Scoping Review - Equivalent and Satisfactory Fire and Rescue Service and Civil Protection*

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This paper is part of an introductory course at the beginning of a PhD. It is not intended to be a complete review, as this may require additional database sources or unpublished material that cannot be found in academic journals.

Abstract

The last decade's shift from detail regulated to a more goal oriented legal framework when it comes to civil protection has put the light on the need to define the purpose and definition of the goals intended. In a Swedish legal context, the goal for the fire and rescue services is to provide an equivalent and satisfactory civil protection. This scoping review is aimed at investigating what is written about the subject in the scientific sphere, as this has not been adequately defined. It is found that there are not many papers that discuss civil protection in those terms. In the 12 articles found, there are four themes that touch on civil protection that is equivalent and/or satisfactory, but they are mostly used to frame specific problem that is addressed. It is concluded that there is a GAP and a need for further research to be able to properly assess if the civil protection provided, mainly by emergency services, is equivalent and satisfactory.

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Contents

1 Background

Civil protection is more important than ever, from car crashes to domestic fires to large-scale disasters like major floods and forest fires. But how can we be sure that the response from the public organizations is satisfactory, equivalent, or good enough to protect communities? Fire and rescue services (FRS) are one of the emergency organizations that typically deal with reducing the negative effects of a diverse set of emergencies and disasters in the community, in some countries this might include ambulance service depending on the system, but in most cases these are separated (Puolokainen 2017).

Over the past few decades, the landscape and assignment for FRS have shifted from a detail-oriented regulation of responsibilities on how to organize work, to a more broad and goal-oriented framework (Koppenjan et al. 2020, Matheson et al. 2011). The shift in mindset from a fire brigade to a fire and rescue service has led to a better and broader service to the public as a whole, not only attending fires but other incidents as well, along with a bigger focus on community and preventative work (Childs et al. 2004). At the same time the complexity of the modern world and landscape brings new challenges for the civil protection agencies such as FRS and how to deal with them (Mlađan et al. 2012).

The main goal of a modern FRS can be described as providing a public good, ultimately preserving human life and property. This can be achieved mainly through two activities, prevention and/or reaction to the rescue events, and therefore the desired FRS outcomes include both emergencies prevented or suppressed, and this is not easily measured (Puolokainen 2017). In a more detailed oriented framework the output is easier to measure, such as number of turnouts or inspections, however in a goal-oriented framework there is a need to move towards measures that asses' effectiveness as it is important that public sector organisations are actually effective in what they do (Taylor et al. 2019).

There are different approaches on how to organize and measure effectiveness within the public management, such as FRS (three main paradigms shifts are described by Puolokainen (2017)), however leaving the public management aside (Abrahamsson et al. 2021) argue that a clear desired outcome to measure the effectiveness against is needed, as without a clear definition, it is hard to evaluate the measures and rightfully say that they are good enough, individually or as a whole. In a Swedish context, the rights and obligations of the FRS are stipulated in the Swedish Civil Protection Act (LSO). The opening paragraph sets the goal, framework and purpose of the civil protection.

> *The provisions in this act aim at, nationally providing an equivalent and satisfactory and comprehensive civil protection, with consideration of local conditions, that affect people's life, health, property and the environment.* (SFS 2003:778, chap.1 §1)[1]

Right from the first implementation of LSO in 2004 it has been unclear what is actually meant by *equivalent* and *satisfactory* civil protection. And even the Swedish Civil Contingencies Agency (MSB) that has the direct authority over the Act, has not

[1] Official translation. Correct Swedish wording: *Bestämmelserna i denna lag syftar till att i hela landet bereda människors liv och hälsa samt egendom och miljö ett med hänsyn till de lokala förhållandena tillfredsställande och likvärdigt skydd mot olyckor.*

been able to define these terms (MSB 2015), as it depends on vague formulations and interpretations of what to include when evaluating the FRS in relation to the main paragraph. Abrahamsson et al. (2010) argue that there is a strong need to be explicit concerning the underlying values and objectives when evaluating emergency response operation. Without such clear intentions and values, the FRSs have difficulties relating to the main goal and intention of The Act, LSO (SOU 2018:54). There have been efforts made to clarify the terms, the majority, however, only look at equivalent and conclude that it is a complex issue that ultimately has to be considered with the term satisfactory that is equally complex, as identified by (Abrahamsson et al. 2021).

Although the described problem takes a stance in the Swedish legislation, the broad aim and purpose of the civil protection is the same regardless of country, i.e. to protect communities and citizens in situations that pose an urgent threat to their life. In the government bill proceeding the last revision of LSO a comparison was made to five different European countries and the management of their FRS, it shows that the general task spanning over what constitutes civil protection is the same and that all countries have similar challenges in adaptation to the fast changes in the complex world. Furthermore, the comparison made, also suggests that similar vague goal formulations using *satisfactory protection* and *reasonable* time frames, exist in other countries.[2] (SOU 2018:54). Although tasks and procedures within the different organisations that provide civil protection, depend on and vary due to the legislative framework and traditions of the individual country, the underlying purpose is the same. This does suggest that the value of defining the terms equivalent and satisfactory in relation to civil protection (or rather the dimensions and aspects of the terms), is also valid outside the Swedish context.

The structure of this paper is as follows: Section 2 describes the literature search and the search criteria, Section 3 continues with the search method used, and Section 4 analyses the articles found. The approach and results are discussed in Section 5, closed by a conclusion in Section 6.

2 Literature Search

As this paper is intended to be a starting point to formulate sound and valid research questions and how to approach the issue of equivalent and satisfactory in relation to FRS and civil protection to take. A useful tool for this is to start with a literature search. The method and the scope of the literature search is outlined in the following sections;

2.1 Search Question

As the terms equivalent and satisfactory have not really been defined, it has been hard for the municipalities and their FRS organizations to relate to and implement the goals of LSO (SOU 2018:54). It is therefore of interest to see what, if anything, can be found in the academic literature on the subject, by formulating the following search question;

> What parts or aspects are discussed in the published academic literature in terms of equivalent and/or satisfactory, with regard to Fire and Rescue Service or

[2] No specific comparison was made per se and further investigation would be needed.

Emergency Services that work with civil protection?

The search question is deliberately broad, in an attempt not to limit the scope of the findings in the academic literature.

2.2 Search Criteria

Several different test searches were made to capture the terminology used to in relevant articles. The search words need to include at least a term for FRS (or equivalent) with terms corresponding to equivalent and/or satisfactory. These different terms used are stated below;

2.2.1 Fire and Rescue Service

There is no unified term for the FRS and there are several different names that could be used interchangeably for the purpose of this search, the following terms were used to capture FRS. Although this literature review is mainly interested in a FRS perceptive, by using the term Emergency Service, ambulance and police are indirectly included. As it could be argued that the terms satisfactory and equivalent are valid as a goal for any emergency service, these are perfectly fine to include, although by not including them specifically, the specific challenges from police and/or ambulance services are omitted. The following search terms are used to capture the concept FRS;

Fire Service, Fire Brigade, Civil Defence, Emergency Service, Fire Department, Fire Authority, Civil Protection, Fire and Rescue Service

2.2.2 Equivalent

The Swedish word *likvärdigt* is not easily translated to English, as it depends on the context. In the official translation of LSO, the word equivalent is used. To capture as many aspects as possible, several synonyms and antonyms have been identified for the search. The following search terms are used to capture the concept equivalent;

unequal, equivalent, equal, comparable, alike, just, fair, unfair, tantamount, comparable, equitable, inequitable

2.2.3 Satisfactory

As the term *likvärdigt* the Swedish word *tillfredsställande* is not easily translated, however in the English translation of LSO the term satisfactory is used. The following search terms are used to capture the concept satisfactory;

satisfactory, adequate, tolerable, decent, acceptable, sufficient

2.2.4 Inclusion Criteria

The words equivalent and satisfactory are quite specific. In a broader sense, it is interesting to define exactly what they mean (general theme for the PhD). As described in the previous Sections, different synonyms or words that touch on the same meaning in various degree were searched for. Articles that relate to these words and discuss the terms in relation to FRS (or even, as outlined broader, Emergency Service in general) as a whole or as a starting point/discussion to motivate the research/contribution at hand were included.

Table 3.1: Searches made 07/10/2022 at webofscience.com. For the different corresponding words, the search operators OR were used and AND for the whole group. The exact search string can be found in the footnotes, that includes all the search terms provided in Section 2.2.

#	Search	Results (N)
1	FRS[3]	19858
2	Equivalent[4]	3883586
3	Satisfactory[5]	1589604
4	#1 AND #2	1621
5	#1 AND #3	954
6	#1 AND #2 AND #3	112

2.2.5 Exclusion Criteria

Articles that did not relate to FRS or Emergency services at all were disregarded. Articles that may relate to the search terms but did not specifically discuss or problematize the search terms were also disregarded. Although a few of these were kept on the side, as shown and motivated in Table A.1.

In addition, the following search hits were not included, (1) proceedings as these do necessary hold the same scientific standard, and in most of the cases a peer reviewed published paper on the same topic could be found. (2) Gray material that is not published in scientific papers, these would by large not found in a scientific database in any case. The gray material is, however, considered important to get a better understanding from a regulating and political point of view for the bigger overarching research question. This will be included at a later stage and not part of this literature review. (3) Lastly, articles found in languages other than Swedish, English or Polish were also excluded for practical reasons.

3 Search Method

The literature search was made in the database Web of Science (WoS) that has multidisciplinary coverage and encompasses tens of thousands high-impact journals and 200 000 proceedings. The idea is to search for FRS with the two different concept of *satisfactory* and *equivalent* together. However, initial search indicated that the result may turn out too low (below 100) and searches with FRS with equivalent and satisfactory separately were also made. The search result for each search is shown in Table 3.1 and although the result (N) for searches #1, #2 and #3 (terms individually) are too broad and not relevant, they are presented for completeness.

Through test searches it could be noted that many of the resulting posts were irrelevant (different fields such as dealing with building constructions or medical aspects).

[3]((((((ALL=("fire service*")) or ALL=("fire brigade")) OR ALL=("civil defence")) OR ALL=("emergency service*")) OR ALL=("fire department")) OR ALL=("fire authority")) or ALL=("civil protection")) OR ALL=("fire and rescue service*")

[4]((((((((((ALL=(unequal*)) OR ALL=(equivalent)) OR ALL=(equal*)) OR ALL=(comparable)) OR ALL=(alike)) OR ALL=(just*)) OR ALL=(fair*)) OR ALL=(unfair*)) OR ALL=(Tantamount)) OR ALL=(comparable)) OR ALL=(equitable)) OR ALL=(inequitable)

[5](((((ALL=(satisfactory)) OR ALL=(adequate)) OR ALL=(tolerable)) OR ALL=(decent)) OR ALL=(acceptable)) OR ALL=(sufficient)

Identifying words or phrases to deduct in the searches, i.e. using NOT operator, to exclude these and consequently lowering the search result, could potentially also exclude relevant posts, as these can include a word to describe the scope of the article or what is not accounted for. Hence, a different exclusion process was needed, as described in Section 3.1.

3.1 Screening Process

Based on test searches it was concluded that, although a search for equivalent AND satisfactory is most interesting, the corresponding #6 search would possibly result in too few articles, and therefore a broader screening was made to capture articles where maybe only one of the interesting factors is discussed included. This is also confirmed by the initial articles retrieved for each search shown in Table 3.1 where the 112 result is in the order of ten times lower. The total sum of 2687 articles was therefore included in the following screening process, however keeping track of from what search result the article is originated from.

The screening process was made by exporting all post and combining them into one dynamic table in an MS Excel spreadsheet, for easy sorting and filtering while bookkeeping all the original search results and keeping track of where the exclusion was made for each post. As illustrated in Figure 3.1 an initial search for duplicated and triplets was made resulting in 233 post that could be excluded. After that, the far majority of articles could be excluded based on the article title alone (2355) and only 99 posts made it to the next step of reading the abstract. 58 were rejected based on reading the abstract, and finally, after reading the remaining (41) articles, 12 were found to fall within the inclusion criteria for analysis and complete read through. Additional 9 (out of the last 41) were also kept, although found to pass the inclusion criteria, as a clear theme emerged, how these articles add to the findings is discussed more in depth in Section 4.2.1

3.2 Additional Articles

Although insights will for certain be made by looking in gray material, such as reports by local and national agencies or in the bills and related reports to LSO, it was a deliberate chose to exclude these for analysis as part of this analysis, as discussed in Section 2.2.5. An examination of all references in the analysed literature and based on the titles a handful of references were checked however none of them met the inclusion criteria. Some more advanced citing analysis tools such as Research Rabbit[6] and Citation Gecko[7] were tried. However, the articles were very scattered in research fields and the results only showed some semi useful results for the theme of Time to Arrival and Spacial Distribution (see Table 4.2).

4 Analysis

A number of aspects that the analysed articles bring to the table regarding equivalent and satisfactory in relation to FRS are summarized and synthesized in this Section. The analysis is based on the 12 articles found are listed in Table 4.1 where authors, year and titles are presented. The additional five articles that technically did not

[6] https://citationgecko.azurewebsites.net/
[7] https://researchrabbitapp.com/

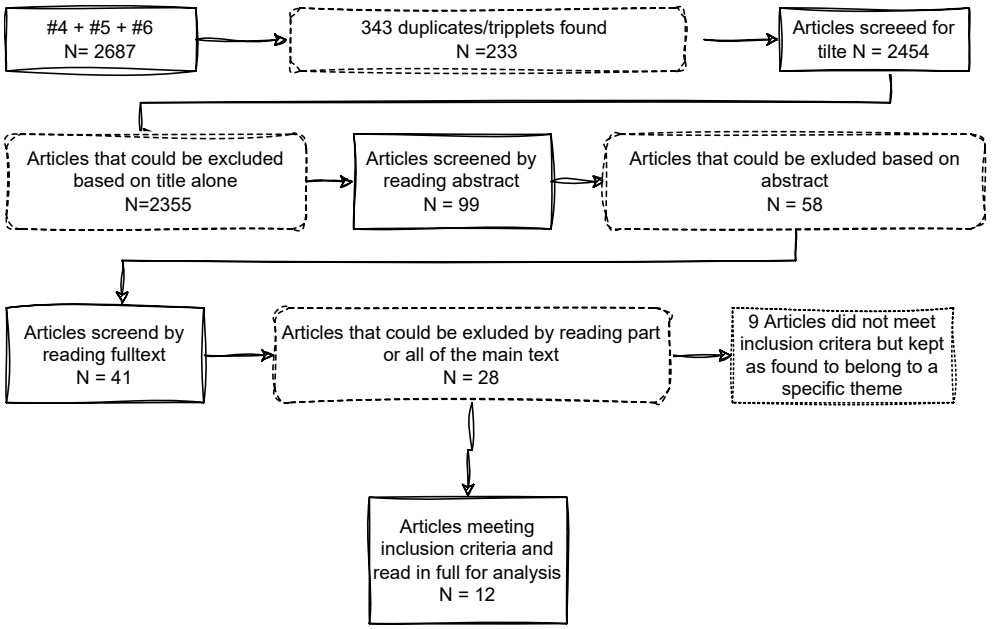

Figure 3.1: Flowchart illustrating the search and selection process, list of articles can be found in Table 4.1 (relevant) and A.1 (additional for a specific theme)

pass the inclusion criteria, but were kept relating to a specific theme, are presented separately in Table A.1.

4.1 General Findings

As per Table 3.1 three different searches were made, one for the terms equivalent and satisfactory each and one for the combination. A total of 343 hits of a total 2687, were found to be a double or a triple, i.e. showing up in two or all three searches, resulting in a total of 233 articles. However, none of these came through to the final stage, which means that there was no article found from search #6 that looked for articles that include both equivalent and satisfactory with FRS. The relative difference between the number of hits between search #4 and #5 (1621 and 954 respectively) suggests that the term equivalent is more frequently discussed in the literature, and this is also confirmed by the fact that 10 out the 12 articles came from search #4 and only 2 from #5.

All, apart from one article (Harkins & Strauss 2008), are from 2015 and forward, despite that no restriction on year was made in the searches. This might indicate that the problematisation of the terms equivalent and satisfactory in relation to FRS starts to be investigated in later years due to the shift in mindset where FRS do more than just attend fires (this transition is exemplified in Koppenjan et al. (2020) and Matheson et al. (2011), as referenced in the background section). Furthermore, as pointed out by Vignieri (2018) public sector organizations have borrowed management practices from the private sector over the last 20 years, putting greater emphasis on performance and results than overlooking compliance with administrative rules and procedures. This

Table 4.1: 12 articles selected for detail analysis and read through. Additional nine articles were identified to a specific theme. And they are listed separately in Table A.1

Author(s) and Year	Article Title
Constantinou et al. (2017)	Inclusive access to emergency services: An action research project focused on hearing-impaired citizens
Di Bucci et al. (2019)	Deciding (or not) on the acceptable level of seismic risk: First behavioural considerations on the L'Aquila trial
Di Bucci & Savadori (2018)	Defining the acceptable level of risk for civil protection purposes: A behavioural perspective on the decision process
Harkins & Strauss (2008)	Access to emergency number services
Hastie & Searle (2016)	Socio-economic and demographic predictors of accidental dwelling fire rates
Janacek & Gabrisova (2019)	User-fair designing emergency service systems
Janacek et al. (2020)	Fair facility allocation in emergency service systems
Janacek & Kvet (2017)	Semi-fair design of emergency service system with failing centers
Kvet & Janacek (2018)	Fair emergency system design under uncertainty
Weibgen (2015)	The right to be rescued: Disability justice in an age of disaster
Yu et al. (2020)	Disruption of emergency response to vulnerable populations during floods
Yu et al. (2022)	Accessibility analysis of urban fire stations within communities: A fine-scale perspective

in turn may also be a reason scholars have turned towards these types of questions only recently. The analysis of this finding would be interesting; however, it is left for a better time and place.

The articles have been, up to date, cited 66 times in total with an average of 6.6 per article. Both year and citation distribution can be found in Figure 4.1. Different analytical tools were tested, but no conclusive results found, as the articles were too scattered or not part of the databases to find any relevant information. Although it was a good exercise to try out the tools.

The articles analysed cover a wide range of research fields. The WoS categories are assigned by a mix of subject experts that index the articles and automated language processing techniques. In this way, each article can fall in to several categories depending on the content. Example of indexed categories are, Business, Economics, Computer Science Cybernetics, Law or Transportation Science Technology. (complete list is given in Table A.2), however, and none of these cover specifically FRS nor civil protection. This doesn't mean that they are irrelevant, as four main themes were found when. These, and the articles, are described in the following sections.

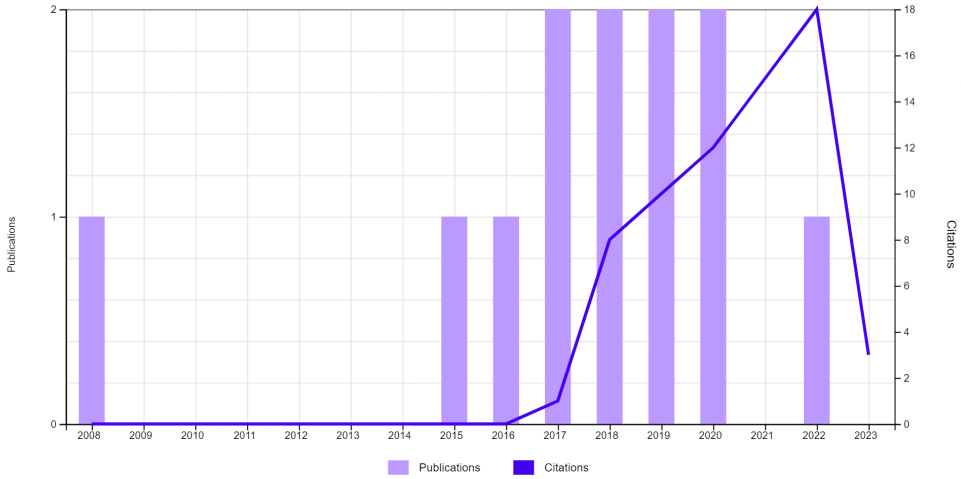

Figure 4.1: Distribution of articles and citations over time, downloaded from WoS analyse tool (2023-02-21).

4.2 Themes

The analysis showed a number of themes that the articles have in common. These themes or groups of articles are presented in the following subsections and their relation to satisfactory or equivalent for FRS, or in most cases emergency service in general. (1) Time to arrival and spacial distribution, (2) Vulnerable groups, (a) Hearing impaired, (b) People with disabilities, (c) Socio-economic aspects, (3) Natural disasters and (4) Legal and behaviour decision aspects. The distribution of the articles over the themes can be found in 4.2, noting that one article can fit in to several themes.

Table 4.2: Analysed articles in relation to found themes. (1) Time to Arrival and Spacial Distribution, (2) Vulnerable Groups, (a) Hearing Impaired, (b) People with Disabilities, (c) Socio-economic Aspects, (3) Natural Disasters and (4) Legal and Behaviour Decision Aspects

Author(s) and Year	1	2a	2b	2c	3	4
Constantinou et al. (2017)		⋆				
Di Bucci et al. (2019)					⋆	⋆
Di Bucci & Savadori (2018)						⋆
Harkins & Strauss (2008)		⋆				
Hastie & Searle (2016)				⋆		
Janacek & Gabrisova (2019)	⋆					
Janacek et al. (2020)	⋆					
Janacek & Kvet (2017)	⋆					
Kvet & Janacek (2018)	⋆					
Weibgen (2015)			⋆		⋆	⋆
Yu et al. (2020)	⋆				⋆	
Yu et al. (2022)	⋆					
Total (N=12)	6	3	1	1	3	3

4.2.1 Time to Arrival and Spacial Distribution (1)

One can argue that travel time (i.e. the time to reach a distressed person, in potentially life and death situations) is one of the more important aspects of an emergency service when it comes to satisfactory or equivalent. Time, to some extent, do address both terms as too long travel time should be considered as unacceptable and therefore non-satisfactory, and uneven time/travel distribution may be considered unfair or unequal. In the articles analysed, the largest theme found is the one of Time and Spacial Distribution, as a more even spacial distribution between emergency centres (i.e ambulance or fire stations) provides a more even and fair time distribution. In the literature, the analysis and placement of emergency centers, and thus the travel time to incident, is refereed to a *fair emergency system design*. Out of the 12 articles, five discuss this specifically (Janacek & Gabrisova 2019, Janacek et al. 2020, Janacek & Kvet 2017, Kvet & Janacek 2018, Yu et al. 2022). While screening and reading the articles additional nine articles (Di Caprio et al. 2022, Janacek & Kvet 2018, Mattsson & Julås 1997, Nyimbili & Erden 2020, Park et al. 2016, Wang et al. 2016, Wang et al. 2021, Xu et al. 2021, Zhang et al. 2017) were found to fit into this theme (see also Table 4.2 for titles). In contrary to the articles included in the analysis, the latter, although relate to a *fair emergency system design*, they do not discuss the terms equivalent nor satisfactory to any relevant extent, thus not meeting the inclusion criteria. These articles are presented here as to show that the theme of time and spacial distribution constituted a major part of the read articles, in total 5 + 9, out of 48, that made it through to reading in the selection process (Figure 3.1). The observant reader will notice that Table 4.2 lists six articles in this theme. The last one (Yu et al. 2020) also deal with respond times, however not with the issue of localization but rather the disruption of response during floods and is therefore described under Section 4.2.3.

All the articles on this theme centre around the *fair emergency system design* apart from Mattsson & Julås (1997) that instead provides a background on time travel and

societal costs. Mattsson & Julås studied the impact of time factor for fire and rescue service operations in Sweden by estimating cost and benefits of delayed turnout times for the fire and rescue service. By comparing arrival time from dispatch, for 50 Swedish municipalities an average damage increase per different type of accident was calculated per 5 and 10 minutes delay. The numbers are old but show an increased cost of 4150 and 8150 USD (1995 prices) per incident on average. In this number, not only the value of damaged property is estimated but also, in a way, the number of fatalities is in-cooperated through using a value (monetary) of a statistical life. The time frames of 5 and 10 minutes were chosen due to the more strictly regulated time frames and delays allowed for, for volunteer stations, that was implemented in Sweden before LSO. Since then, Sweden has moved away from regulating fixed time frames to arrival for FRS (and instead framed the requirement as the need for *satisfactory time*), however as understood from the literature, many countries have stipulated times such as 4 minutes (Yu et al. 2022) for FRS in China or 7–8 minutes for Ambulance in England (Yu et al. 2020).

As outlined, time is one of the bigger factors in controlling damage and saving life by emergency services. A central way of doing this is to spatially distribute service centres such as Fire- or Ambulance stations in a way to maximize coverage while still maintaining stipulated (or fair travel times). All the articles found take a mathematical approach to this localization problem, with different variations to accommodate for various *real life* conditions that need to be considered in the models. The most common organizational model for providing a *(*fair emergency system) could be described as follows:

> *A finite set of service centres located at nodes of the road network of the region represents a structure of the emergency system. Demands for service originate mostly at dwelling places of the region. The set of dwelling places is denoted as the set of system users, where each user is specified by his location and frequency of demands. When a service system structure is to be designed, the number of service centres is usually given. Disutility perceived by an individual user is proportional to the network distance between the user and the nearest service centre.* (Janacek et al. 2020)

Yu et al. (2022) takes a fine scale approach and develops a model by looking at building footprints to estimate faster (more correct) travel times in comparison to making bigger blocks/nodes and then connecting those with main roads. This can then be used to accommodate a new fire station or allow for micro stations to be put in already developed areas to keep turnout times low and thus *fair*. The situation and the case study that Yu et al. look at is favourable as the emergency service allocation is high on the agenda in urban planing in China, largely because the cities are growing fast. In other instances, one can not design the spacial distribution early but rather need to adapt to existing stations and calculate the best position for adding new stations, hence (Janacek et al. 2020) look at where to best deploy a new emergency centre when adding to an existing set.

Janacek seems to be the main authority on these calculations, as he is the author or co-author of five articles in the search result. Additional approaches are to analyse and compare two different methods when accounting for minimizing the disutility for the worst situated user (Kvet & Janacek 2018). Or trying to minimize the disutility for the worst users in a semi-fair system (Janacek & Kvet 2017). A last approach that is to account for failing facilities, as one can be busy and the second or third closest

to the incident need to respond (Janacek & Kvet 2017), and thus delaying the average travel time.

Although these models provide valuable input and comparisons between different approaches considered, they only look at one aspect, i.e. travel time to address a satisfactory or equivalent access to FRS, and other aspects have to weigh in to assess the terms from a more holistic point of view. Furthermore, in practice, only looking at the physical allocation of stations is not a flexible way to adapt to a growing and shifting needs of a modern city.

4.2.2 Vulnerable Groups (2)

One reasonable aspect when discussing satisfactory or equivalent civil protection would be to investigate if vulnerable groups have disproportionately poorer access to emergency services or *lower* protection in case of emergencies. As it turns out, out of the 12 articles analysed, four deal with vulnerable groups. Two discuss aspects of deaf or hearing impaired people (Constantinou et al. 2017, Harkins & Strauss 2008), one deals with people with disabilities (PWD) in general (Weibgen 2015) and one analyse the possible socio-economic and demographic impacts (Hastie & Searle 2016).

Hearing Impaired (2a)

This theme relates to hearing impaired access to emergency services, or rather how inaccessible it is, two articles were found Constantinou et al. (2017) and Harkins & Strauss (2008).

Constantinou et al. (2017) makes the case that it is close to impossible for the hearing impaired to communicate with a dispatch centre to call for help, and thus making the access to this crucial community service non equal. Through an action research project, a tool has been developed and evaluated by 74 hearing impaired that enables communication with emergency services. The system consists of a mobile application that records and sends details about the incident and a central management system to receive these calls to dispatch the right resources.

Harkins & Strauss (2008), on the other hand, take a different approach to describing the problem for hearing impaired from a historical and technological point of view with the *Access to Emergency Number Services* in US. The authors argue that the right to have access to the emergency number is statued in various Acts; and the main challenge is found to be that it has taken the industry many years to do the necessary reforms. The result in some cases being a policy *overcome by events*, meaning that the reforms stipulated are obsolete in terms of newer technology, and this is arguably due to the responsibility being too scattered with several independent actors who are not coordinated.

People with Disabilities (2b)

Weibgen (2015) explores the legal responsibilities that local governments have towards marginalized communities. By looking into a series of legal class cases where it was concluded that the City of New York has failed to ensure that people with disabilities (PWD) have meaning full access to emergency services, especially during extreme weather events such as hurricanes. The article falls fit in to three themes found in this paper, thus the parts on natural disasters and legal framework are commented in

the following Sections. However, Weibgen the main point is that bigger events that put stress on the emergency services, such as Hurricane Katrina or Hurricane Sandy in US, do not impact all the population equally. Many PWDs including those who are blind, deaf or hard of hearing, have difficulties accessing information (as described by Harkins & Strauss (2008) in the previous Section). Further more Weibgen (2015) looks at the moral challenges inherent in disaster planing for PWD and a dedicated chapter talks about the tendency to under-plan for the needs of PWD.

> *Communities will be forced to grapple with two essential questions: in preparing for disasters, how "ready" is ready enough, and to what degree should identity and social status determine who is put in danger, left in misery, and left to die?* (Weibgen 2015)

Socio-Economic Aspects (2c)

As identified by Hastie & Searle (2016), there is much literature that establishes that dwelling fire are not distributed evenly through society. As the interest for this literature search did not specifically look for these studies, only one article on the topic was found (i.e Hastie & Searle 2016).

Hastie & Searle (2016) identifies that fire safety and prevention work has grown to become an increasingly significant part of the role of FRS since the mid-1990's and that it is now a statutory duty. A hope with the study is that it will help FRS to improve and target fire safety and community work by identifying where it has the greatest potential to reduce both response, demand and inequality. Although the specific results may not answer the underlying search question in this scoping review, the article ties the findings to the aspect of inequality (equivalent protection) and identifies communities where this can be improved. These are worth listing here as they differ from the "normal" picture. (Findings are to some degree cultural and country specific, and the following is from a UK context).

- People with varying degree of deprivation are disproportional in the statistics of dwelling fires. Worthlessness seems to be the strongest factor however income, health and housing are also linked to a high accidental dwelling fire rates.
- Minorities, such as in the UK study, Black African, Black Caribbean or Black Other were found to be overrepresented even when adjusted for the factors of deprivation stated above.
- The final set of associations relates to areas with a high concentration of single households. As per citations in Hastie & Searle (2016) this link has been found before, however the new insight contributed is the linkage to age. Where the span of single households, 35-54 years of age are of significance for the rate of fires whereas the linkage to 65 years and up is weak or even negative.

4.2.3 Natural Disasters (3)

On the theme of Natural Disasters there are three articles found (Di Bucci et al. 2019, Weibgen 2015, Yu et al. 2020) and the articles take different approaches, as outlined in this section.

Di Bucci et al. (2019) look at the acceptable level of risk within civil protection (i.e satisfactory) from a behavioural perspective. This is done by continuing on Di Bucci

& Savadori (2018) article (described more in detail in Section 4.2.4) and exemplifies those findings on the so called L'Aqula trail, where scientists and public officials were found guilty of multiple manslaughter and multiple unintentional serious injuries for having provided inadequate risk assessment and incomplete information to the public regarding seismic risk levels in Italy. This was a result of the aftermath following a major earthquake of M_W 6.3 hitting the central region Abruzzi in Italy on April 6th 2009, causing 309 deaths.

Weibgen (2015) also takes a standpoint in the legal field and is perfectly summarized with the title *The right to be rescued: disability justice in an age of disaster*. This article fits in to the theme of natural disasters as it uses an example of heavy storms and the fairness in access to emergency services (i.e equivalent). However, the emphasis is on legal aspects; hence the article is more described in detail in sections 4.2.2 and 4.2.4.

Whereas the above articles also fall into the legal and decision theme, the article by Yu et al. (2020) does not. Instead, the issue of response time is highlighted, and more specifically emergency response to vulnerable populations during floods that also fit under the theme of natural disasters. The findings reveal significant inequalities between population groups when it comes to provision of ambulance service and fire and rescue response time in England. Flood, coastal/fluvial and surface water scenarios reduce the spatial coverage to all population and subgroups dramatically, however disproportionately for the elderly population. One of the key conclusions by Yu et al. (2020) is the need to highlight the importance of addressing the geography of inequality in emergency planning.

4.2.4 Legal and Decision Aspects (4)

In this theme, there are three articles found (Di Bucci et al. 2019, Di Bucci & Savadori 2018, Weibgen 2015) that are outlined below.

The article by Di Bucci & Savadori (2018) addresses high level political decision-making when it comes to acceptable level of risk in the civil protection field, by taking a behaviour perspective on the process. The process of this decision-making is described as a continuous one which affects through time multilevel levels, - from local to international - and multiple activities. Di Bucci & Savadori (2018) starts by describing different aspects of decision-making when it comes to risk and civil protection. Two dedicated chapters discuss various aspects of the definition of risk and the meaning of *acceptable risk* (i.e satisfactory). One interesting definition of what is safe enough (as cited in Di Bucci & Savadori 2018) states that *A thing is safe if its risks are judged to be acceptable*. This poses an interesting question of who should judge whether a given risk is acceptable or not, and acceptable from whom. This can be illustrated by the following description;

> *The term risk can be read from two points of view. The first one is the people's perspective, from which the idea of chance and possibility is usually emphasized: e.g., talking about the risk of an accident. The second one is the technical perspective, from which, instead, the consequences are usually emphasized, for instance talking about "potential" losses referred to any specific disaster and to its place and time of occurrence. It is worthwhile noticing that the perception of the general population on the meaning of the different risks and of the subtended causes can be very different from that*

of technicians. (Di Bucci & Savadori 2018)

Where the public perception of what a risk is and the acceptable risk, or level of protection, comes from a more intuitive gut feeling that is rather non-forgiving to bigger losses, the expert's view of risk is more black and white (with a clear calculated number) and accepts an amount of loss. This poses a challenge for policymakers as both perspectives need to be addressed and in some cases the public view can change rapidly. Di Bucci & Savadori (2018) continue describing different aspects of civil protection and in particular who and how gets to decide on the acceptable risk levels (i.e. when it is satisfactory). Here the main argument made is that the decision on what is acceptable or not, i.e. what is good enough, has to be made by politicians, however it is also shown why this is not a simple task and that other stakeholders are involved. This is described as the iron triangle of mutually interest. In the three corners of this triangle we find politicians, the scientific community and the *advocates of special interests*. Di Bucci & Savadori (2018) sets a framework on the risk level and decision aspects of civil protection, and these findings are exemplified by Di Bucci et al. (2019) on, the so called, L'Aqula trail as described in the previous Section. A different trail on the theme of equal civil protection plays a main role in the paper by Weibgen (2015). In this case, the state of New York was sued for failing to provide an equal planning and response for its citizens when it comes to PWD. There were several similar events leading up to the class action that deals with the failing to live up to the responsibility towards PWD by New York state before, during and after the Hurricane Sandy, that hit the area in 2012. The article in part examines the moral challenges inherited in disaster planing for PWDs and tries to explain the tendency for the under-planing that exists. Weibgen (2015) then continues to argue that it is not merely morally correct but that it is legally required, and that it is critical for local governments to get their plans in order before the next storm. An in-depth analysis is made that looks into how the PWD "right to be rescued" is legally mandated through existing discrimination acts in the US, i.e. Rehabilitation Act of 1973 and The Americans With Disabilities Act of 1990. The conclusion is made that it is difficult to determine what the Acts require under ordinary circumstances, and that this is an even greater challenge during times of emergency. The following passage in the conclusion part of the article Weibgen (2015), summarizes, in my opinion, the issue, and importance of, providing an agreed equivalent and satisfactory civil protection.

> *Disasters are becoming more and more frequent. As our society confronts more emergencies that test the limits of our capabilities, tough decisions will lie ahead. Although popular media accounts sometimes insist that "[a] tenet of natural disasters is that they choose their victims capriciously and without remorse," the truth is far more disturbing — **we** choose our victims by failing to accommodate their needs. BCID* [Brooklyn Center for Independence of the Disabled] *v. Bloomberg, like the disability rights statutes upon which it is based, serves as a reminder that we cannot settle for what is good enough for most of us if doing so leaves some of us behind.* (Weibgen 2015)

5 Discussion

The literature search was deliberately open-ended to catch what is published to find a cluster of themes and what gaps there may be in relation to what *should/could* be included in the terms equivalent and satisfactory in relation to FRS and civil protec-

Table 5.1: Comparison between two search engines. Searches as per original search strings found in Table 3.1. Scopus' searches were made 2023-02-09 with no further analysis.

#	Search	Web of Science	Scopus
1	FRS		
2	Equivalent		
3	Satisfactory		
4	#1 AND #2	1621	24 311
5	#1 AND #3	954	7842
6	#1 AND #2 AND #3	112	1702
	Total:	2687	33 855

tion. Although the terms, per se, were not always specifically discussed in detail, the largest theme was found to be the one of time and spacial distribution of emergency centrers. The articles found all try to solve this problem mathematically with different approaches to identified challenges. The rest of this section discusses aspects that impact the result of the literature search.

5.1 Literature Scope

This literature overview is not meant to be a complete systematic review as it is missing gray literature where valuable input may be found as the aspect of equivalent and satisfactory and civil protection, at least in a Swedish context, is a question of a legal framework. Hence, by reading through the proposals and bills leading up to LSO a better insight from a regulatory point of view on the subject could be found. However, this would at this stage contradict with the broad search purpose intended. On the subject of literature scope, it could be argued to use a broader or more specific academic search engines for the search. A quick comparison (after the analysis) between two databases Web of Science (used) and Scopus[8] (possible alternative or complement) was made and the comparison in number of hits is shown in 5.1.

There was no consideration made on the chose of database, and Web of Science was simply chosen as this is the more common used by the division of philosophy at KTH. The difference between the two search engines is described by ChatGPT as follows;

> *Asked question: What is the difference between web of science and Scopus search engines?*
>
> *Web of Science and Scopus are both large databases for scientific and scholarly research. They are used by researchers, librarians, and students to search for journal articles, conference papers, and other types of academic literature. However, there are some differences between the two:*
>
> 1. *Content: Web of Science has a larger database, which includes a greater number of journals in the natural sciences and social sciences. Scopus, on the other hand, has a wider range of journals in the field of engineering, technology, and medicine.*
> 2. *Indexing: Web of Science uses a more selective indexing process and*

[8] https://www.scopus.com/

only includes articles from journals that are deemed to be of high quality and prestige. Scopus is more inclusive and indexes a wider range of journals, including those from smaller publishers and open access journals.

3. *... [evaluation metric described]*
4. *... [user interface described]*

In summary, both Web of Science and Scopus are valuable resources for academic research, and the best one for you will depend on your research needs and the type of literature you are looking for. https://chat.openai.com/chat[9]

Although the search results may result in a different set of articles to analyse, the general findings are not considered to differ that much at this stage in the research. On the other hand, it might have been better to start off with a bigger and broader set. That being said, more careful consideration of search engines needs to be done when a sound research question is formulated, as more targeted and specific articles may need to be searched for.

5.1.1 Gray Material

The search does not claim to be complete, as in the case of the search engine used, some articles may have been omitted. Furthermore, a deliberate choice was not to include gray material, i.e. scientific unpublished material. For this particular search question and context, there are unpublished papers or reports such as governmental bills, tender documents or academic papers that may shine a light on the problem. Such gray material is important because it should show the legislative intentions and values that have or have not been considered in concluding the main goal of the FRS. Complementing this search with an in-depth analysis of such documents is a natural next step. That being said, those documents may also lead to published peer review documents that have not been found through the relative narrow search (in terms of search terms) described in this document.

5.2 On the Matter of Words

The search terms originate from a Swedish regulatory setting (i.e. LSO) that uses Swedish wording. These have specific meanings, but could be substituted with synonyms that describe the same phenomena. The official English translation was used as a starting point and by including a set of synonyms and antonyms the search was made broader, inevitably this makes an impact on the search result. The small number of hits might mean that other terms might be used as well. The search terms were adopted in accordance with initial trail searches and consulting peers and other scholars to obtain a well-balanced set of reasonable terms to begin with.

As identified in 4.1 the majority of the articles cover the aspect of equivalent however the used term is more framed as fairness and right to get rescued/be protected against incidents that pose a threat to life, and 10 of 12 analysed articles were discovered by this search term. It seems there are two approaches to describing fairness on a general level. One is on the individual level and one is on a group or community level. I would

[9] ChatGPT Jan 30 Version (2023-02-09)

argue that these approaches are not mutually exclusive, and instead show two different sides of the coin that need to be accounted for.

Although a synonym term, equal, was included, it is important to emphasize that equal is not the same as equivalent. As equal implies as stricter similarity than equivalent that is more open for alternative approaches with the same result. I would argue that this word is used intentionally in the legislative framework of LSO, to open up for different and adopted solutions for providing a *.../civil protection, with consideration of local conditions/...* (SFS 2003:778, chap.1 §1). And more importantly, this implies the need to explore and weigh different dimensions against each other to fulfil the intention of an equivalent and satisfactory civil protection.

As shown in the legal decision theme (see Section 4.2.4) personal governmental liability has been concluded for not providing a satisfactory civil protection to the public, and in one case (Weibgen 2015) the protection for PWD is concluded non- satisfactory on a equivalent basis (equal right). This would imply that equivalent could be seen as a dimension of satisfactory, in other words, if the civil protection is not fair and considers all citizens or communities needs adequately (equivalent), it cannot be considered satisfactory.

5.3 GAP

The main purpose of this literature search has been to act as support and guide for formulation of a sound research question(s) for PhD studies. Although the search (as described) is incomplete and has to include additional literature, it does provide valuable insights. It can be concluded that relatively little literature discusses the terms satisfactory and equivalent in relation to FRS or civil protection in a broader sense, and instead focuses on specific dimensions or aspects to solve problems or questions of interest.

Depending on the country, the regulatory framework provides guidance, in some cases requirements are *hard* and in others are more open-ended on exact solution. I would like to argue that there is a set of general dimensions and aspects that need to be considered when designing and evolving the way an FRS operates before, during and after an incident to maintain satisfactory and equivalent civil protection. In addition, the emphasis of these dimensions and aspects need to change and be adopted to local conditions and over time to accommodate for the fast-changing complexity of the modern world. As the literature search shows, there is a GAP in the published literature and that very little is found that addresses the intent and meaning of a satisfactory and equivalent civil protection.

6 Conclusion

Based on this literature search, the results indicate that there is not much research done that describes or discusses the terms satisfactory and equivalent in relation to civil protection or FRS. In the majority of the found literature, the terms are only mentioned or briefly discussed as a background to show that there is an unfairness when it comes to the utilization and access to emergency services to motivate and look into a specific identified problem. That being said, there are two articles found that stand out in this part (Di Bucci & Savadori 2018, Weibgen 2015) as these provide a more thorough background and do discuss the complexity of both philosophical

and moral aspects combined with the legal parts while providing a equivalent and satisfactory civil protection.

The literature search described in this document serves as a good starting point and provides valuable insight into the existing published literature in the field. This information will be used moving forward, eliciting a sound research question. The findings suggest that there are philosophical aspects to be explored regarding FRS and the level and type of civil protection provided. I believe that it is necessary and possible to identify high-level key dimensions and aspects. And to demonstrate progress towards the goal of providing a satisfactory and equivalent civil protection, such key dimensions would need to be included and discussed in various degree, both in strategic planning and day to day activities. It is only when we can demonstrate to have been actively accounting for and working with such dimensions that we can say that the service provided is equivalent and satisfactory. By doing so, we are one step closer to answering the opening question and agree that the response from the public organizations is satisfactory, equivalent when it comes to civil protection. Results from this scoping review indicates that such dimensions and aspects would need to be drawn from, but not necessary limited to, the four found themes; (1) minimizing time to arrival (2) working with and identifying vulnerable people/groups (3) preparing for natural disasters in an inclusive way and (4) paying attention to behaviour decision aspects and deciding on acceptable risk levels. Also, worth noting is that the literature in addition suggests that such dimensions need to be valid for all the civil protection phases, meaning pre-planing, operational (during incident) and post incident phases.

The underlying aspects may even be applicable outside the responsibilities of the emergency service organizations (such as FRS), depending on the local and/or national legal framework setting. A recent example of this is the building code environment, where poor implementation of seismic regulation, is a plausible contributing cause of the horrible aftermath of the February 2023 earthquakes in Turkey, and that this probably had an impacted on the level of equivalent and satisfactory passive civil protection provided.

6.1 Next Step

In the context that this paper is part of an introductory course for a PhD meant to identify a way forward, it is valuable to make a brief comment on the next step. The findings indicate that the published literature is short on a more holistic and philosophical approach on dimensions and aspects to consider when discussing a equivalent and satisfactory civil protection. The natural next step is to look into the gray material in a structured way to identify the dimensions considered behind the formulation of the main goal paragraph of the Swedish Civil Protection Act. A suggestion is made to identify such dimensions and aspects from a more general point of view that could be considered valid for all types of emergency services (or agencies/organisations that work with civil protection) and not only to the traditional tasks of an FRS. This is as the values behind the general goals for providing a equivalent and satisfactory civil protection could be argued, at this stage, to be valid regardless of the specific tasked organisation.

A Tables

Table A.1: Nine additional articles found in search that did not make inclusion criteria but fit into the theme of Time and Spatial Distribution

Author(s) and Year	Article Title
Di Caprio et al. (2022)	A Novel Ant Colony Algorithm for Solving Shortest Path Problems with Fuzzy Arc Weights
Janacek & Kvet (2018)	Min-Max Fair Emergency System with Randomly Occupied Centers
Mattsson & Julås (1997)	The Importance of the Time Factor in Fire and Rescue Service Operations in Sweden
Nyimbili & Erden (2020)	Gis-based Fuzzy Multi-criteria Approach for Optimal Site Selection of Fire Stations in Istanbul, Turkey
Park et al. (2016)	First Responders' Response Area and Response Time Analysis With/without Grade Crossing Monitoring System
Wang et al. (2016)	A New Partial Coverage Locating Model for Cooperative Fire Services
Wang et al. (2021)	Emergency Facility Location Problems in Logistics: Status and Perspectives
Xu et al. (2021)	Evaluating Spatial Configuration of Fire Stations Based on Real-time Traffic
Zhang et al. (2017)	Covering location problem of emergency service facilities in an uncertain environment

Table A.2: 12 articles distributed over WoS field categories, one article can belong to several categories.

Web of Science Categories	Record Count
Operations Research Management Science	2
Business	1
Computer Science Cybernetics	1
Economics	1
Engineering Civil	1
Environmental Sciences	1
Environmental Studies	1
Ergonomics	1
Geochemistry Geophysics	1
Geography	1
Geosciences Multidisciplinary	1
Green Sustainable Science Technology	1
Law	1
Materials Science Multidisciplinary	1
Meteorology Atmospheric Sciences	1
Rehabilitation	1
Transportation Science Technology	1
Water Resources	1

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