaluations. What has the municipality done? The Police is not so interested in that angle and do not want to have fire [services] in the midst of the investigation”*. The problem that the police must produce legally binding conclusions to their investigation gives little room for uncertainty. When a fire cause is not a 100 % clear and could be hindering the cooperation with fire service on site.

The fire and rescue 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 follow up findings to prevent similar fires later.

The authorities (DSB & DiBK) may however commission investigation reports that covers topics across sectors and organisations, and are examples of more holistic investigations of fires in Norway. The main motivation when the authorities commission these reports

is to gain new insight into whether the relevant rules and regulations are adequate.

## 4.4. Relations and network

### 4.4.1. Degree and structure of collaboration between municipality and the fire services

Considering that the municipality administration is responsible for managing the construction of new buildings through the municipality's plans, as well as ensuring housing for vulnerable groups the interface with the fire and rescue services is interesting. Sharing knowledge on past fire incidents from the fire rescue services could influence the municipalities' preventive efforts on following up vulnerable groups and managing construction of new building. On the other hand, the insights from contact with the vulnerable groups and new buildings from the municipality side could be of value for the fire rescue services both for preparedness and prevention efforts.

Overall, it seems like the fire and rescue services vary in how and to what extent they collaborate with municipalities. The fire rescue services in one of the larger municipalities have made an initiative to visit several city districts within the municipality and presented common issues with regards to fire prevention. This has resulted in positive feedback and more interaction with the city districts, including an increased number of messages of concern. Another fire department reported that they had dedicated representatives for each city district and especially for vulnerable groups. One informant claimed that collaborating with municipal house owners was less troublesome than private actors.

Based on the comparison of informants from small and larger fire rescue services it seems like the collaboration with the municipality is easier within the smaller municipalities, however, it is also less formalised. One example was given from an informant working with fire prevention. In the fire and rescue services, they wanted the home care services to notify in case of lack of a minimum fire safety level in the houses of vulnerable groups. The informant's experience was that establishing this collaboration with the municipality was no problem in smaller municipalities, but more cumbersome in a larger municipality. The barrier was that from municipal side there was push towards the collaboration having to be formalised through union representatives, because it was assumed to increase the workload of municipal workers,

### 4.4.2 Sharing of best practices and lessons learned among fire departments is of a varied nature

In the interviews, the sharing of knowledge between fire rescue services was regarded as limited. One informant mentioned that there 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 ties in with the finding commented in the chapter on culture, but also the regional variations in quality of investigational work and information gathering. Some informants gave examples of the opposite, and that some regions have made improvements on cross-organisational learning. The informants noted that the institutional Fire school should have a clearer role in facilitating learning across fire rescue services.

#### **4.5. Interactions**

##### **4.5.1 Preparedness and prevention - collaboration and differences**

A reoccurring topic in the interviews was the distinction between preparedness and preventive efforts within fire departments. The "prevention departments" have historically had a lower status, according to some informants. Earlier, firefighters with health problems or higher age would be relocated to work with fire prevention, and that led to the derogatory labelling "*geriatric department*". In the interviews, there was expressed a change in terms of status of the preventive efforts. Especially one of the larger fire departments reported to have experienced improvements after also having personnel with experience in both preventive and preparedness efforts. However, there are still differences between the two different departments, which may be seen in context of the reported lack of prioritization of prevention efforts in general.

The fire prevention departments are characterised with a different set of backgrounds and competencies than the preparedness departments. Personnel situated in the prevention efforts are of a more heterogenous background and are also more of an academic and/or knowledge-based nature. The background and competence differences manifest themselves with different language and terminology that by itself may be a challenge when collaborating with other parts of the fire and rescue service. The preparedness department seems to be more practice-oriented towards the response. One informant also pointed out that the different working hours contributed to little contact between the two departments.

Experiences from a smaller fire and rescue service indicates that perhaps the cultural and structural differences between the two departments are fewer in small organisations, where personnel may have

responsibilities both with prevention and preparedness efforts. Several informants noted that a new education forthcoming involved rotations within the department, and that this could potentially accommodate the issues.

The cultural differences have led to not fulfilling the potential of learning from each other; where prevention efforts could be guided by actual events and responses, and preparedness efforts could be guided by for example the knowledge-oriented analytical work within fire prevention.

##### **4.5.2 Personal relations as determinants for collaborations**

In the interviews, personal informal relations were mentioned as a contributor to collaboration between the fire service and the police during investigations, the authorities and the fire service and between the fire service and municipalities. The Fire protection association, which acts like a spider in the web of actors, seems to work efficiently through established personal contacts along with some formal collaborations. Furthermore, the personal relations are even more apparent in smaller fire and rescue services. One example was that a fire and rescue services department was collaborating with an investigator from the police, with annual gatherings 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 person got the position, and the collaboration was (unintentionally) not continued. The informants generally wanted a formalization of the collaboration between the police, the fire services and the local electrical inspectors. In conclusion the emphasis of personal relations (as opposed to mere formal collaborations between actors) is an interesting precondition that seems to influence how and to what extent actors manage to learn from fires.

## **5. Discussion**

The objective of this study has been to investigate preconditions for learning from fires in Norway. We have structured our findings by using the Pentagon model of organisational safety. Recalling the model of Drupsteen et al. (2013), dividing learning from incidents into several phases with feedback loops, we will first sum up our results within some overarching phases of learning from fires. Secondly, we will discuss some main insights of our findings with theoretical and practical implications.

### **5.1. Obtaining knowledge on incidents – The investigation and information gathering process**

There are several processes that leads to obtaining knowledge from fire incidents in Norway; various investigations, assessments and evaluations that are made by different actors such as the fire departments, the police, insurance companies, and investigations commissioned by

the authorities. One main finding is that the initiatives are based on different mandates, that sometimes hinder effective cooperation between the efforts. One example is the polices' focus on determining potential criminal activities in relation to a fire and the direct cause, while the fire department is more concerned with underlying causes and to learn from their own response. When a fire occurs, they have to collaborate on the knowledge creation. An independent central investigation commission could have a unifying role in this regard. Such a commission seem to be welcomed by several informants, however there are concerns of how this should be organised.

Another main finding is that in the interviews, concerns were expressed with regards to the quality of investigations of fires. This may be seen in relation to a general lack of resources, both within the fire departments and the police. In the fire departments this may especially be seen in the lack of prioritisation of preventive efforts. There is also a reported lack of competence with regards to how investigations should be performed, especially there seems to be a focus on the technical aspects of causes for fires as opposed to more underlying causes.

With regards to assessments and evaluations of the fire departments own performance during response operations, there is a high degree of variability both in how, when and to what extent evaluations are performed. However, especially in the larger rescue services, there are efforts towards standardizing professional learning systems with evaluations and debriefs.

### **5.2. Sharing of knowledge obtained**

Reporting and analysis of data from fires may be important resources to be used for sharing information about causes and consequences of fires. According to the informants both the databases that gather information of fires seem to have potential for improvement both with regards to better input data and adequate analysis of the data, both locally and nationally. This requires adequate competence and training of the personnel that is going to provide this input. Importantly, most 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.

Sharing of knowledge and experience within and between organisations seems to be very varied, and often dependent on individual efforts and personal relations. Some of the reluctance to sharing information may be a fear of showing "bad sides" of the fire and rescue services. This relates to what Schilling & Kluge (2009) highlights on individual and group level on "Organisational silence and fear of ridicule", as well as blame culture, lack of psychological safety outside their own fire brigade, and exposing weaknesses in media or to

authorities. In studies of the Swedish fire rescue services, Sanne (2018) also highlighted that the services do not always "allow" questions – especially if the rescue operation has not gone according to the plan.

In some of the larger fire departments there is a drive towards more systematic efforts with regards to facilitating evaluations and learning. However, the informants noted that sharing of experiences is lacking, due to the individualistic nature of the profession. The cultural challenges indicate a schism between two different rationalities; one predominantly oriented towards systematic standardisation and functionalist view on work, one more oriented towards individualism, practice and experience. These potential differences could be related to the profession identity of the firefighter, and established conventions of what is proper work.

### **5.3. From knowledge to implementation and change**

The lack of resources both with regards to preventive efforts in the fire and rescue services and for investigations in the police department impairs the possibility of learning from fires and for disseminating lessons learned from fires.

The implication cultural aspects have with regards to learning is the lack of systematic structures to gather important organisational knowledge and the potential reluctance to share information about lessons learned, both within and across fire departments. This is especially relevant when key personnel retire or leave the job.

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 and/or more knowledge-based work, and the personnel with highest informal power are the first responders out in the field (Bye et al., 2019).

When a formal framework for collaboration does not exist between actors on investigation and sharing of knowledge, personal relations seem to be deciding the degree of collaboration instead. These collaborations may have short term benefit for learning, however, as with the lack of systematic learning within the fire departments, this is vulnerable when key personnel leave the job.

The reliance on personal relations bears the resemblance of a Janus face - on the one hand it seems to have had positive effects there and then. On the other hand, as organisations can lose individuals like an experienced officer retiring, taking with him his personal contacts and relations, the vulnerability in terms of capturing and storing knowledge in and within organisations is shown.

The introduction of technological equipment like helmet cameras may be an example of an aspect that is triple loop or deutero learning (Visser, 2007). By using this technology, the fire services are learning to learn in different ways. It provides grounds for challenging

underlying assumptions on how to conduct a response. An informant claimed that using tools could hinder that the learning processes ended at evaluation, because the data would be objective and difficult to disregard.

## 6. Conclusions & practical implications

Some interesting theoretical and practical remarks could be made from our findings. First, the structural and cultural aspects of the actors involved in learning from fires, especially the fire rescue services, lays the bricks for which learning takes place. The findings show that preconditions for learning from incidents is not primarily a technical or procedural issue, but rather of an interrelated complex systemic nature, with both informal and formal factors. This also implies that interventions and measures for improving the learning must acknowledge that.

If we consider the phases proposed by Drupsteen, it is clear that the findings show that most emphasis is made on the first phases of learning from incident – obtaining knowledge, thus being in line with previous findings (Drupsteen & Guldenmund, 2014). Although most emphasis is made on this information phase, the informants also points towards clear weaknesses within the phase - especially in terms of number and 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 sizes 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 in between fire rescue services of different sizes with regards to informality versus formality in the learning processes.

Further, we see that the Pentagon model as a pragmatic analytical tool and framework is helpful in structuring a complex phenomenon like learning from fire incidents and accidents.

The informants also provided recommendations for improvement of the conditions for learning from fires, including a better formalised organisation of the investigations, strengthening the existing collaborations within and across organizations, increasing competence on fire safety and investigation, and lastly, prioritising more prevention-related efforts.

With regards to further research, the main findings made here should be pursued with in-depth studies to shed light on how they relate to the actors' ability to learn efficiently from fire incidents and accidents.

## Acknowledgement

The authors gratefully acknowledge the financial support by the Research Council of Norway and several partners through the

Fire Research and Innovation Centre ([www.fric.no](http://www.fric.no)), RCN project number 294649.

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