Durham University

Vocational Dissertation

‘A critical evaluation of the methodology employed by the UK Fire and Rescue Service to analyse risk in their local communities’

MA Risk

Durham University

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Executive Summary

Introduction

As outlined in the Fire Services Act 2004, all Fire Services are required to produce an Integrated Risk Management Plan to identify and assess all foreseeable risk in their local communities. Despite this requirement, there is currently no UK-Wide Methodology to analyse risk in the Fire Service. County Durham and Darlington are currently in the process of updating their local Community Risk Profile, therefore this project will provide insight into what methodology is used nationally and how this could be applied to their risk profile.

Aims and Objectives

The aim of this project is to critically evaluate the current methodological practice implemented by the UK Fire and Rescue Service (FRS) to analyse foreseeable fire and rescue related risk in their communities. This evaluation will contribute towards a series of recommendations for the consideration of County Durham and Darlington Fire and Rescue Service (CDDFRS) when developing their local Community Risk Profile. This evaluation will primarily use document analysis and a critical framework to provide textual analysis allowing the cross comparison between documents.

Key Findings and Recommendations

- There is currently a great disparity in the content, purpose and audience of IRMP documents produced to analyse risk in communities. This could be attributed to obsolete government guidance documents used to inform the IRMP process.
- The methodology currently implemented by CDDFRS for the analysis of dwelling fire is well developed, reflecting current notions of risk used within disaster risk academia.
- The methodology in place by CDDFRS for the analysis of commercial fire risk and special service risk has the potential for greater development, incorporating wider data sources and connections with wider agencies and organisations.

It is these findings that have lead to the following recommendations;

- Supplement existing commercial fire risk methodology with data that goes beyond historic instance and past audits. Using a similar methodology to that developed with ADF's, building a model that incorporates variables such as 'food hygiene' would have the ability to progress
- Look to incorporate seasonality and temporality into the analysis of risk in the Community Risk Profile. Translating this risk to the public along with addressing the Five W's, helps to communicate risk effectively
- Look to develop greater connections with other agencies to enable the ability to share data. Although there are certain restrictions on the sharing of data because of privacy laws, even greater access to publicly available data such as business hygiene ratings and flood risk properties could be highly beneficial.

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Acronyms

FRS: Fire and Rescue Service

CDDFRS: County Durham and Darlington Fire and Rescue Service

FRA: Fire and Rescue Authority

RTC: Road Traffic Collision

ADF: Accidental Dwelling Fire

IRMP: Integrated Risk Management Plan

1.0 Introduction

Section 21 of the Fire and Services Act 2004 declares the Secretary of State to be responsible for the preparation of a Fire and Rescue National Framework that sets out the objectives and expectations for all Fire and Rescue Authorities in England. Within this framework there is a requirement for all Fire and Rescue Authorities (FRA's) to produce an Integrated Risk Management Plan (IRMP) to identify and assess all 'foreseeable' fire and rescue related risks that have the potential to affect the communities they serve. The term 'foreseeable' can be recognised as the analysis of risk in the broadest sense, encompassing local to national scale, cross border and multi-authority and as wide ranging as incidents of fire to terrorist attack (Home Office, 2017). Despite the requirement for risk identification and assessment, there is currently no single UK-wide methodology to assess risk within the fire service (NFCC, 2017). As outlined in greater detail below, this report has been prepared to provide an evaluation of current methodological practice used within UK FRA's. Working in partnership with County Durham and Darlington Fire and Rescue Service (CDDFRS), this report will evaluate a sample of methodology used nationally and produce recommendations on methodology to CDDFRS that can be considered when developing their local Community Risk Profile.

1.1 Project Aim and Objectives

The aim of this project is to critically evaluate the current methodological practice implemented by the UK Fire and Rescue Service (FRS) to analyse foreseeable fire and rescue related risk in their communities. This evaluation will contribute towards a series of recommendations for the consideration of County Durham and Darlington Fire and Rescue Service (CDDFRS) when developing their local Community Risk Profile.

a) To develop the current definition of risk and vulnerability used in the Fire and Rescue Service through the use of academic theory
b) To compare and critically evaluate the methodologies employed by different fire and rescue authorities
c) To produce recommendations that can be considered by County Durham and Darlington Fire and Rescue Service when developing their local community risk profile

1.2 County Durham and Darlington Fire and Rescue Service (CDDFRS) Partnership

CDDFRS is one of the 45 fire and rescue services operating across England covering an area of approximately 939mi^2 that consists of a predominantly rural west that transitions eastwards through historic, commercial and industrial centres to serve a population of over 600,000 (CDDFRA, 2017). As a region, the North East of England faces a unique set of challenges. Already ranked as one of the most deprived areas, by 2022, the North East is projected an increase of 4% of its total population to be living on a low income (McGuiness, 2018). This deprivation also being represented in some of the lowest life expectancies from birth for people in England. The unique set of challenges faced by County Durham and Darlington dictate much of the prevention work used by the Fire Service to target fire safety.

CDDFRS is currently revising its existing methodology and looking towards the development of a Community Risk Profile. The implementation of a successful risk methodology is essential to resource areas adequately, target prevention work and protect human life and property, therefore this provides practical importance in the development of this project.

1.3 Structure and Scope of Report

Structured in six parts, this report will begin by articulating the background context behind the report, briefly addressing the legislation and literature that underpins ‘Risk and the Fire Service’ before then progressing to a discussion on existing academic literature. This culminates in a discussion of the definition of risk and vulnerability that can be used practically when considering future methodology. The second section of this report will then provide a brief overview of the methodology used to analyse and evaluate the methodology employed by the UK Fire Service, discussing the development of a critical framework of analysis.

The findings of this report are structured in three sections, the first providing an evaluation of the IRMP as a method in the analysis of risk. The second section will then outline the stages of CDDFRS’s methodologies, linking them to the work conducted by other services. It is at this point I note it is not the intent of this report to provide a full national picture. Specific examples have been chosen to outline similarities and differences in methodology

for the primary benefit of CDDFRS, with the strategies to mitigate these risks lying outside the scope of this project.

2.0 Background Context

This section of report provides a critical examination of the existing literature pervading fire and risk. The primary purpose of this section is to articulate both the practical and theoretical context behind this report. This review is divided into four sections, firstly risk will be analysed in the context of the Fire Service, before then developing into discussion of the wider use of risk in academia. This report will then progress to analysing the theme of social vulnerability, highlighting who is 'at risk' of fire according to current literature. Finally, this section will conclude by examining the emerging work in academia that interlinks to Fire Service methodology, with particular focus on the prediction of risk in communities.

2.1 Defining Risk in the Fire Service

In June 2003, the Government published a White Paper entitled 'Our Fire and Rescue Service' in which the service assumed greater responsibility in wider community safety. Since 2003, it has been a requirement for all Fire and Rescue Services in the UK to produce an IRMP (Communities and Local Government Committee, 2005) as further outlined in the Fire and Rescue National Framework for England 2018. The IRMP is considered to be a key tool in the prevention and mitigation against risk and can therefore be considered a method of overall analysis in its own right. In this regard, 'risk' in the Fire Service is largely attributed to a 'risk management' perspective. This evidenced in official Fire Service operational guidance for risk assessment that outlines risk to be the chance of somebody being harmed by hazard along with the indication of how serious that harm could be (CLG, 2009).

Within existing IRMP literature a recurrent theme develops of risk being regarded as calculable and the combination of likelihood when multiplied by consequence**.** This formula of understanding risk is frequently expressed in a matrix structure exemplified in Figure 1. In this approach both likelihood and consequence formulate a scale. Perhaps what is less developed in this literature is an understanding of what 'consequence' actually incorporates. Although Fire Services will be aware of the circumstances of hazard that dictates consequence, this is perhaps not truly reflected in how risk has come to be

defined. Advancement in the definition and understanding of risk can be developed through wider academic approaches; these are examined further in the following section of this review.

Figure 1: Risk Management Matrix

		Consequence				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Almost certain	Medium	High	High	Extreme	Extreme
	Likely	Medium	Medium	High	Extreme	Extreme
	Possible	Low	Medium	Medium	High	Extreme
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Source: University of Melbourne

2.2 Defining Risk in Academia

In the last century risk has taken prominence in our everyday vocabulary (Tulloch and Lupton, 2003). Theorists such as Beck (1992) have heralded this era as a time of heightened risk and unpredictability, the resulting factor of increased affluence in the world. This being said, there is no single accepted interpretation of what risk actually constitutes within academia. A predominantly scientific outlook, frames risk to be measurable and the product of probability and consequence (Lupton, 1999), this befitting of how the Fire Service currently defines risk (as explored in the previous section of this review). Often described as a cognitive scientific approach, this scientific framing of risk assumes risks to be pre-existing in nature, identified through measurement and controlled through knowledge (Ibid). Although this has practical value; within academia there has been criticism of how this account fails to consider the way risk can be socially (Lupton, 1999), culturally (Douglas, 1992), and politically produced (O'Malley, 2010).

Social theorists such as Lupton (1999) have emphasised the importance in acknowledging that risk is in large imagined, given ascribed meaning through historical, social and political interaction. In this regard, the uncertainties of life have become controlled through the creation of the concept of 'risk'. The repercussion of this thought process questions the

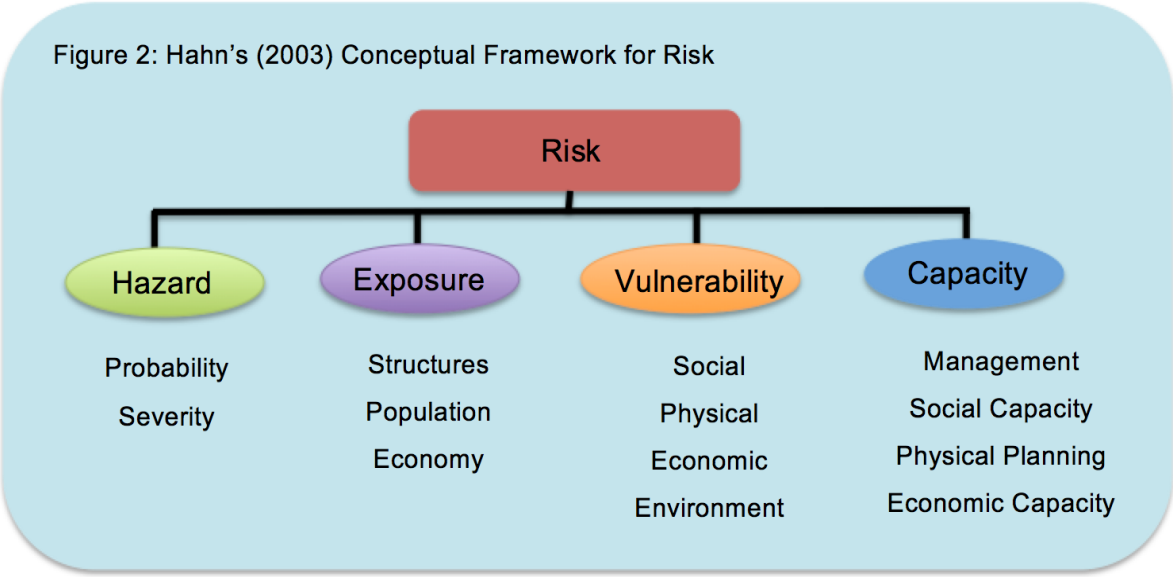
role that people have in determining risk. Although, this offers insight into the creation of the term, this theoretical stance does not have huge practical value to institutions. Greater practicality can be found in more poststructuralist bodies of work. Amoore and De Goede (2008) build upon the work of Foucault (1997:82) in analysing risk as part of the wider 'techniques and procedures for directing human behaviour'. This provides insight into understanding the power and role that the Fire Service has when communicating risk to the public. When institutions such as the Fire Service deem something as a hazard they have the ability to influence and dictate behaviour due to the power they possess in society. Although this is still limited in practicality when defining risk in the Fire Service, it is a theoretical stance that does have relevance and can widen the understanding of risk beyond a narrower scientific outlook.

Although narrow, there is still a place for the discussion of risk in a scientific context, this being due to the practicality of the report brief given and its emphasis on risk as calculable and measurable. Work by Wisner et al. (2004) argues that risk itself must be considered as the intersecting combination of hazard and vulnerability. The emphasis on vulnerability providing explanation as to why some individuals seem to suffer greater consequence than others when faced with the same hazard. Although this approach by Wisner et al. (2004) engages with the necessity of social production in risk analysis, it also inherently assumes individuals to be passive and vulnerable. Indeed, this perspective fails to account for the variable characteristics that make some vulnerable individuals more resilient to hazard (Cannon, 2000). Work by Cannon (2000) is influential in its ability to account for human capability as a capacity to cope against hazard. This thought process leading to discussion as to the complexity of determining someone to be 'at risk'.

Further development in academia has sought to include 'exposure' into wider risk contexts. Work by Crichton (1999) provides an important basis for discussion on consequence when interlinking exposure into the risk formula. This development, feeding into how it is only when those vulnerable to risk are exposed to a given hazard that they truly become 'at risk'. More recent work by the likes of Hahn (2003) has tried to develop risk as a conceptual framework to give rationale behind risk analysis. The conceptual model presented by Hahn (Figure 2) demonstrating that in order to manage risk there is a requirement to understand the threat posed by hazard, the magnitude to which lives and values are exposed to threat, along with vulnerability, and the capacity and measures to protect against risk (Hahn, 2003: 10). This framework presented provides a more

developed outlook of risk that answers critique and provides insight into how 'consequences' of an event materialise.

Figure 2: Hahn's (2003) Conceptual Framework for Risk



Therefore to summarise, in this report risk can be regarded as not only calculable and measurable but also a tool in the way a population's behaviour towards risk can be managed. Risk can be understood as the result of a hazardous event coinciding with exposure, probability and vulnerability of an individual, this being offset by an individual's circumstance and their ability to cope.

2.3 Vulnerability

Much like the term risk, vulnerability is a concept that is contested, with different meanings to different people. In the broadest of terms vulnerability has been simplified to symbolise the potential for loss (Cutter, 1996). As exemplified in Hahn's (2003) Conceptual Framework for Risk in Figure 2, vulnerability consists of the complex interaction between social, physical, economic and environmental pressures. It is these pressures that can manifest hazards into a disaster. According to Birkman (2006:10), disaster cannot merely be considered as physical occurrence; instead disaster is better reflected as a 'complex interaction between a potentially damaging physical event and the vulnerability of a society, infrastructure, economy and environment, which is determined by human behaviour'.

Work by Cannon (2002) has been influential in stressing the importance of the temporal nature of the term, encapsulating the need to consider vulnerability as an on-going state. This is part of a wider movement that seeks to critique the use of the term in academia, this in large due to vulnerability ascribing a person to victimhood. Cannon (2002) reflects on the need to acknowledge the individual capabilities of a person in order to instigate a counter balance, victim led approach. This presents a valid and interesting argument; it is therefore essential to consider the capacity to cope with inherent vulnerability. For the Fire Service, this could have practical benefit. For example, an individual determined as high risk due to being elderly could incite questions such as do they have a supportive family network? Do they have frequent visitors or are they completely isolated and alone? These questions build upon the notion of coping capacity and move away from regarding individuals as being helpless and just victims.

2.3.1 Social Vulnerability to Fire

Social vulnerability is the susceptibility of certain social groups to concur potential loss from hazard (Cutter, 1996). For this report, social vulnerability has an important role in the determination of who is most ‘at risk’ from hazardous events. We are all susceptible to hazard in our everyday lives, although our experiences are not uniformed. Fire is proven to disproportionately affect particular individuals (Jennings, 2013), particular areas (Ardinato et al. 2015) and intersect with certain environmental conditions (Corcoran and Higgs, 2013). This disparity in experience of hazard manifests into social vulnerability where certain sectors of society are inherently at a greater risk from fire. Over the last decade there has been significant research conducted to isolate the individual variables that determine certain groups to be ‘at risk’ of fire. The variables investigated are diverse in nature and build a profile as to who is at greatest risk from fire; these academic reports complement that of the FSEC (Fire Service Emergency Cover) package that was built to take these social considerations into account.

Age has consistently been a key variable used to acknowledge those with greater vulnerability in academic studies. Work by Runyen (1993) and Warda et al. (1999) identify the very young, old (65+) and elderly at greatest risk of fatality in fire. Even though these studies are now dated, age can still considered as a high-risk variable (Wuschke et al. 2013). Further social traits such as deprivation (Jennings, 2013), gender (Warda et al. 1999) and drinking and smoking have all been well documented as increasing an

individual's risk of fire (Howland and Higson, 1987; Xiong et al. 2017). This alongside a persons living situation can determine the extent to which they are socially vulnerable. In addition to this literature has sought to examine the vulnerability of those living in lone households (see Smith et al. 2008; Holborn et al. 2003), with more recent work looking to gain greater insight into the risk of those under 65 year olds living alone and the risk they face (Hastie and Searle, 2016).

The surrounding building environment has also been considered as a determinant factor in safety, with building density not only having an impact on the number of fires experienced (Jones et al. 2013) but also the response time you are likely to receive (Corcoran, 2015). Slower response times are documented as having a positive correlation to subsequent structural damage, death and injury resulting from fire (Castillo, 2002; Li et al. 2011; Challands 2010). What these studies indicate is that it is not only social background, but also the built environment that interplay to determine whether a person is 'at risk'. The sheer number of variables examined in the analysis of fire could be considered as bewildering and indeed detrimental. The challenge in using these variables is identifying how they interlink and depend on one another. Work by Halvorsen et al. (2017) in Norway outlines a tendency to treat fire vulnerability as a collection of individual traits, particularly within policy documents. One key consideration when analysing these variables is they often intersect one another, with an individual conforming to many different risk factors. It is therefore necessary to consider how all these variables can amalgamate into forms of vulnerability.

Additionally, it is also important to acknowledge that social vulnerability is dynamic and can change according to development in an individual's circumstance (Wisner, 2004). Although these studies have been researched in accordance to understanding vulnerability to fire, many of the variables can also be applied to analyse the risk factors associated with other specialist incidents attended by the fire service. For example, in the case of Road Traffic Collisions (RTC's) variables such as: age, gender, ethnicity, response time and drinking/drug use can all be used to analyse those at greater risk. It is how these variables feed into the methodology of calculated risk that is perhaps less explored and an area that requires greater research.

2.4 Fire Risk Methodology

In recent years there has been an increase in the availability and quality of spatial data, this has resulted in a substantial body of literature that emphasises the importance of risk in understanding the spatiality and temporality of fire. This being said, there is still paucity in research addressing the methodology behind the attribution of people and places as high risk. The use of Geographic Information Systems (GIS) in the analysis of the spatial distribution of fire is commonplace, along with the statistical tools that accompany this work. Spatial and temporal modelling draws upon these tools to demonstrate areas to be at greater risk. Previously, the UK Fire Service relied heavily on the Fire Service Emergency Cover (FSEC) package developed in 2008. This toolkit used various data sources to produce a risk model. Now a decade old, this toolkit is considered in large obsolete. For CDDFRS it was acknowledged that the toolkit was not reflective of the actual risks in County Durham.

Work by Corcoran et al. (2015) has looked to the use of spatial data to analyse the response time to residential fire in Brisbane. The results of this study highlighting that the use of temporal modelling can aid resource allocation to those areas deemed at greater risk. The use of modelling has also been explored in the work of Ardinato et al. (2015) who look at urban residential fire in Melbourne. One particularly interesting finding in their study is that ‘experiencing past residential fires within [a] neighbourhood is likely to have effects and influence residential behaviour to mitigate fire risk in the future’ (Ardinato et al. 2015:1159). There is no denial in acknowledging that risk modelling has the potential to benefit cities in the future. However, one key critique presented by Walia et al. (2016) is that many of the Fire Risk models in use worldwide are static and based upon historical incidence. Based upon this, Walia et al. (2016) note that risk levels should be the production of constant reassessment of data, enabling models to retrain, allowing cities to evolve. Perhaps one of the key limitations evident in the spatial and temporal methodologies so far is that the majority of these studies are place specific in their analysis and therefore are perhaps not as practical when used widespread.

In contrast to the practical research conducted, Wuschke et al. (2013) present a theoretical basis for analysing spatial and temporal risk of fire. Through the use of methodology traditionally employed in criminology theory, Wushcke et al. (2013) account for the spatial clustering of fires and distribution of fire events. The main emphasis of this work looks to

the advancement of research, highlighting how looking further afield to inform risk prediction can offer beneficial insight.

3.0 Methodology

One of the main objectives of this project is to compare and critically evaluate the methodological practice of fire and rescue services in analysing foreseeable risk in communities. One of the central requirements for conducting a project of this nature is to consider a suitable methodology that is both credible and legitimate when comparing the different fire services. To do so, this report has developed a framework to compare IRMP's across services. This providing a basis to which methodology can then be compared. Structured in three main parts, this section analyses the methodology that underpins the examination of methodology, concluding by suggesting ways this study could be enhanced in the future.

3.1 Document Analysis

Document analysis is the systemic process in which documents can be reviewed and evaluated (Bowen, 2009). The purpose of conducting document analysis is to critically engage with texts, examining and interpreting not only content but also the reasoning, motivations and culture behind a texts production (Bauer et al. 2014). The term document is purposefully broad, encompassing a full range of media as far stretching as artefacts to policy. Each media source is scrutinised, interpreted and then synthesised for analysis.

In this project, document analysis forms an integral basis in the evaluation of IRMP documents as a method in the identification and assessment of community risk. Each IRMP will undergo an evaluation and be analysed as part of a critical framework. The evaluation will consist of coding documents and attributing certain traits to determined themes. Coding in qualitative research can be regarded as 'a process of labelling and categorizing data as a first step in analysis' (Flick, 2014:373). This process forms a key tool in the sorting and comparing of excerpts, preparing written data ready for interpretation. In this study, coding provides an important basis to contrast and compare a large collection of documents, enabling a fuller evaluation. As a technique, this was used firstly to develop the critical framework and then afterwards to further evaluate IRMP

documents when using the framework, the details of which are included in the following section of this report.

3.2 Critical Framework

In order to produce a coherent mode of comparison, this project develops a critical framework to aid the document analysis process. In developing a more rigorous and systematic approach, this facilitates and directs analysis, enabling a more focused outlook. The use of a critical framework is inspired by work such as (Swartz, 2014) in nursing literature that uses set criteria as a way of comparing and contrasting literature. The work of Coughlan et al. (2007) presents a good basis for the development of a framework, encouraging the researcher to include thoughts on audience, content and credibility. Ryan-Wenger (2002) examines how questions in the research process can be subdivided to 'credibility variables' and 'integrity variables' these providing a tool of critique and aiding evaluation. These 'credibility variables' are designed to question the legitimacy of the researcher, whilst the 'integrity variables' are there to assess the research itself. Due to this projects reliance on the evaluation of IRMP documents, it is necessary to have such a framework in place due to IRMP's being varied in both content and structure.

To develop this framework, a selection of ten IRMP's were first analysed and coded, key differentiations and similarities were highlighted. This analysis culminated into six key categories to which IRMP documents would be analysed against.

1. **General:** This provided basic background information, including key information such as the name of documents and year of production.

2. **Risk Questions:** This category instigates how risk is examined, alerting the reader to what was being identified in the discussion of risk.

3. **Fire Risk:** This provided insight into what Fire Risk formed the basis of discussion in the documents.

4. **National and Community Picture:** This category viewed and instigated thought on whether IRMP documents looked at the wider picture to risks faced nationally.

5. **Special Service Risk:** This provided insight into those risks analysed outside of Fire and within other statutory duty.

6. **Temporality:** This category's primary aim was to analyse the temporality of the document and the focus on past, present and future when analysing risk.

A framework was then formulated to allow the reader to follow set questions and thought processes when analysing each IRMP, this was compiled in the form of Table 1. Much like the use of critical frameworks in nursing, this framework enables the researcher to have a more rigid and structured comparison between IRMP's. This approach could be considered as a productive means to analyse a high volume of documents in a short research timescale. The framework itself becomes a critical tool when paired with subsequent textual analysis that instigates evaluation through the summarisation of information.

When choosing my sample of IRMP's to study, I had in mind that primary aim for this project was to produce recommendations for the use of CDDFRS. When choosing Fire Services to analyse I wanted those that were both different and similar in methodology and approaches to risk. To study every Fire Service in the UK's methodology would be counterintuitive and out of the scope of this project, with this mind three services from five service areas were sampled at random. In random sampling every Fire Service had an equal chance of being selected as part of the study, this being an appropriate and simple way to formulate a sample population (Marshall, 1996).

Table 1: Completed Critical Framework Table for IRMP Analysis

	North East			Yorkshire & Humber			North West			West Midlands			
	Durham	Cleveland	Tyne and Wear	Humberside	North Yorkshire	South Yorkshire	Cumbria	Lancashire	Greater Manchester	Hereford and Worcester	Warwickshire	West Midlands	Greater London
General													
Name of Main Document?	IRMP	IMRP	NE1	IRMP	YH1	IRMP	IRMP	IRMP	IRMP	IRMP	IRMP	IRMP	L1
Year of Document	17-18	14-18	15-18	18-21	16-21	17-20	16-20	17-22	16-20	14-20	17-20	18-21	17-18
Supporting Document?	X	✓	✓	X	X	✓	✓	✓	✓	✓	✓	*	*
Name of Supporting Document?	X	NE2	NE3	X	X	YH1	NW1	NW2	NW3	WM1	WM2	X	X
Corporate Risk?	/	X	/	/	X	X	X	✓	X	✓	✓	/	/
Personnel Risk?	X	X	X	✓	X	X	X	X	X	X	X	✓	X
Fire Risk													
Dwelling Fire Risk	X	✓	✓	✓	X	✓	✓	✓	✓	✓	✓	X	X
Business Fire Risk	X	✓	X	X	X	✓	X	✓	✓	✓	✓	X	X
Industrial Fire Risk	X	✓	X	X	X	✓	X	/	X	✓	/	X	X
Deliberate	X	✓	X	/	X	X	/	✓	X	X	✓	X	X
Accidental	X	✓	X	✓	X	X	✓	✓	X	✓	✓	X	X
Heritage	X	✓	X	X	✓	✓	✓	✓	✓	X	✓	X	✓
Waste Disposal	X	/	X	/	X	X	X	✓	X	X	X	X	X
Wildfire	X	X	X	X	✓	X	X	✓	X	X	X	X	X
Special Service Risk													
RTC Risk	X	✓	✓	/	/	X	/	✓	✓	✓	✓	X	/
Water Risk	X	✓	✓	✓	/	✓	/	✓	✓	X	✓	X	X
Flooding	X	✓	✓	✓	X	X	/	✓	/	X	✓	X	X
Rescue from Height	X	✓	X	✓	X	X	X	X	X	X	X	X	X
Building Collapse	X	X	/	X	X	X	X	X	X	X	X	X	X
Industrial Accident	X	/	✓	✓	X	X	X	/	X	X	X	X	X
Other	X	✓	X	✓	✓	X	/	✓	/	X	/	X	X
Risk Questions													
Who is at HR?(1)	/	✓	✓	/	X	✓	X	✓	X	✓	/	X	✓
What is HR?(2)	X	✓	X	X	X	✓	✓	X	X	/	✓	X	/
Where is HR?(3)	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
When is it HR?(4)	X	✓	✓	X	X	X	✓	✓	X	X	/	X	X
Why it is HR?(5)	X	✓	X	X	X	✓	X	✓	X	X	/	X	X
How it is at HR?(6)	X	✓	X	X	X	✓	X	X	X	X	X	X	X
What makes someone HR?(7)	X	✓	X	X	X	✓	X	/	/	✓	X	X	X
National/Community Registers													
CRR	X	✓	/	✓	✓	✓	✓	✓	X	/	X	X	/
NRR	X	✓	/	✓	✓	✓	✓	✓	X	/	X	X	/
Security challenges?	X	X	X	/	✓	✓	X	✓	/	X	X	X	✓
Environmental challenges?	X	X	✓	X	X	✓	✓	✓	✓	✓	X	X	X
Data from partners?	X	✓	✓	✓	X	X	✓	X	X	X	X	X	✓
Temporal													
Is Future Risk considered?	N	Y	Y/N	Y	N	Y/N	Y	Y/N	N	Y	Y	N	Y/N
Is it mainly Historically Based?	Y	N	N	N	N	-	N	N	N	N	N	Y	N

Key

/	Limited Coverage
✓	Covered
X	No real coverage
NE1	Strategic Community Safety Plan
NE2	Community Risk Profile
NE3	Tyne and Wear Profile
YH1	Community Fire Risk Model
NW1	Risk Review
NW2	Strategic Assessment of Risk
NW3	Supporting Document
WM1	Risk Review
WM2	Risk Profile
L1	London Safety Plan
*	Online Safety Tool

3.3 Informal Interviews

This project uses an informal interview structure to gain insight into methodology, allowing for fluidity in the research process. Having this unstructured approach enables the researcher to elaborate answers and raise issues that may not have been previously accounted for (Silverman, 2006). Using the critical framework as a guide and knowledge base, I was able to elaborate upon methodologies and use this as a source of discussion. The casual nature of questions that orientated around conversation could be linked to the social research method of participant observation. In participant observation the researcher uses casual questions to complement the experiences of working in their research environment (Jorgenson, 2015). As these encounters were conversational in nature, they were not aurally recorded; instead notes were taken either at the time or from memory after the conversation had occurred. The justification behind using this approach is based upon the purpose behind the conversations. The primary purpose of these conversations was to enhance knowledge and to provide justification to the documented data, therefore these conversations occurred sporadically and largely without formality.

3.4 Future Development

The main priority for this project is to provide a reflection of current methodology used nationally and to use this to inform recommendations to CDDFRS that could be used for the development of their community risk profile. The methodology chosen therefore reflects this scale, allowing a large amount of data to be summarised, with examples being sought to fit the requirements of CDDFRS. However, for a project where the end result is much larger, there comes a requirement for analysing this data more broadly. With a greater timescale and greater access to resources I would consider questionnaires to be a relevant form of analysis, this being said, it is important to acknowledge there already has to be an existing awareness of the methodologies in place to be able to target the questionnaires to address the correct issues.

4.0 National Methodology in the UK Fire Service

This chapter critically evaluates the current methodology in use by Fire Services in a national context. Building upon the premise that there is no UK wide methodology in use by the Fire Service (NFCC, 2017), this section of report will primarily analyse the IRMP document as a method in the analysis of risk in communities. Structured in six parts, using the categories and framework developed in Table 1 along with document analysis; this chapter will compare approaches to risk analysis across Fire Services.

4.1 The IRMP (Integrated Risk Management Plan) as a Method

The definition of a method orientates around the idea of technique and procedure, in this regard the IRMP can be considered a method through its role as a technique in the overall analysis of risk. What is evident in Table 1 and existing literature is that there is large disparity across fire services of content, audience and purpose in their IRMP's. Although under the 2018 National Framework, the IRMP should 'reflect up to date analyses including an assessment of all foreseeable fire and rescue related risks', the range of foreseeable events analysed varies vastly. This disparity could in large be attributed to the outdated guidance documents on the creation of IRMP's that perhaps don't encapsulate the extent of 'all foreseeable' events that the fire service are expected to account for. The guidance documents themselves are offered to 'help fire and rescue services understand what to consider when preparing their IRMP' (Home Office, 2008), however they were last updated in 2008 and consist of seven documents as outlined below;

- **Environmental Protection Guidance:** Outlines main ideas surrounding pollution and flooding as risk areas that could be developed.
- **Equality and Diversity:** Risk analysis that has 'detailed awareness and understanding of the diverse demographic profile within its area'. Emphasis on the Fire Service reflecting the population they serve.
- **Protection of Heritage and Structures:** Encourages work on reducing risk to listed buildings
- **Road Traffic Collision (RTC) Reduction Guidance:** Encourages the co-operation between partnering agencies in order to address the risk of RTC
- **Community Safety Guidance:** Requirement to identify those most 'at risk', suggests methods for assessment of dwelling fire risk.

- **Business Continuity Management:** Requirement to consider corporate risk, those that would threaten the effective running of the Fire Service
- **Wildfire Guidance:** Suggests the need for Fire Services to consider assessment of risk of wildfire in their area.

Within these guidance documents there is very little in practical advice on the methodology to identify and assess such risk and therefore other than suggesting a few risks to be examined they are not entirely influential. In the IRMP literature sampled in this report, there tends to be an exclusion of the internal risks of equality and business continuity presented in the guidance documents. Corporate and personnel risk rarely feature, instead these understandably contribute to the corporate plans of their respective services. Generally, those Fire Services with supporting documents provided greater insight into risk in their communities, this helping to inform and target their IRMP documents. It is this reason that CDDFRS' move to the creation of a Community Risk Profile will no doubt be beneficial. In my findings there are three key areas in which the IRMP documents and supporting documents differ across the Fire Services;

4.1.1 **Content**; it is understandable to an extent that the content of IRMP's will differ, this being a reflection on the different requirements of each community. However, as evident in Table 2, there are some risks that are widespread such as road traffic collisions and flooding that are not evident in every IRMP or supporting document. Indeed, Table 2 demonstrates that the content of IRMP literature varies vastly. Although it is to be expected that the content will differ, Fire Services such as Lancashire and Cleveland address an extensive range of community risks, far more so than many other Services.

4.1.2 **Purpose;** the purpose of the IRMP is to consider all risk in communities, more generally this has come to include how to mitigate against the hazards listed. However, some IRMP documents such as County Durham are largely historic based, listing what has been already done as opposed to what risks are likely to develop in the future. On occasions, some IRMP documents are used more broadly to list achievements rather than plan for the future.

4.1.3 **Audience;** Interlinked to this notion of purpose, the audience to which the IRMP literature is aimed also encounters disparity. For example, The London Safety Plan

produced by the London Fire Brigade (LFB) is a very effective document in the communication of risk. Rather than use terms such as ‘primary fires’ and ‘special service’ that could cause confusion to the public, terms such as ‘intervention’, ‘assistance’ and ‘reassurance’ are used instead. This change in terms demonstrates a focus from LFB on not only analysing risk in communities but also communicating the risk to communities. Other services such as Kent structure their IRMP in a more strategic way, outlining key performance measures and asset management strategies that perhaps do not cater for the same audience. Perhaps a solution to this strategy would be to change the expectation of the IRMP away from communicating internal and corporate risk and instead allowing the focus to remain on community risk.

To resolve this disparity between the quality of IRMP’s there is a requirement for updated guidelines that allow structure for Fire Services in how the IRMP should actually be composed.

4.2 Who, Where, When, Why and What is the Risk?

The ‘Five W’s’ are used across disciplines to target critical thinking. Thinking about who, what, where, when and why in the context of risk can also prove effective. Upon referring back to Table 1, it is possible to pick out certain Fire Service’s that address almost all of these questions in their supporting documents or IRMP’s. Both Lancashire and Cleveland are very successful at presenting risk in a structured way that addresses these questions and builds mutual understanding. Working upon these target questions of what, where, when and why allows risk to be communicated more effectively. The following section of this report will analyse how these are effectively used within IRMP literature.

4.2.1 Who

Identifying individuals at risk from hazard form the majority of focus in existing IRMP literature. Social vulnerability is used as a way of targeting resources. Perhaps what is less developed is the consideration of those individuals who are ‘a risk’. One Fire Service that is already looking to. Humberside FRS perhaps go further than this instead looking at who pose a threat to the safety of others. In their IRMP they mention the creation of the CCR

(Community Contact Record). The CRR is a way of identifying those people who require greater monitoring and may pose a threat to the safety of others.

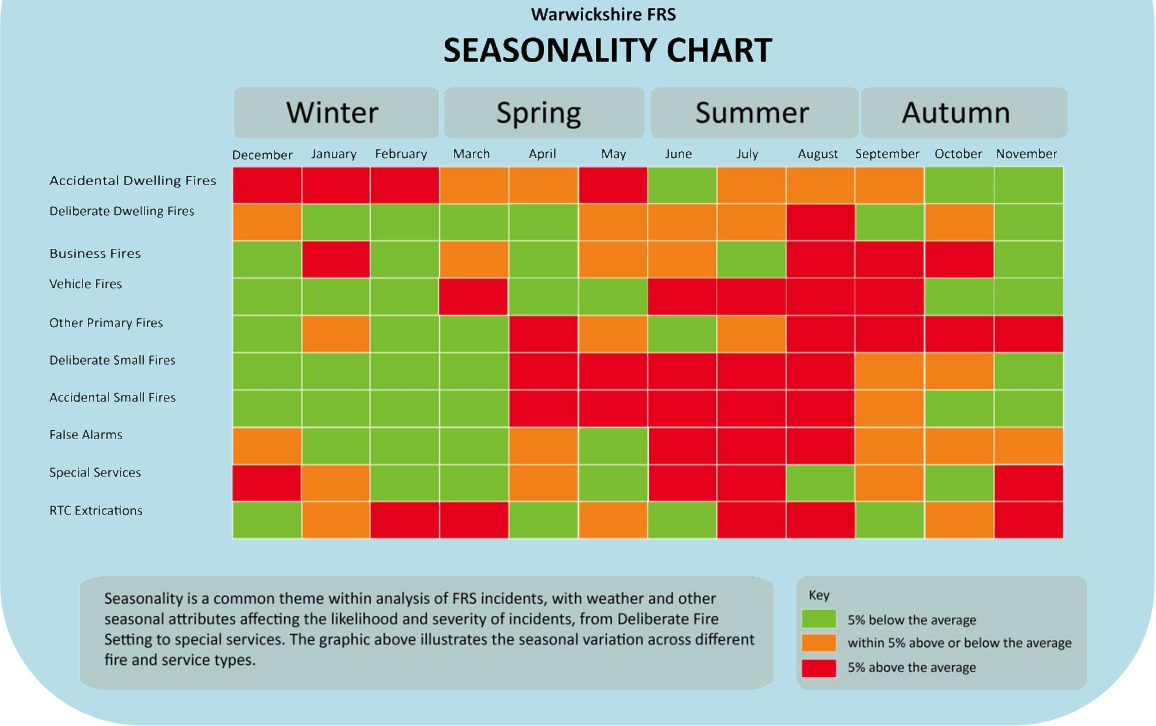
4.2.2 Where, What and Why

The tools used to identify those locations at greatest risk are well established. The use of risk mapping is undertaken by the majority of Fire Services and offers an effective way of communicating risk to the public. The identification of what these risks entail is also an aspect that has been explored in greater depth. Perhaps an area that seeks further development is explaining why areas and people are deemed at greater risk. When connecting these elements it can help to improve the communication of risk to the public.

4.2.3 When

Temporality is an area that County Durham and Darlington could easily use to enhance their Community Risk Profile. Time and Month are already analysed as part of analysis in CDDFRS, particularly in relation to deliberate fires, therefore this would be an easy addition to the Risk Profile. However, using likelihood as a base for risk has restricted the notion of ‘when’ to a daily, monthly and annual outlook. Although this is practical for quick comparison and to give an idea of frequency it doesn’t give the public an indication as to what day and what time of year they are most likely to be at risk. As a member of the public, understanding the seasonality behind risk can be useful. For example, if I was made aware that there is greater risk of accidental dwelling fires in the months of December and January and this was accompanied by an explanation why; such as ‘Christmas lights left on overnight’ then this would be likely to change my behaviour. Warwickshire Fire and Rescue Service present the seasonality of risks in their community in a simple yet effective table (see Figure 3).

Figure 3: Warwickshire FRS Seasonality Chart



Lancashire FRS outline the seasonality of incidents through a series of graphs that separate incidents such as Road Traffic Collisions and Dwelling Fires by month (see Figure 4). Although useful, this is perhaps harder to interpret for members of the public unfamiliar with the analysis of data. Again, this feeds back into uncertainty surrounding the intended audience for the supporting documents and IRMP themselves. Further to this, an interesting example of temporality can be found in the supporting document of Cleveland FRS. 'When' in this instance is represented by hour of the day (see Figure 5), in some instances this timescale could be useful, especially when there is an evident trend. For example, if there is a greater instance of commercial fires at night and this is linked to then business owners may want to act accordingly to prevent such circumstances.

Figure 4: Lancashire FRS seasonality of RTC and Dwelling Fire casualties by month

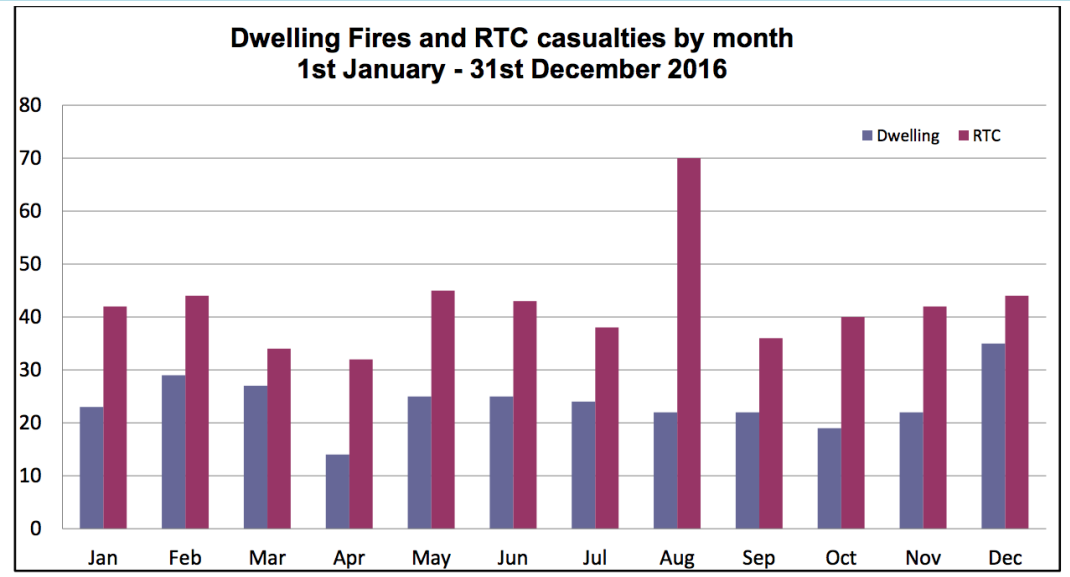
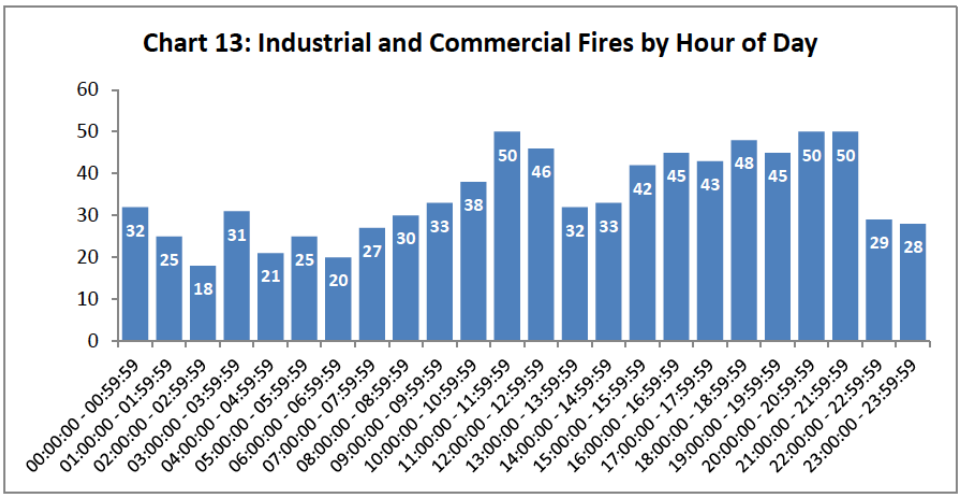


Figure 5: Cleveland FRS use of hourly analysis for industrial and commercial fire



4.3 Methodologies for the Prediction of Special Service Risk

4.3.1 Road Traffic Collision (RTC)

The analysis of RTC in IRMP literature is somewhat limited, this in large because the Fire Service does not have complete responsibility for RTC's as a hazard. Instead, they are expected to offer assistance and support to other agencies, it is this supporting role that perhaps creates a greater challenge in predicting the risk that RTC presents for communities. In the analysis of RTC's in IRMP literature, Cleveland and Lancashire analyse RTC's in regards to who is most at risk and when they are most at risk. This could be an area that CDDFRS could develop further, it would be interesting to analyse 'where' risk is at its greatest by mapping the road network according to the number of incidents. However, an important consideration for CDDFRS is that there is already substantial work that analyses data in regards to RTC's. The work of Gateshead council in analysing RTC's is highly valuable, and therefore the risk of RTC is already documented. In this regard, sharing this data becomes the most important focus.

4.3.2 Flooding

There is considerable work done by the Environment Agency in predicting the risk of flooding to communities. So much so that they have online tools in which the public can use their postcode as a basis of analysing whether their property is at risk. Humberside Fire and Rescue Service use data from the Environment Agency as a cross comparison to information already used in the identification of higher risk households to determine vulnerability to flooding. If CDDFRS was to use this approach, flood risk mapping could be cross-complied to produce a list of high vulnerability households, those individuals that in a time of flooding might require greater assistance. Not only would early identification of vulnerable individuals improve public safety in a time of flooding but it would also help to allocate resources to those areas at greatest risk.

4.5 Temporality in Methodologies

One key area in which IRMP literature could be enhanced could be found in the temporality of the documents. In this regard, temporality can be understood as the relationship between risk, past, present and future. As demonstrated in Table 1 some

IRMP documents did not include any indication of risk in a future sense. Considering these documents have a three-year timescale, future risk should really form a significant factor in discussion. Those Fire Services that did include a reference to the future often did so in the forecasting of population growth or changes in poverty/deprivation. Perhaps an interesting area of development in the inclusion of a community risk profile could be, what new housing and commercial developments there are.

5.0 County Durham and Darlington FRS Fire Risk Methodology

In this next chapter I begin by outlining the current focus of methodology in use by CDDFRS. I then progress to an evaluation of the methodology introduced in 2018 to predict high-risk areas prone to dwelling fires; this will be done through a discussion of the various inputs that contribute to the creation of a risk score and percentile. Additionally, I evaluate the current commercial building methodology in use at CDDFRS and suggest ways it could be enhanced with future work.

5.1 ADF Methodology

Within CDDFRS, the analysis and prediction of risk is largely focused on primary fires, with particular emphasis placed upon the calculation of risk of dwelling fires in a given area. This is in line with all other fire services and is justifiable when considering primary fires present the greatest threat to property and life (Home Office, 2017). Furthermore, the emphasis on dwelling fires is reasonable when considering on average dwelling fires have accounted for 35% more fires than all other buildings in the past decade (see Figure 6). The methodology to identify those areas with a higher risk of accidental dwelling fires (ADF's) was introduced in CDDFRS in 2007, following the aftermath of a series of fatalities. This methodology has been further updated for the 2018 year, something that is discussed in greater depth in section 5.1.1 of this chapter.

Although risk analysis for ADF's has been in place for over a decade in CDDFRS and seen much development, there has been less progress in the calculation of risk for the other types of incidents attended. Figure 7 highlights incident type as a percentage of total incidents per year. As demonstrated, primary fires only accounted for an average of 14% of total incidents attended by CDDFRS from 2010-2016, comparatively, special service incidents account for an average of 19% of total incidents for the same period.

Figure 6: A graph to show the number of fires in dwellings in comparison to those in commercial/other buildings in County Durham and Darlington

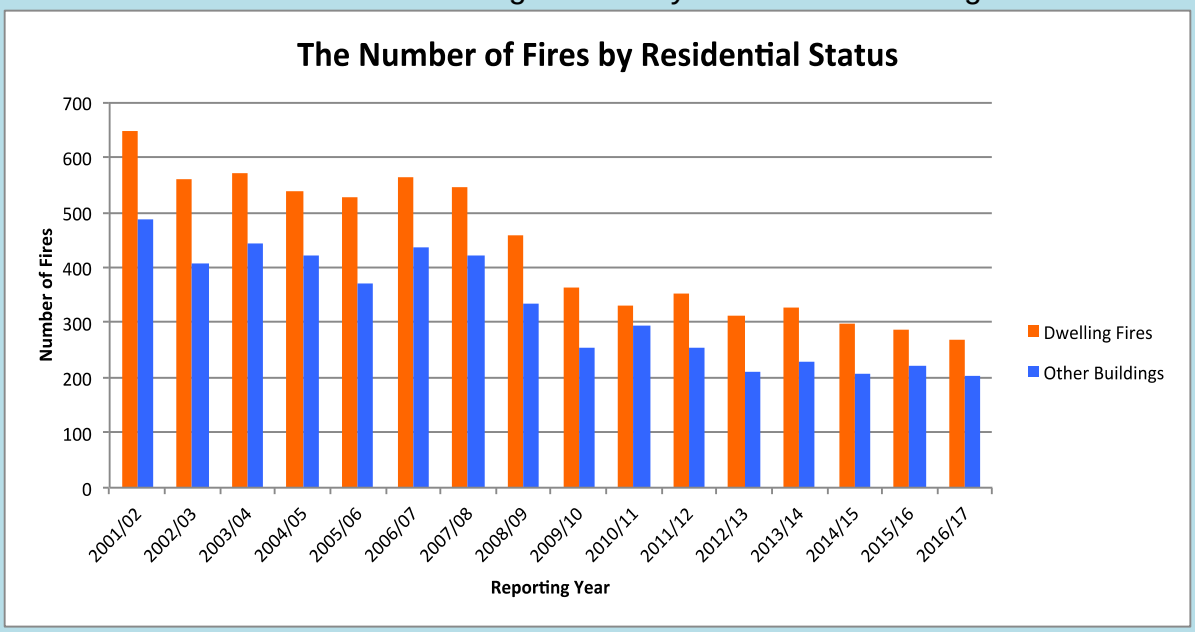
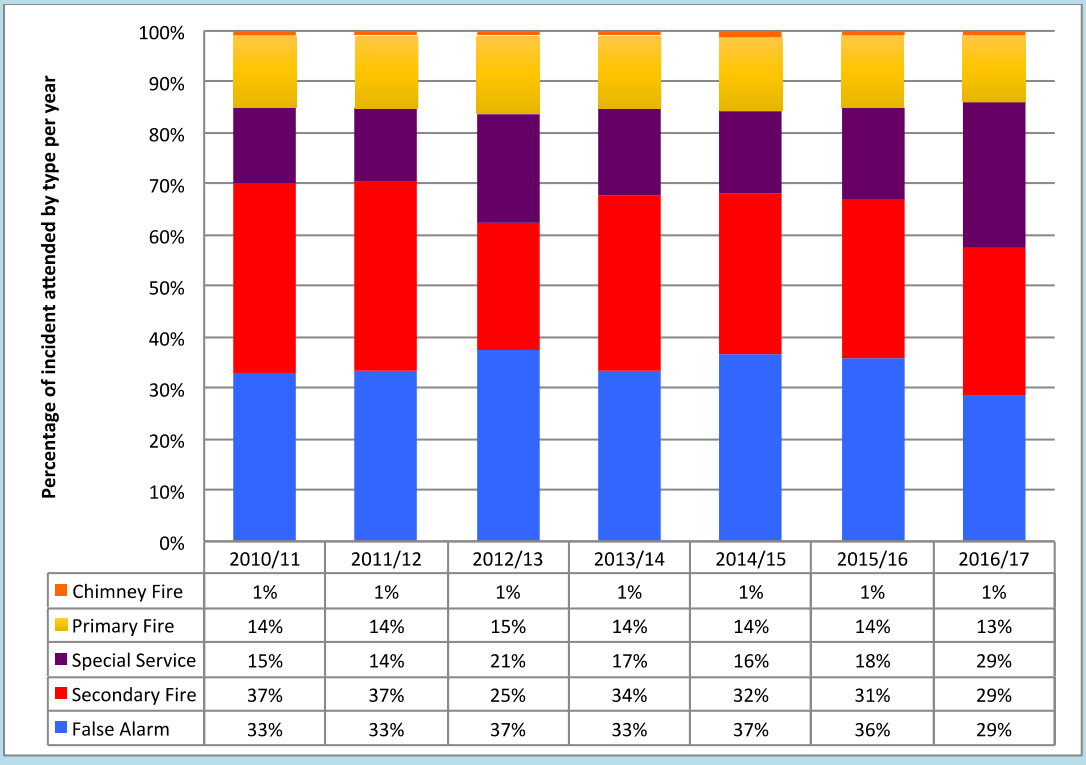


Figure 7: A graph to show the percentage of total incidents attended sectioned into incident type per year in County Durham and Darlington



	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Chimney Fire	1%	1%	1%	1%	1%	1%	1%
Primary Fire	14%	14%	15%	14%	14%	14%	13%
Special Service	15%	14%	21%	17%	16%	18%	29%
Secondary Fire	37%	37%	25%	34%	32%	31%	29%
False Alarm	33%	33%	37%	33%	37%	36%	29%

5.1.1 Lower Level Super Output Areas (LSOA's)

The use of LSOA's in the calculation of risk has become commonplace, this is in large due to the availability of census data, IMD data on a LSOA scale. In England there are 38,844 LSOA's (ONS, 2018), each LSOA dividing an area into spatial units containing an average of 1500 residents. In 2018, Graeme Lockhart of CDDFRS introduced new methodology that moved risk analysis from ward level to the use of LSOA's. This move to a new methodology was required as many of the 2008 wards previously used were no longer in existence in the County Durham area. Figure 8 is an example of the old methodology that was in use by CDDFRS up until 2018. Figure 8 highlights Darlington Lascelles and Darlington Bank Top as being in the top 10% of wards in the CDDFRS area at risk of ADF's, as represented by the red shading. Under this old system, this whole area would be the target for prevention activities and issued extra resources. Comparatively, Figure 9 demonstrates the new methodology in use from 2018 using LSOA data. In this Figure there is a significant difference within the old ward areas shown in Figure 8. For example, when the old ward area of Darlington Lascelles is divided into LSOA's, one neighbourhood (LSOA: E01012341) has a calculated risk percentile of 95.6 whilst its neighbouring area is calculated as 5.7. The old methodology of using wards for the creation of risk scores would aggregate this risk, creating a levelling effect in which risk is spread across the ward (Coleman, 2014). As demonstrated further in Figure 10, incident data on ADF's from the past five years accentuate the benefit of LSOA's as the points of past incidents generally accumulate in the high risk areas calculated by the 2018 methodology. Therefore, the use of LSOA's is highly beneficial in the targeting of resources and is a justifiable scale in the methodology.

This being said, one of the key limitations in the use of LSOA's is its application operationally. Unlike at ward level in which areas are given names, the LSOA system uses codes to distinguish areas. For example, the previous ward of Darlington Lascelles now contains the LSOA's of E01012340 and E01012341. Therefore from an operational point of view, when communicating risk to fire station managers it is harder to indicate an area as high risk by referring to the LSOA alone, as the code names are harder to attribute to direct locations. This is where the use of risk mapping becomes an essential tool in communication. However, the benefits of using the LSOA scale outweigh the limitation in operation, as long as risk is communicated in an effective manner.

Figure 8: Map of High Risk Wards, Darlington.

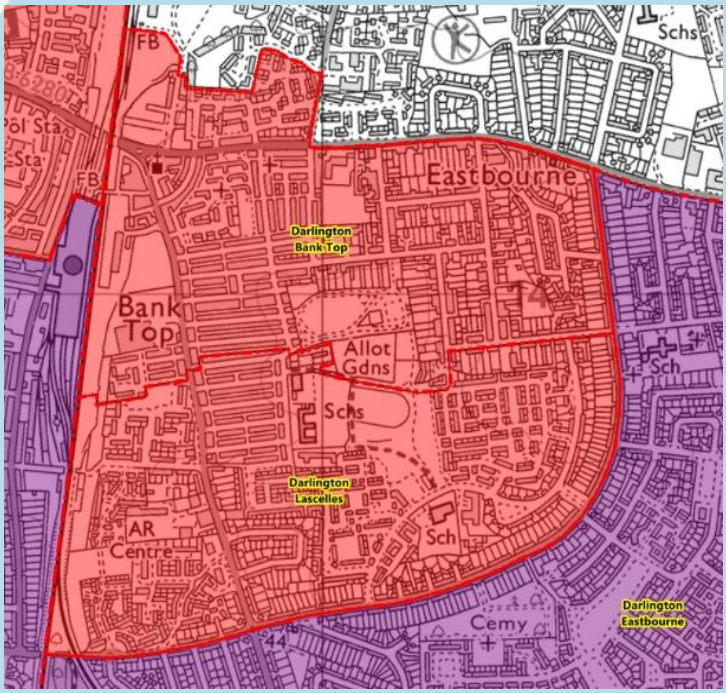


Figure 9: Map of High Risk LSOA's, Darlington.

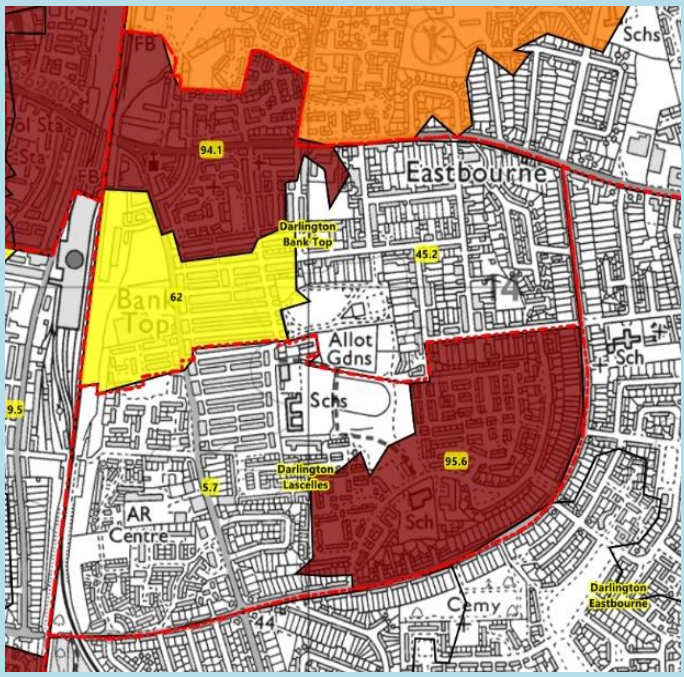
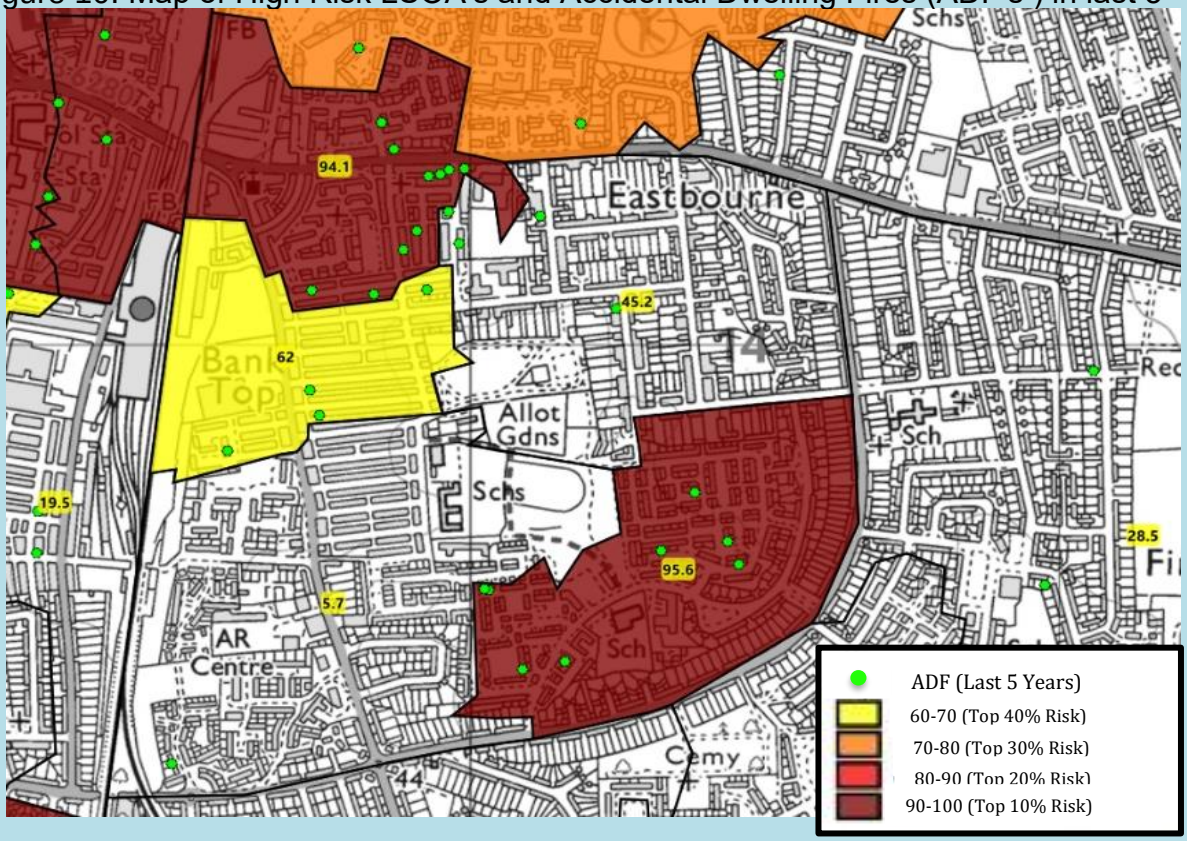
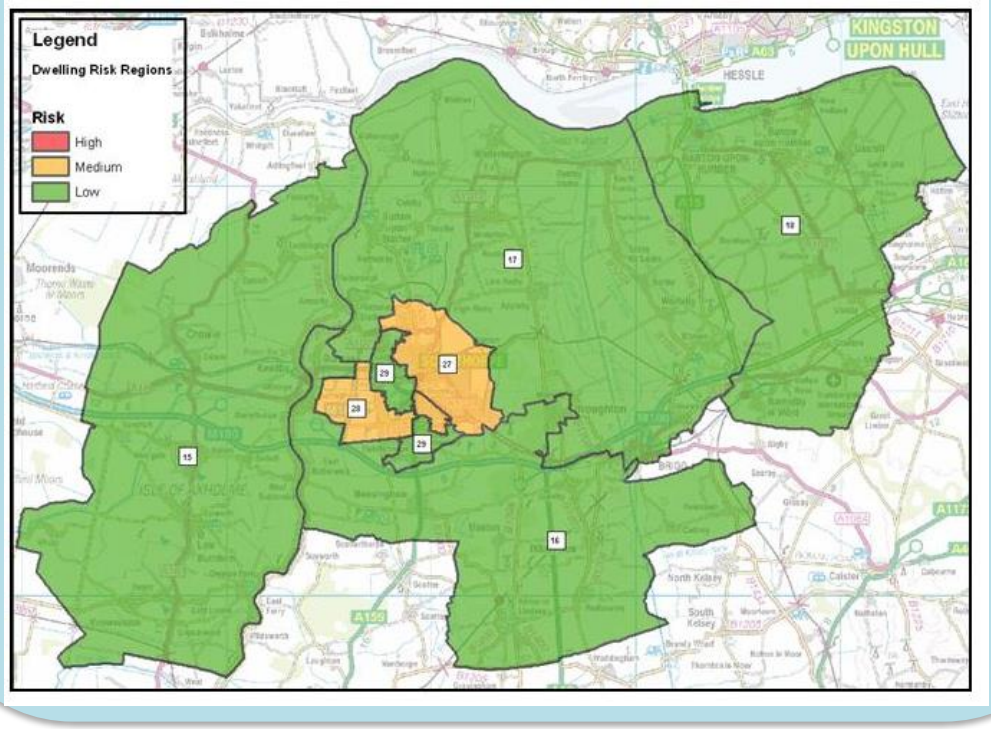


Figure 10: Map of High Risk LSOA's and Accidental Dwelling Fires (ADF's) in last 5



Although the use of LSOA's is widespread, not every Fire Service uses them in the calculation of risk. Humberside Fire Service use larger 'Risk Regions' where the population of an area is grouped to contain approximately 20,000 residents, the rationale behind this is the larger groupings of population produce more statistically significant results (see Figure 11). Although statistical significance is an important consideration, the risk rating maps produced for Humberside perhaps lack practicality. When approaching this map as a member of the public, the large scale of geographies being used does not give a real indication of what risk is like in a local community. Therefore, as a tool for reassuring and communicating risk to the public, the maps produced could be viewed as ineffective.

Figure 11: Example of Humberside FRS 'Risk Region' in North Lincolnshire



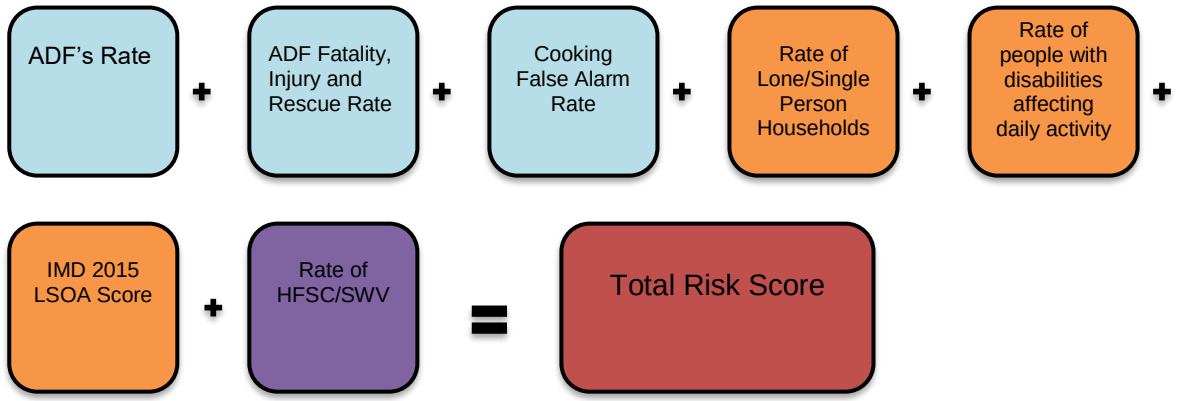
5.1.2 Risk Factors

Within CDDFRS' 2018 methodology, seven risk factors are identified and used to calculate areas of potential risk. Data that is not already available at LSOA level such as incident rates have undergone aggregation to normalise the data to geographic and population sizes using census data from 2011. The seven risk factors and the weighting within its use are detailed in Table 2 below. Additionally, the calculation for the use of these risk factors are included in Figure 12.

Table 2: Risk factors and weighting used in the calculation of risk in CDDFRS

Risk Factor	Weighting
Rate of accidental dwelling fires over the most recent 5 year period (per population for LSOA)	17 %
Rate of fatalities, injuries and rescues from accidental dwelling fires over the most recent 5 year period (per population for LSOA)	17%
Rate of cooking related false alarms in dwelling over the most recent five year period (per population for LSOA)	17%
Rate of single person/lone households (census data from 2011) per number of dwellings for LSOA)	13%
Number of people with disabilities affecting day to day activities (census data from 2011, per population for LSOA)	13%
LSOA Deprivation score (IMD 2015)	13%
Rate of home fire safety checks/wellbeing checks over the most recent 10 year period (per number of dwellings for LSOA)	10%

Figure 12: CDDFRS Dwelling Fire Risk Calculation



Historic data is attributed a higher weighting, this is in line with the majority of Fire Services sampled. Individually, the risk factors used in CDDFRS methodology are in line with other services, the key difference arises from how these factors are combined. Particular similarity can be found in the methodologies employed by South Yorkshire Fire Service who also use near miss events such as cooking related fires in their calculation of risk. The use of near miss events by County Durham and South Yorkshire are evidence based, working on the premise that those properties with high near miss events are at greater risk from a more serious event occurring. The use of lone households in this risk formula

supports existing literature from Smith et al. (2008) and Holborn et al. (2003) that details lone households to be a major variable in injury and fatality from dwelling fire. The inclusion of this variable into the risk formula is therefore well justified. In addition to lone household, the incorporation of disability data and deprivation as a risk factor is also justified. Both Greater Manchester and South Yorkshire give the IMD (Index for Multiple Deprivation) considerable weighting in their risk analysis formula, although Greater Manchester does not individually account for other forms of vulnerability. The IMD incorporates seven factors in its calculation and ranks every small area according to the calculation of the indices in Table 3, this accounts for a wide range of vulnerabilities including economic, environmental, social and physical.

Table 3: Index for Multiple Deprivation Indices used in its calculation

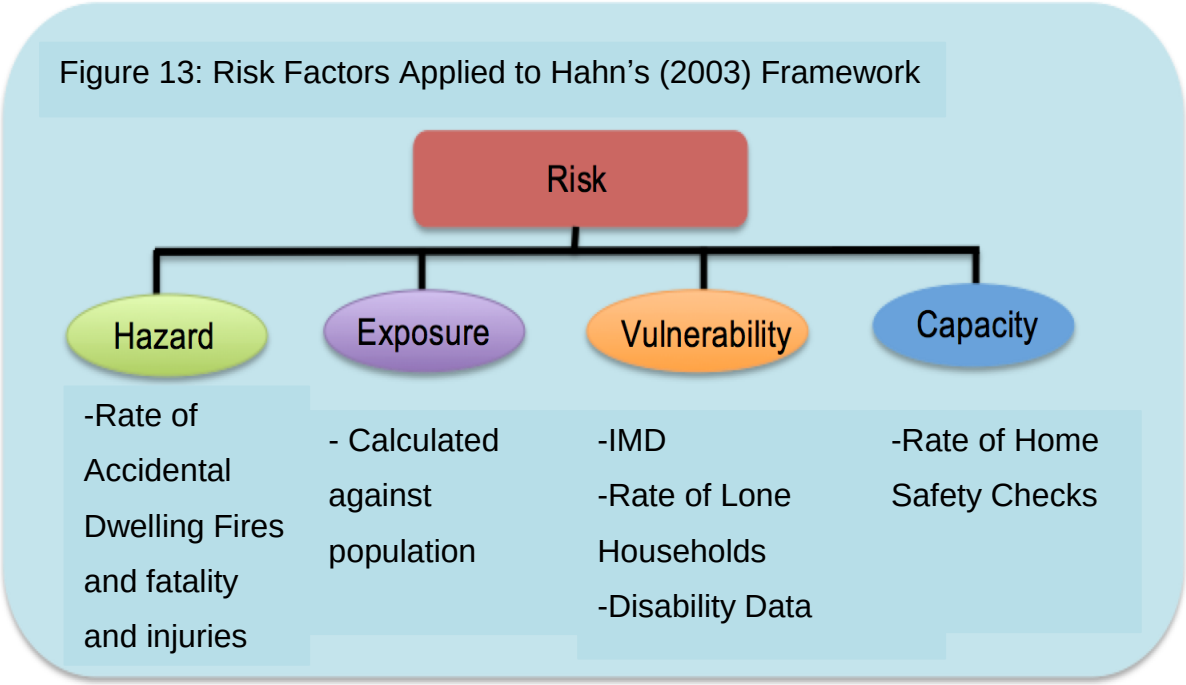
Indices	Weighting
Income Deprivation	22.5%
Employment Deprivation	22.5%
Education, Skills and Training Deprivation	13.5%
Health Deprivation and Disability	13.5%
Crime	9.3%
Barriers to Housing and Services	9.3%
Living Environment Deprivation	9.3%

5.1.3 Applying CDDFRS ADF Methodology to Academic Theory

Upon reflection, the risk factors used in the equation of dwelling fire risk in CDDFRS can be applied to Hahn's 2003 Framework of Risk, as demonstrated in Figure 13. This insight is promising, it shows that County Durham is accounting for risk beyond a simplistic 'likelihood x consequence' outlook. In Hahn's (2003) work, Hazard is considered as probability and impact, this is accounted for in County Durham's use of the rate of the historic occurrence of dwelling fire alongside the impact e.g rate of fatalities and injuries concurred and cooking false alarm. Additionally, in this framework, 'exposure' could be considered to be the population at risk of subsequent events, therefore the use of population in the formula when coupled with their indexing of risk areas by LSOA accounts for the exposure of a population to hazard.

Further to this, vulnerability is also accounted for. The use of disability and lone household data uses both social and physical vulnerability as a basis for risk, whilst the use of IMD gives a more general outlook. The indices used to calculate IMD include environmental and economic vulnerability and therefore the inclusion of IMD in CDDFRS' risk formula presents a fuller representation of vulnerability in the dwelling fire risk formula. Finally, the use of home and fire safety checks account for the 'capacity to cope' in Hahn's framework. Fire Safety and wellbeing checks answer the question 'how likely does a person have the capacity to cope in the case of a fire?' In these visits, smoke alarms may be fitted; fire safety advice given out or households may be flagged as having vulnerable tenants. In instances where a property has had no visits this outlines uncertainty and therefore could indicate higher risk in itself. Capacity to cope is an area that is often overlooked in the theorisation of risk, and the inclusion into the risk formula supports work by the likes of Cannon (2000) in ensuring that people are considered beyond just being victims to hazard. The risk factors used by CDDFRS and calculation of dwelling fire risk can therefore be considered advanced and in line with existing academic theorisation of risk, addressing aspects of risk that are typically under-represented.

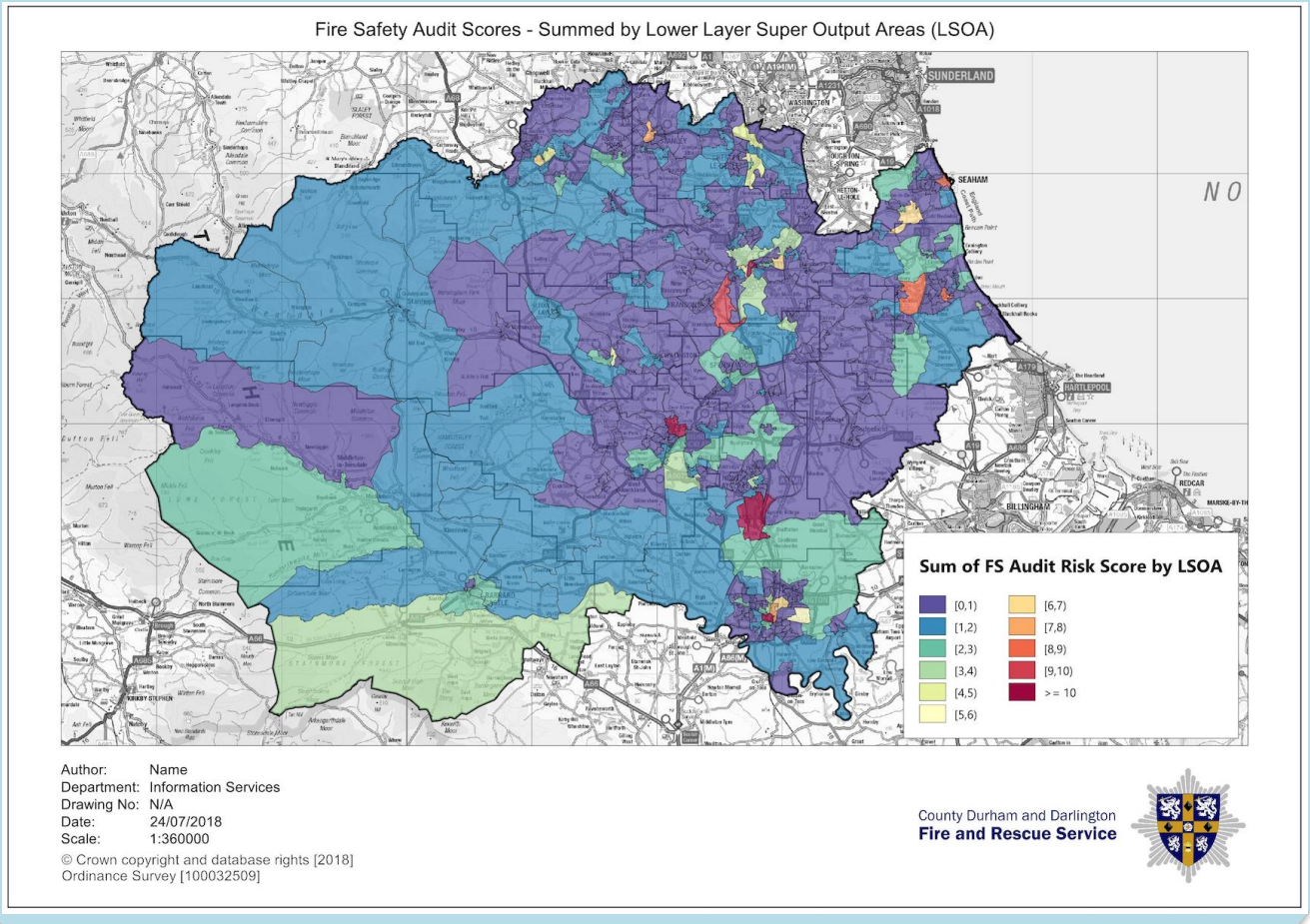
Figure 13: Risk Factors Applied to Hahn's (2003) Framework



5.3 Industrial and Commercial Fire Methodology

An industrial and commercial building can be defined as a building other than a dwelling where there is significant risk to life or the economy (FSEC, 2008). The methodology in use by CDDFRS for analysing commercial and industrial property risk is considerably less developed than that currently in place for dwelling fires. This is a trend that is reflected nationally, the methodology tending to orientate around historical instance. Cleveland Fire and Rescue Service use a very similar methodology to CDDFRS, this entails using fire audit data as a basis for identifying those properties at highest risk. The audit system in place accounts for factors such as whether people using the building have familiarity, the results of loss assessment and any historical incidence of fire. The properties are then placed on a scale based upon their allocated score and this can be overlaid onto LSOA data and create risk maps. Figure 14 demonstrates County Durham and Darlington's risk maps for commercial property.

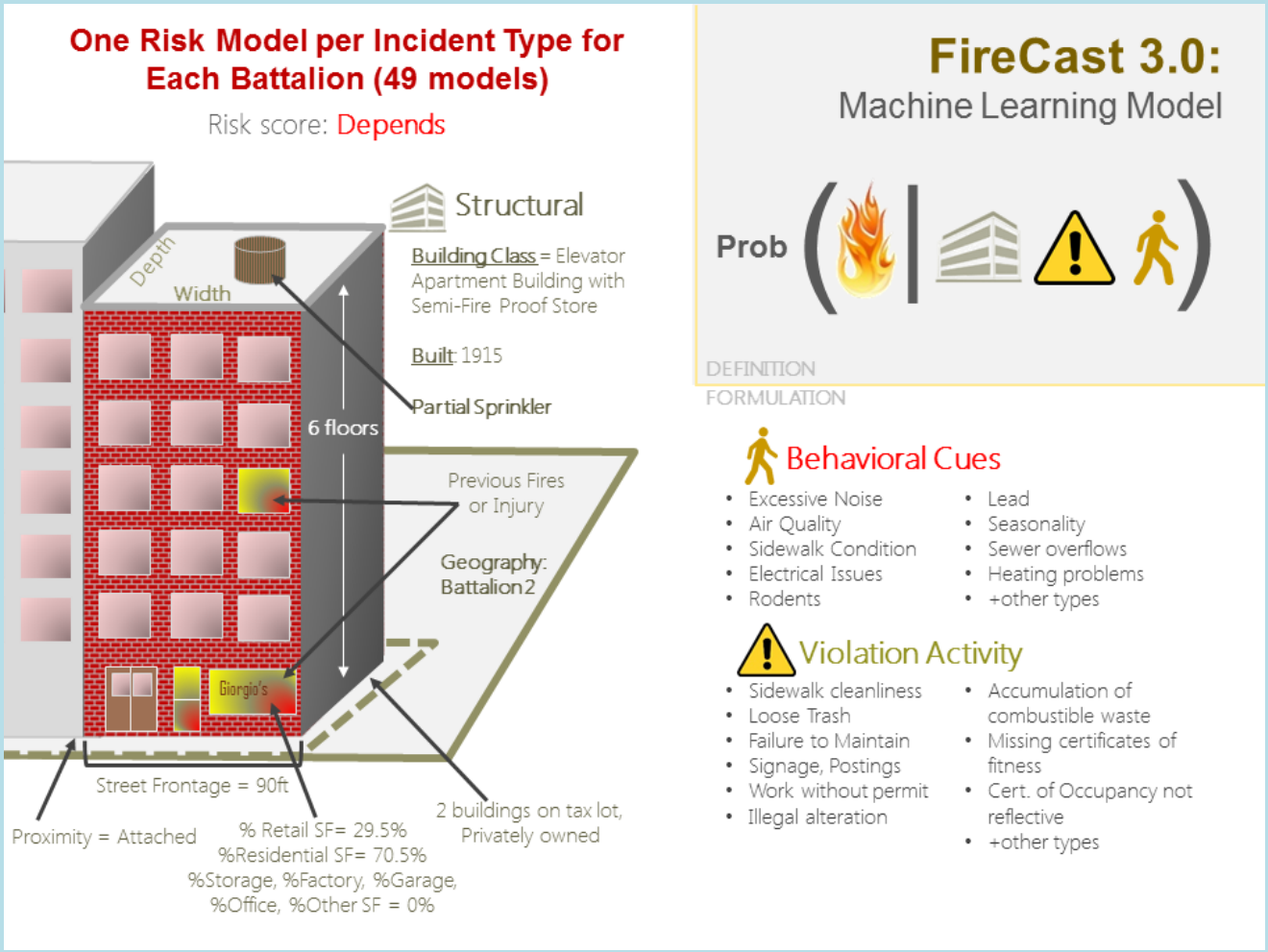
Figure 14: A map of commercial risk areas in County Durham and Darlington



One critique that arises from this data is that is largely hisorically based, using past audit data to inform future instances of risk. This historic focus has been critiqued more generally by Walia et al. (2012) who instead recommend looking to more current data forms, some examples of which include; building sale price, any tax exemptions and unintentional fire alarms. Further to this the FDNY (Fire Department of New York) use a similar appraoch with their FireCast Model. The FireCast system uses an algorithm which updates daily that feeds in data from different agencies, this helps to not only determine which properties at greatest risk but also identifies the priority to which buildings are inspected (Rieland, 2015). If a property was to receive a violation then this would update the system and identify them as at greater risk in the future. This use of data is useful and is already in consideration by some Fire Service's in the UK, mainly London Fire Brigade who have been looking into the use of data such as hygiene ratings and reviews to indicate those commercial buildings at greatest risk from fire. This all works on the principle that if a building is failing in other health and safety areas then the chances are that the fire regulations in place will also be sub standard.

In the FireCast system, the risk of fire is determined through strucural, behavioural and violation data (see Figure 15). It is this use of violation data that addresses the critique by Walia et al. (2012) and places a more current focus of risk. However, for such a system to be put in place there needs to be complete co-ordination with other organisations and a constant feed of data, for a smaller service such as CDDFRS the use of such a wide range of factors could be unsustainable. Going forward, a reccomendation in methodology would be to choosing a couple of the violation sources and looking into whether this could be rooted into risk scores using similar methodology currently in use with predicting accidental dwelling fires.

Figure 15: FireCast Model used by New York Fire Department



6.0 Summary and Conclusion

The purpose of this study was to evaluate the current methodology being implemented by the UK Fire Service. This was conducted through the critical examination of IRMP's and supporting documents in order to determine how Fire Service's identify and assess local community risks.

One of the key findings of this report is that there is a vast disparity in the content, audience and purpose for which IRMP's are being produced. This disparity could be attributed to the out-dated National Guidance offered by the Home Office produced in 2008 to advise Fire Service's on 'what to consider' when preparing an IRMP document. This guidance should go further and set out a template of how this information should be translated, a suitable example of this would be how the National and Community Risk Registers are currently presented across regions.

The methodology employed by CDDFRS for the prediction of ADF's is advanced to a level that works for the region. Although this methodology is currently in its infancy, the locations of incidents over the past 5 years indicate that the use of LSOA's are more accurate in risk prediction than that of wards. The testing of this methodology can only begin to occur in the next 3 years when there is sufficient incident data, however when testing is conducted this will provide a good indication as to the reliability of the newly implemented methodology. The analysis of risk outside of ADF's at CDDFRS is perhaps less developed than some of their counterparts; this is an area that has the potential for development. Examples such as the FireCast system in New York and the use of flood risk mapping in Humberside, demonstrate some of the risk analysis methods that could be employed to enhance risk analysis in special service incidents and in commercial fire.

One further key finding in this report is the importance of shared data to enhance knowledge. Consistently, the sharing of data between agencies is highlighted as an important factor in not only being able to identify those at the greatest risk in communities but also to inform what property is at greatest risk (this particularly prevalent in the analysis of the commercial risk of fire).

4.2 Recommendations

The final outcome for this report is to produce recommendations for CDDFRS that can be considered when developing their Community Risk Profile. After careful evaluation, the recommendations produced below highlight some key areas for future development.

- Supplement existing commercial fire risk methodology with data that goes beyond historic instance and past audits. Using a similar methodology to that developed with ADF's, building a model that incorporates variables such as 'food hygiene' would have the ability to progress.
- Look to incorporate seasonality and temporality into the analysis of risk in the Community Risk Profile. Translating this risk to the public along with addressing the Five W's, will help to communicate risk more effectively.
- Look to develop greater connections with other agencies to enable the ability to share data. Although there are certain restrictions on the sharing of data because of privacy laws, even greater access to publicly available data such as business hygiene ratings and flood risk properties could be highly beneficial.
- When analysing who is at risk, also consider who and what may be a risk to the local community. This feeds into a greater awareness in the analysis of future risk rather than focusing on historic past incidents.

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