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PERCEIVED AND ACTUAL RISKS IN THE GEMIENDE FÄLLANDEN

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A Study of the Perceived And Actual Risks In Gemeinde Fällanden

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Abstract

Fällanden's fire brigade asked WPI to determine public opinion of the fire brigade, risks facing the Gemeinde, and to examine the decline in Brigade volunteers. We used statistics, interviews, and questionnaire results to determine the actual and perceived risks facing Fällanden. The research demonstrates that perceived and actual risks do not coincide. In order to determine the actual risks it's necessary to combine all aspects of risk present in that community and vulnerability, and that recruiting is a worldwide problem.

Introduction

Risk is inherent in our everyday lives. Whether it be a result of a personal act, the local environment, or the particular moment in time it is impossible to completely escape the reality that we are constantly at risk. Although this is a universally known concept, it is a concept that is often overlooked by people in their everyday lives.

Though risk is present in every situation and setting it varies considerably depending upon a variety of factors. These factors include the nature of the activity itself, the people that perform it or those affected by it, the location where it unfolds, the resources used, time of day or year, and much more (Community-wide Vulnerability and Capacity Assessment [CVCA], 2001). Therefore, to perform an accurate risk assessment of the entire community, it is necessary to identify those factors which the citizens themselves feel to be risky, as well as identifying scientifically those factors which are specific to that community, that make a community vulnerable to risk.

The Fire Chief in the Gemeinde Fällanden, Switzerland seeks an assessment of the actual risks present within his community. The chief also asked for the opinion that the citizens have of the fire brigade based on the brigade's ability to respond and mitigate risks the community feels are important. This study investigated these aspects of the community and examined them along with actual risks present in the community.

This article begins by exploring factors that can make a community vulnerable to risks that the fire brigade is responsible for protecting against, the models used to both quantify and qualify our results, and the methods used to collect this data. Next, we have reported the results that we obtained from a risk analysis, vulnerability study, and the perceptions of the citizens from the mail questionnaire. In order to find the Gemeinde's vulnerability to risk we looked at data specific to the community such as socio-economic, ethnic, and age composition of the community, environmental factors, and those factors which would impede a prompt response by the fire brigade. Next, the results from our risk assessment and perception of risk questionnaire provide for a comparison between the risks that exist in Gemeinde Fällanden, and what the residents in Gemeinde Fällanden perceive as risks. Finally, this paper suggests plans and proven methods of action designed to help the fire brigade prepare for future risk.

Research Context

Gauging the level of satisfaction that a community has with its public service institutions is not a novel area of study. Different communities conduct this type of analysis in an attempt to determine whether or not their public service institutions are dealing with the specific risks and general desires of the members of the community. It is our goal not only to gauge the community's level of trust and satisfaction with the fire brigade's level of protection, but also to determine whether or not brigade volunteers are protecting their jurisdiction from the risks and vulnerabilities present.

Risk and Vulnerability

Before it is possible to determine whether or not a particular public institution is adequately prepared to meet the risks that it faces, it is first necessary to have a uniform definition of risk. According to Elspeth Young of the National Centre for Development Studies at the Australian National University (1997), risk is composed of two major components, the likelihood of an event occurring and the consequences that result from the occurrence of this event. Fire and medical emergencies are risks that can be found in any community and the severity of these risks depends on the likelihood of the emergency's occurrence and the amount of human life and dollars lost from the occurrence of these emergencies. It is thus important to be able to gauge risk, and have pre-drawn plans and procedures for dealing with emergencies in an attempt to lower the severity of the consequences.

Risk severity reduction is an important function of fire brigades. This function is carried out through decreasing the number of events that lead to emergencies and by controlling dangerous situations through fire prevention, suppression and rescue methods (National Fire Protection Agency 1201 [NFPA], 1989: p. 6). According to the Gebäudeversicherung Kanton Zürich (GVZ (www.gvz.ch)), a Swiss insurance agency that is in charge of regulating the fire brigades of Kanton Zürich, Swiss fire brigades are "obligated to the rescue of humans, animals, and real values as well as to the damage control with fires, explosions, and elementary events. It renders help with oil-, to chemistry and jet events".

It has to be understood however that regardless of the requirements of a fire brigade to reduce the level of risk in a community, risk can never be completely eliminated, and that not every member of a community is affected by risk in the same way. These facts lead us to an important discussion of the concept of vulnerability and how this alters the risk experienced by a community or different groups within the community.

A working definition for vulnerability is the likelihood of a certain subgroup of a community to be affected by risk. The technical definition of vulnerability is " people's differential incapacity to deal with hazards based on the position of groups and individuals within a physical and social world [with the underlying theme that] not everyone suffers equally." (Anderson and Woodrow, 1991). Factors that can make a group more vulnerable are age, family structure and social networks, education, housing and building structures, income and material resources, lifelines, and ethnicity (Clark, 2002: 4). Some examples of groups within a community that are at a higher level of vulnerability for fire deaths are children under 5, adults over 59, people who reside in one and two family residential dwellings, minorities, and men (US Fire Administration, 1998).

By analyzing trends in the United States, it has been established that these groups are at an increased vulnerability to fire death. According to the Office of Critical Infrastructure Protection and Emergency Preparedness in Canada, these vulnerability factors can be assumed to be universal throughout different cultures and geographical locations (Kuban, 2001: 3). It is important to note that not everyone in a generalized vulnerability group is necessarily vulnerable. It is possible for one to label groups as more vulnerable because, in general, most people within these groups have similar qualities that increase their vulnerability (e.g. elderly people generally have more trouble

evacuating in the event of a fire thus increasing the group's vulnerability). The vulnerability a group faces can be lowered by different elements within the community however, which will be explained below.

Community Aspects Affecting Vulnerability

The social networks of a community (social interactions between community members) greatly affect the level of vulnerability experienced by a community. These networks have an influence on the level of vulnerability with regards to the sharing of rebuilding costs, warning of disasters, perception of risks, and the behavior of a community when facing a potential disaster (Drabek and Key, 1984). A close-knit community will tend to fair better in a disastrous situation because the citizens will all know each other in some way or another and thus have a higher tendency to warn and help fellow community members in the face of a disaster.

Community groups are a form of a social network that allows people of a village to come together to support an idea or group, and therefore increases the closeness of the community. Fällanden has a large number of community groups that range from sporting clubs to activist groups and local groups that focus on the continued well being of the community (Hirt, 2002). An important example of a community activist group that is present within Fällanden is Flugschneise Süd Nein. This is a group that was created in July of 2002 with the intention of increasing public awareness of the proposed change in flight paths of planes arriving in Zürich airport from the north to the south (which means that planes would be flying directly over Gemeinde Fällanden at a very low altitude). This community group, which is opposed to the proposed alterations, started out with very few members, but rapidly increased in membership over the next few months. This group now consists of over 800 members residing within the Gemeinde Fällanden and surrounding towns. This rapid increase in membership shows a sense of common concern felt by the members of the community towards this issue, and a shared sense of concern being felt by other communities surrounding the Gemeinde. It is important to have the support of surrounding communities as well as simply having an inter-supportive community, since this would allow for the presence of mutual aid agreements throughout a region.

As with any fire department, there are limits to what Fällanden's fire brigade is capable of handling. This makes it necessary for the fire brigade to rely on outside help in the event of a large scale emergency. The GVZ states "each fire brigade is obligated to the assistance outside of their operational area." Fällanden's fire brigade has a plan in place with the relatively close city of Uster, which has a larger fire brigade with increased capabilities, which obligates Uster's fire brigade to come to the assistance of Fällanden's fire brigade if it is deemed necessary by Fällanden's fire chief. Once Uster's fire brigade has arrived to the scene of the emergency it is then their responsibility to call for more assistance if it is deemed necessary (Maurer, 2002). The presence of mutual aid agreements such as this is just one of the many factors that goes into having a well protected community and works to increase the effectiveness of lifelines present within the community.

Lifelines are resources that exist in a community that are designed to reduce risks to the community's citizens. Lifelines that are present within a community include transportation, communication, utilities, emergency response teams (including, but not

limited to, fire brigades) and hospitals. It is intuitive that all of these lifelines help to lower the vulnerability experienced by a community, but what may not be as obvious is that these lifelines may also have negative effects on the level of vulnerability (if they provide inadequate services). For example, if a community has an excellent transportation system the benefits could be lost if traffic build-up impairs travel. Under normal circumstances, however, lifelines can prove invaluable to a community's public service institutions. In general, the efficiency of these lifelines will have a direct effect on the level of vulnerability experienced by a community (NRC, 1984; Platt, 1991). It will be necessary to evaluate these different lifelines within the village of Fällanden so that we can further assess the vulnerability of the village.

Building structures are also an important factor in determining the level of vulnerability experienced by a community. For example, the presence of strict building codes will provide standards for how a structure or building can maintain it's strength and allow for escape in the event of a fire. The spatial layout of different structures can also lead to the spreading or the containment of a fire (i.e. the density of residential zones). Finally the materials used to construct a structure will have a great effect of how this structure will hold up in a fire (Bolin and Bolton, 1986; Godschalk, Brower, and Beatley, 1989). The GVZ has very strict building codes that address all of these previously mentioned issues. By assessing the fire prevention practices that were followed in the construction of different structures that people inhabit within Gemeinde Fällanden, we are able to determine the risks posed to these residents and assess their vulnerability to fire.

The level of risk education available to the citizens can also affect the vulnerability experienced by a community. For example, it has been proven in the United Kingdom that when fire education programs are offered to the community the incidence of accidental fires decreases (James, 1986: 24). In an attempt to educate the citizens of Fällanden of the risks facing them, it will be important to have knowledge of educational programs that have been implemented in other neighboring towns. If we determine that there is a lack of adequate fire safety and prevention education present within Gemeinde Fällanden it will be possible to conclude that the vulnerability of the community in respect to fire deaths would increase.

Through the determination of these different aspects of Gemeinde Fällanden we established how vulnerable the citizens of Fällanden are to identified risks. The level of vulnerability will then be used as a basis for a risk assessment procedure in an attempt to determine the severity of the different identified risks within the community. It is thus necessary to examine the different type of risk assessment models that are available for evaluating the severity of different risks to the community.

Review of Risk Assessment Models

The EPC model of risk assessment, which is introduced in great detail in The Evaluation of Peacetime Disaster Hazard (Emergency Preparedness Canada, 1992), is a simple assessment model that follows seven steps. These steps include creating a list of hazards, collecting historical data about the different hazards, ranking these hazards according to a comparative relative scale, determining what factors within the community that affect the probability of the occurrence of the hazard, giving these factors a value from -3 for significantly reduced risk to +3 for significantly increased risk, determining external

factors that affect the probability of the occurrence of the hazard, and ranking these in the same manner as the community factors. This risk assessment procedure is effective because it involves different factors within the community and external to the community that can affect the occurrence of risks. Including this factor in the risk assessment procedure is helpful because it gives the probability more of a realistic basis, but the values that should be given to these different values are chosen on an arbitrary basis.

The Awareness and Preparedness for Emergencies at Local Level (APELL) model is "based on the 1989 *Swedish Rescue Services Board Handbook* and refined by the United Nations Environment Program Industry and Environment Program Activity Center (UNEP) (1991). It is primarily aimed at reducing technological accidents and improving emergency preparedness" (Pearce, 2000). This risk assessment model involves choosing an object of study, determining what operations are being conducted at this object, listing the items capable of producing a hazard, determining the risk types, determining who would be threatened, considering the consequences of the occurrence of this event, examining and ranking four possible consequences (life and health, environment, property, and the speed of development of the hazard), determining the probability of the occurrence, and looking at the rankings for each of these categories (Pearce, 2000). This risk assessment model, although very systematic in its approach, is not very helpful for the type of study we are conducting. This study is interested in looking at the effects of certain risks to Gemeinde Fällanden, not the different risks facing different objects of study (such as industrial facilities, schools, etc.) that is the main focus of the APELL model.

Australia's Ministry of Civil Defense and Emergency Management's Seriousness, Manageability, Urgency and Growth (SMUG) risk assessment model is another model that we evaluated. This risk assessment model assesses each risk according to five factors, each of which is ranked from 1(low) to 10(high). The five factors that are explored when using this model are; the relative impact of the risk in terms of monetary value and people, the manageability of the risk, how quickly after the risk takes place does action need to be taken, the probability of the risk occurring and the chance of growth from the consequences of the risk. This risk assessment model is more useful for consultants or other people interested in the effects different risks have on business type operations, and thus would not be very helpful in determining the level of risk experienced by the community.

The National Oceanic and Atmospheric Administration (NOAA) model involves an eight-step process that allows a group to conduct a community wide risk assessment. Each step within this process concentrates on a separate factor of the community. These steps include; risk identification, risk analysis, critical facilities analysis, societal analysis, economic analysis, environmental analysis, mitigation opportunities analysis, and finally the creation of a results summary. This model provides a very in depth risk analysis procedure that looks into nearly every risk affecting aspect of the community. Key to the success of this risk assessment model is also the introduction of risk mapping, which involves locating areas within the community that have a high risk potential and marking them on a community map. Ideally, this would have been the model that we would have used in this study, but unfortunately the lack of data and time constraints made the use of this model impossible.

It was discovered shortly after beginning the review of the United Nations Disaster Relief Organization (UNDRO) model that this model that is only applicable to natural hazards and only one technological hazard (i.e., pollution from damage to industrial plants). Although the assessment of different natural hazards to determine the risk posed to the Gemeinde is an important process, this is not within the scope of this study and thus we determined the UNDRO model was of little use.

Next, we examined the Hazard Impact Risk Vulnerability (HIRV) model. This risk assessment model is a tool that was designed for local communities and regional governments that relies heavily on the knowledge provided by local experts. It is thus necessary for the creation of a broad-based committee of experts in order to complete the HIRV method. This creation of a broad-based committee is beyond our capabilities due mostly to the presence of a rather large language barrier and thus will not be used by our study.

The final risk assessment model that we reviewed was the Federal Emergency Management Agency (FEMA) model. The FEMA model assesses four different categories for a given risk, and each of these categories is given a rating. These different ratings are then scaled according to the weighting value given to each of the categories and a total risk score is determined for each specific risk (this is done by adding the scaled ratings for each of the categories). The different categories that are rated are; the history of the occurrence of a risk, the vulnerability of the citizens to the occurrence of a risk, the maximum degree of threat posed by a risk, and the probability of the occurrence of the risk over a period of a year. Different criteria are used within the rating process for each of the different categories allowing for a rigorous rating procedure (as opposed to the arbitrary rating procedures of some of the other risk assessment models). Finally each category's rating is multiplied by scaling factors (history is given a 2, vulnerability is given a 5, maximum threat is given a 10 and probability is given a 7). This scaling aspect of the risk assessment model is very important since it actually looks into the importance of each of the categories with respect to each other.

We determined that the FEMA risk assessment model is the most appropriate for our study, and thus it is the model we used for the assessment of the actual risks we found to be facing Gemeinde Fällanden. We decided to use this model because we were able to obtain the information that it required about each risk and so it could be a complete assessment. Understanding the actual risks facing Fällanden is important, but it is also important to understand what the citizens of Fällanden perceive to be the significant risks they face.

Public Perceptions of Risk

All of the previously stated vulnerability factors that affect vulnerability also influence the actual severity of a risk, but it is important to note that sometimes the actual severities, that are calculated through our risk assessment procedure, do not necessarily coincide with the publicly perceived severities of risks. It is thus clearly apparent that there must exist some phenomenon that causes this discrepancy. The idea of social amplification is introduced by Kasperson (1992) in an attempt to describe this phenomenon.

> *Social amplification is based on the fact that events pertaining to hazardous events and disasters interact with the psychological, social, institutional and cultural processes in ways that can either heighten or lower the perceptions of risks and shape risk behavior. Behavioral responses extend beyond direct harms to human health or the environment to include specific indirect impacts such as liability, insurance costs, loss of confidence in institutions, stigmatization or alienation from community affairs. It is these secondary effects that can often lead to demands for additional institutional responses and protective actions, or place barriers in the course of providing needed protective actions. (Kasperson 1992, 158)*

This theory of social amplification is useful to our study because it allows us to conclude that a discrepancy between perceived and actual risk severities indicates that some social issue is present that is affecting what the citizens of the Gemeinde perceive to be risky. Therefore, by obtaining the publicly perceived risk severities and comparing these to the actual risk severities, we will be able to determine whether or not social amplification is present within the Gemeinde. The existence of social amplification (or the lack of social amplification) will give us some insight into the actual mentalities of the citizens of Gemeinde Fällanden and allow us get a good idea of the public's perception of the fire brigade and its capabilities.

Methods

We used two different research methods for this study. The first method we used to determine the actual risks facing the Gemeinde Fällanden. The second method we used to determine the perceived risks in the Gemeinde Fällanden.

The first step that we took in determining the actual risks in the village of Fällanden was to interview the Fire Chief of Gemeinde Fällanden, Ruedi Maurer, to gain an understanding of how the fire brigade works, the responsibilities of the fire brigade, and to get some more background on the community that the fire brigade protects. We conducted three other interviews with leaders of the community and an activist group in Fällanden, and a fire chief in a neighboring town. The interviews of the Gemeinde officials and the representative of the community group helped us understand the community itself, and what sorts of vulnerabilities and risks they face. The interview of the fire chief from another town gave us a different perspective on how another Swiss fire brigade operates not only in terms of procedure, but also in recruiting and education. Throughout the study we also collected statistical data on the risks that we determined may be most prevalent in the community; automobile accidents, a plane crashing into the community, residential fires, and industrial accidents.

After we collected this information about the community it was then possible to attempt to determine the actual severities of the risks facing the community. To do this we used the FEMA risk assessment model because it is not only universal in nature, but also because we were able to adapt it to the data that we had available to us. Collecting data to determine the actual risks in the village of Fällanden was complicated due to the

fact that much of the data we needed, such as statistics about average family size, tax distributions, fire death and injuries, property loss due to fires, and number of fires in the Gemeinde, Kanton, and country, was not available (the Kanton statistics office had no such records and the fire brigade only had emergency records for the years 2002 and 2001).

To assess Fällanden's perceived risks we used a mail questionnaire. This questionnaire was designed so that we could determine the risks that the citizens of Fällanden are most concerned with, as well as some reasons that members of the community have not joined the fire brigade. We hand delivered 620 (18.75% of total residents) questionnaires to different residences throughout Gemeinde Fällanden. We distributed a proportional amount to each of the three villages based on the percent of the total population that each village makes up. The questionnaires included a self-addressed, stamped envelope for easy return. The sample that we used was all of the households that had a listed telephone number. We then assigned a number to all of the addresses, and used a random number generator to select our sample for each village. Our response rate of 31.6% was also nearly proportional amongst the three villages. Out of the 196 questionnaire's returned by the cut off date 46.9% came from village Fällanden, 24.5% came from Benglen, and 28.6% came from village Pfaffhausen. See appendix B for the questionnaire, C for specific survey data, and D for specific questionnaire distribution methods.

The final step of our methods was combining our data into a vulnerability map. This map is intended to show areas within Gemeinde Fällanden that have been proven through our study to be at a relatively high vulnerability to risk. The following results show first the demographic breakdown of the Gemeinde Fällanden. Next, we present the results of our risk analysis study, followed by the results of our perception of risk questionnaire. Finally, we conclude with the results from our vulnerability assessment, and vulnerability map of Gemeinde Fällanden.

Results and Analysis

Composition of the Population of Gemeinde Fällanden

Since risk does not affect everyone equally it is very important to know what factors make a certain group most vulnerable and the extent to which these groups are present in a community. This section describes the various groups present within the population of the Gemeinde and the overall composition of the Gemeinde. This information proved useful in our determination of the different vulnerabilities groups within the Gemeinde.

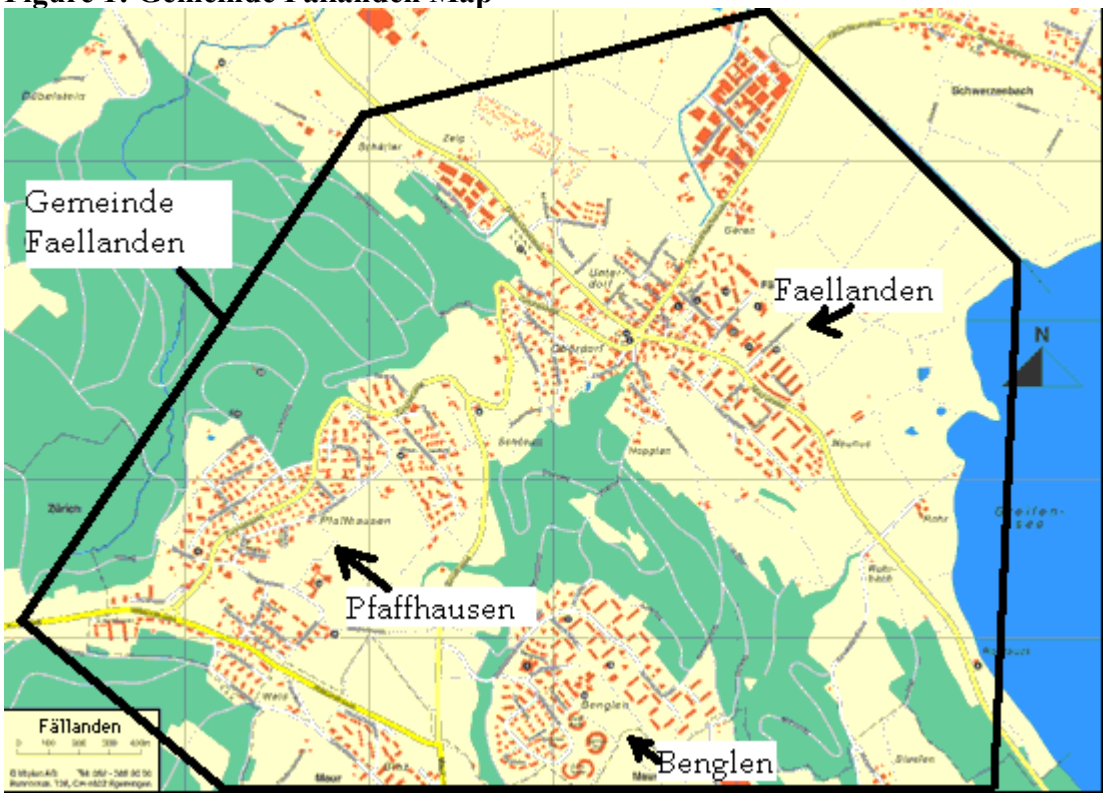
The total Gemeinde population is 6596, 43.54% of the population resides in Fällanden, 29.99% of the population resides in Benglen and 26.49% of the population resides in Pfaffhausen (see Table 1). 50% of the Gemeinde population is over the age of 41 and, more importantly, 20.2% of the Gemeinde population was over the age of 59 and 5% of the Gemeinde population is under the age of 5. It was previously mentioned in the context section that people over the age of 59 and under the age of 5 have a higher vulnerability to fire death, so the large presence of this group within the Gemeinde shows a high vulnerability to fire death.

Table 1: Population Composition

Category	Number of Citizens	Percent of Population
Population of Fällanden	2872	43.54%
Population of Pfaffhausen	1747	26.49%
Population of Benglen	1977	29.99%
Male	3185	49.6%
Female	3235	50.4%
Swiss Natives	5307	80.5%
Non-Swiss	1113	19.5%
1-5 Years of Age	302	5%
6-17 Years of Age	781	12%
18-40 Years of Age	2107	31.94%
41-58 Years of Age	1897	30%
59+ Years of Age	1333	20.2%

Source: Gemeinde Fällanden census data

Figure 1: Gemeinde Fällanden Map



Source: Gemeinde Fällanden Webpage

Actual Risk Assessments

This section assesses actual risks facing Fällanden, based on our use of an adapted version of the FEMA risk assessment model. We found through our assessment

procedure that the risk with the highest impact on Gemeinde Fällanden was plane crashes, with a total risk score of 159 (see Table 2 for compiled results).

It is important to note however that the main reason for plane crashes having such a high risk score is that this risk has the highest maximum impact score. The worst-case scenario of a plane crashing into the center of Fällanden would be devastating, but the probability and history aspects of this risk show that there is next to no chance of this event actually occurring. It is true that the fire brigade could attempt to invest in equipment that would expand their capabilities in the event of this sort of emergency, and thus lowering the extent of devastation that would be caused by this type of accident, but this would be an ill-advised course of action. If a plane were to crash into Fällanden there would be little that could be done by the fire brigade even if it had the capabilities to deal with the results of a plane crash, since all any fire brigade would be able to do in the event of a plane crash is contain and suppress the resulting fire. It is thus our recommendation that the Gemeinde and citizens of the Gemeinde should not become overly concerned with this risk, despite the fact that plane crashes received the highest score according to the assessment using the FEMA model

The other risks that we assessed using an adapted FEMA model were residential fires, industrial accidents, and automobile accidents. Automobile accidents are the risk with the second highest risk score 87, followed by industrial accidents with a risk score of 84, and residential fires with a risk score of 69. The assessment sheets for each of the indicated risks along with explanations for our reasoning for our scorings as well as the adapted parameters and scoring procedures for our adapted FEMA model are shown in Appendix A. Below Table 2 is a brief commentary on the analysis for each of the identified risks.

Table 2: Compiled Risk Assessment Results

Assessed Risk	History Category Score (X 2)	Vulnerability Category Score (X 5)	Maximum Threat Category Score (X 10)	Probability Category Score (X 7)	Total Risk Score
Plane Crashes	Low Score: 1	High Score: 10	High Score: 10	Low Score:1	159
Car Accidents	High Score: 10	High Score: 10	Low Score: 1	Low Score: 1	87
Industrial Accidents	Low Score: 1	Medium Score: 5	Medium Score: 5	Low Score: 1	84
Residential Fires	Low Score: 1	High Score: 10	Low Score: 1	Low Score: 1	69

Source: data collected from team

The first identified risk that we assessed using the adapted FEMA model is plane crashes. We obtained information regarding the number of plane crashes in Switzerland during the ten-year period 1990-2000 through the database located on www.planecrashinfo.com. We found that three plane crashes have occurred in Switzerland during the ten-year period, but no ground deaths or serious injuries had resulted from these accidents. Since we are only concerned with ground deaths or serious

injuries to people on the ground in the event of a plane crash, the history of ground deaths related to plain crashes in Switzerland over the ten year period was zero and thus receives a low rating.

To determine the vulnerability of the citizens of Fällanden we used maps of the proposed flight paths superimposed over maps of Gemeinde Fällanden (this map was made available to us by Flugschneise Sued Nein and by the Unique airport homepage). This map shows that the entire Gemeinde Fällanden will be located under the new flight path and thus the entire Gemeinde would be vulnerable to death or serious injury as a result of a plane crash, giving this risk a rating of high for vulnerability.

The maximum threat of the alteration of the flight paths is a plane crashing directly into the center of Fällanden. The results of such an accident would be devastating due to the densely packed arrangement of residences and businesses (including a saw mill and many old wooden buildings) in the central Fällanden area and the fact that the fire brigade lacks the capability to deal with a jet fuel fire. According to the FEMA risk assessments model the devastation that would result from the occurrence of this event results in a high maximum threat rating.

The final category used to determine the risk score for plane crashes was probability per year of the occurrence of this risk. We scaled down the number of crashes that occurred in Zürich over the past ten years (2) to represent the number of planes that theoretically would have crashed in Fällanden over the ten-year span using a population proportion ratio. We then reported this number of planes on a per year basis and then used this with the number of landings at Zürich airport per year to obtain the probability of a plane crash within the Gemeinde; this probability was small enough to receive a low ranking. We then applied the scores for each of the rankings and the weight that each of the categories received to this risk to give the risk of ground death or serious injury as a result of a plane crash an overall risk score of 159.

The next identified risk that we assessed using the adapted FEMA model was the risk of death or serious injury as a result of an automobile accident. A lack of data for the occurrence of automobile accidents in Gemeinde Fällanden forced us to use a proportional approach for the history aspect of car accidents. We obtained the total number of deaths and serious injuries resulting from automobile crashes for the ten-year period 1990-2000 for the Kanton of Zürich. We then multiplied this number by the ratio of Fällanden's population to Kanton Zürich's population to give us an estimate as to the number of deaths or serious injuries resulting from a car accident in Gemeinde Fällanden over this ten-year period (185). This estimated number of automobile accidents within Gemeinde Fällanden over the ten year period gives the history aspect of this risk a high rating.

We determined that every licensed driver is vulnerable to the risk of automobile accidents. This means that the vulnerability aspect of this risk would receive a high ranking according to the FEMA model's parameters. We determined the probability of the occurrence of this risk for a one year period by using the estimated number of automobile crashes within the ten year period, scaling this down to one year and dividing this number by the number of citizens within the Gemeinde. We found this probability to be 0.0028, which received a low rating according to the FEMA model. The final aspect of this risk that had to be ranked was the maximum threat. This aspect deserves special

consideration as to what factors cause serious injuries and deaths as a result of an automobile accident.

Most deaths or serious injuries that result from automobile accidents occur in head on collisions at high speeds. It is important to note that the main intersection in Gemeinde Fällanden with the most traffic is a traffic circle, which decreases the chance of high speed and head on collisions. All other roads within the Gemeinde are two lane residential roads where speeds are kept relatively low. This allows us to say that the worst case scenario is a 4-way intersection where four cars at full capacity are traveling at a relatively high rate of speed and collide simultaneously. This assumption can be made since we are dealing with the maximum threat due to this accident, it is very unlikely due to the nature of the transportation system within Fällanden that this scenario would actually occur, and thus this maximum threat serves as an upper bound to the risk. We are also assuming that the full capacity for these four cars would be four people. This assumption is justified by the fact that the majority of vehicles within the Gemeinde are relatively small vehicles. It would thus be concluded that 16 people would be seriously injured or killed in the event of this accident which is a very small percentage of the entire population of Fällanden thus giving this risk a low rating for the maximum threat aspect. We then calculated the final risk score for death or serious injury as a result of a car accident using the rankings for each of the aspects and found to be 87.

Death or serious injury as a result of an industrial accident was the next risk that we assessed. Data as to the number of occurrences of industrial accidents over the past ten years was available to us and we found the history aspect of this risk to be low (only one occurrence over the ten year period). We determined the vulnerable area of the Gemeinde to be the two industrial sections, which are separated from each other and the other residential sections of the Gemeinde. These two industrial areas have a surface area of 0.45 kilometers which only makes up 5.602% of the total surface area of the Gemeinde (8.0325 kilometers). According to the FEMA parameters the percentage of surface area vulnerable to industrial accidents would give the vulnerability aspect of this risk a medium rating.

We determined the maximum threat that results from this risk to be the complete destruction of only one of the two industrial areas since a simultaneous accident, or an accident at one site causing an accident at the other site would be improbable (due to the large separation between the two industrial areas). The area covered by the larger of the two industrial areas, off of Schwerzenbachstrasse was found to be 0.405 kilometers, which is 5.042% of the total surface area of the Gemeinde This surface area affected gave industrial accidents a medium rating for maximum threat.

The final aspect of this risk that we assessed for the use of this model was the probability of this risk occurring on a yearly basis. We did this by scaling down the number of deaths and serious injuries over the ten-year period to a per year basis and dividing this number by the number of citizens to give a probability of 0.00001516, which receives a low ranking according to the FEMA model parameters. The scores for each of the rankings and the weight that each of the categories receive were applied to our risk to give the risk of death or serious injury as a result of an industrial accident received an overall risk score of 84.

The final risk we analyzed using the adapted FEMA risk assessment model was death or serious injury as a result of a residential fire. The fire brigade chief was able to

give us the number of deaths and serious injuries within Gemeinde Fällanden as a result of residential fires over the past ten years (1 serious injury). This was low enough to have the history aspect of this risk receive a low rating.

We then made the assumption that no home is completely fire proof when human behavior is a factor; every person who lives within a residence is vulnerable to death or serious injury due to a residential fire. Thus it was found that the vulnerability aspect of residential fires received a high rating.

The maximum threat of residential fires would again be the occurrence of a large scale residential fire within the center of Fällanden that completely destroys the area. As mentioned before, a fire in the densely packed residential area in the center of the Gemeinde would result in a large amount of spreading, this area is also the oldest part of the villages and thus there are building present that are constructed with wood and may not meet all of the GVZ's building codes. The area that would be affected by the occurrence of this large-scale fire would be 0.054 square kilometers, which is only 0.67% of the total surface area of the Gemeinde. This gave residential fires a low rating for the aspect of maximum threat.

The final aspect that we rated for residential fires was the probability of the occurrence of the risk. We found this by taking the number of deaths or serious injuries that have resulted from the occurrence of residential fires over the past ten years and calculating a per year fire death or injury value (0.1). We then divided this value by the number of residents within the Gemeinde to give a probability of 0.00001516 which receives a low rating according to the adapted FEMA parameters. The scores for each of the rankings and the weight that each of the categories receive were applied to our risk to give the risk death or serious injury as a result of a residential fire an overall risk score of 69.

After completing these risk assessments it was possible for our group to compare the differences between the perceived risks ranking and the actual risks ranking for the Gemeinde of Fällanden. This comparison will be discussed in detail below, but first we will present the public perception data that was obtained through our surveying of the community.

Perceived Risks in Gemeinde Fällanden

Profile of Fällanden

This section describes the demographic profile of Gemeinde Fällanden as determined through our mail questionnaire. The distribution of the respondents mirrors the distribution of the population, which allows us to extend the findings from our sample to the entire population of Fällanden. Also since 196 of our 620 questionnaires were returned we can say with 95 percent confidence that the results of our questionnaire are accurate within plus or minus 6.9% (Creative Research Systems, 2002).

As Table 3 shows, nearly three quarters (74.0 %) of the population have lived in Gemeinde Fällanden for 5 years or more. This implies that Fällanden has a stable population of long-time residents, and suggests that our respondents have in-depth knowledge of the risks facing Gemeinde Fällanden. Our findings regarding the length of residence are counter to the observations of some of the Gemeinde officials mentioned in

our context, who stated that Fällanden was becoming a bedroom community, where residents move in and out as their jobs in city Zürich change.

Table 3: Length of Residence

	Less than 6 Months	6 Month – 1 Year	1 Year – 3 Years	3 Years – 5 Years	5 Years or More	Whole Life	N
Frequency	3 (1.5%)	6 (3.1%)	13 (6.6%)	12 (6.1%)	145 (74.0%)	14 (7.1%)	196

Source: mail questionnaire

From our questionnaire, we found that nearly two-fifths (38.8%) of the community lives in single-family homes, 31.1% of the community lives in apartments and 29.6% live in multi-family residences. In Pfaffhausen, 50% of those who responded live in single-family houses, in Benglen nearly 40%. Fällanden had the largest percentage of apartment dwellers (38.0%), followed by both Pfaffhausen and Benglen where around 25% of respondents live in apartments. Finally, in both Fällanden and Benglen nearly 30% of respondents live in multi-family homes. These findings are valuable for determining certain regions of the Gemeinde, which may be considered more vulnerable than others to fire risk. As stated in our context single and multi-family residences are at a higher risk to fires than apartments, therefore we begin to speculate that Pfaffhausen, with 75% of its residents living in either single or multi-family residences, is subject to a greater risk of fire than Benglen or Fällanden according to the questionnaire responses.

The Risks Perceived in Fällanden

Respondents answered two questions regarding their feelings about the risk of injury or death to themselves or someone in their family from automobile accidents, an airplane crash into Fällanden, single-family home fires, multi-family home fires, and industrial accidents. First, they were asked how risky they felt each event to be using a Likert scale, where 1 equals not risky and 5 equals very risky. Next, we asked them to rank the events from 1 to 5 in order of how risky they felt each event to be in respect to each other with 5 being the highest concern and 1 being the lowest concern. Tables 4 and 5 show the results from these two questions.

Table 4: Level of perceived risk

			Not Risky				*Very Risky*	
	Mean	*Std. Dev.*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*N*
Automobile Accident	3.59	1.11	7 (3.2%)	6 (13.8%)	26 (13.8%)	48 (25.4%)	51 (27.0%)	189

Plane Crash	2.56	1.25	38 (20.4%)	68 (36.6%)	38 (20.4%)	21 (11.3%)	21 (11.3%)	186
Single-family Fire	2.22	1.02	48 (28.4%)	57 (33.7%)	44 (26.0%)	18 (10.7%)	2 (1.2%)	169
Multi-family Fire	2.51	1.07	31 (18.7%)	53 (31.9%)	56 (33.7%)	18 (10.8%)	8 (4.8%)	166
Industry Accident	2.19	1.04	54 (30.5%)	61 (34.5%)	40 (22.6%)	19 (10.7%)	3 (1.7%)	177

Source: mail questionnaire

Table 4 shows the risk that residents in Fällanden are most concerned with is automobile accidents, which received the highest mean rating of 3.59 followed by plane crashes (2.56), multi-family house fire (2.51), single-family house fire (2.22), and finally industrial accidents (2.19).

Comparing this order to results for the actual risks presented in a previous section, we have determined two cases where social amplification occurs. According to our actual risk assessment model a plane crash is the greatest risk to the Gemeinde, followed by automobile accidents, industrial accidents, and residential fires. Thus there is social amplification present between people's level of concern of automobile accidents, where people are very concerned with automobile accidents and not as much concerned with plane crashes. This topic is addressed later in this section.

Social amplification is more prevalent in the case of residential fires. According to Tables 4 and 5 residents are concerned with residential fires (both single- and multi-family residences) that, according to our risk assessment, are not as big of a risk. However, people do not show very much concern about industrial accidents, which we determined to be a larger risk. The fire chief, Ruedi Maurer offered a hypothesis to attempt to explain this discrepancy. He believes this may have to do with people's tendency to feel safer in their workplace, and not consider the dangers present there. Also, when people think about risks to themselves and family they tend to worry about their personal space as well as family, and not necessarily the environment surrounding them (such as a nearby industrial sector) or the dangers present at work. In an attempt to backup this hypothesis, we examined correlations between those who live in Fällanden (where the industrial sectors are present) and their level of concern about industrial accidents, and we found no significant correlation.

Table 5: Ranking of risks in relation to one another

	Mean	*Std. Dev.*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*N*
Automobile Accident	4.39	1.23	10 (7.6%)	5 (3.8%)	7 (5.3%)	11 (8.4%)	98 (74.8%)	131
Plane Crash	2.66	1.38	37	27	27	24	16	131

			(28.2%)	(20.6%)	(20.6%)	(18.3%)	(12.2%)	
Single-family Fire	2.60	1.21	33 (25.2%)	24 (18.3%)	36 (27.5%)	34 (26.0%)	3 (2.3%)	131
Multi-Family Fire	2.92	1.15	17 (13.0%)	32 (24.4%)	35 (26.7%)	38 (29.0%)	9 (6.9%)	131
Industry Accident	2.40	1.15	34 (26.0%)	43 (32.8%)	26 (19.8%)	24 (18.3%)	4 (3.1%)	131

Source: mail questionnaire

Table 5 shows results that are, for the most part similar to the individual assessments in Table 4. Residents were by far most concerned with automobile accidents, which nearly three quarters (74.8%) of the respondents gave a 5 ranking to, with a mean rating of 4.39. Next was multi-family house fires (2.92), plane crashes (2.66), single-family house fire (2.60), and industrial accidents (2.40).

Table 5 shows that, though in general plane crashes are less of a concern to the community than automobile accidents and multi-family residence fires, the people's perception varies much more than the other risks. In an attempt to explain this we looked at Pearson correlations between peoples response to plane crashes and their age, village of residence, gender, and how long they have lived in the Fällanden. We found only one significant correlation, this was between the age group 61- 70 and plane crashes. For this reason we are able to say little about the reasons for residents concern, or lack of concern, other that there is there is no significant relationship between most of the factors above and residents level of concern with airplane crashes.

The true reason for this result cannot be determined from our study; however, our speculations include a range of social, economic, or personal reasons. Some possible explanations for this occurrence may be anything from those who fly frequently are not as concerned because they are aware of how small the probability of a plane crash really is, while on the other hand activist groups such as Flugschneise Süd Nein may heighten peoples fear inadvertently simply by advertising all over the community and keeping the issue in the forefront all the time.

Despite the concerns of the fire brigade chief and all of the publicity that flight path changes have received, as both Tables 4 and 5 show, community members are not as concerned with a plane crash, as they are with a more everyday event, automobile accidents. Some insight into this finding comes from the fire chief, and other community members who describe the "Swiss-mentality" (Maurer, 2002) as being one where there is no need to worry, about an event that does not happen frequently. An extension of this statement can be noted from the results in Table 4, that out of all the risks listed, people tended to be least concerned with injury or death from single-family residential fires, and in the past 10 years there has been only 1 injury and no deaths from fire in Gemeinde Fällanden.

This finding is further supported by the responses from Question 3 on the questionnaire that asked respondents if they had personally experienced any of the events; e.g. automobile accident, or house fire. While only a small percentage of residents have experienced a residential fire, or industrial accident, close to one-third (29.6%) of the population has been involved in an automobile accident. It would thus be reasonable that citizens would be most concerned with this event because not only does it

occur frequently, but once someone is in an accident they are likely to then have heightened fears about being in an accident.

Identification of Vulnerability Groups

There are certain groups of people who are at higher risk because of their inability to cope in an emergency. Some typical vulnerability groups are children under 5, immigrants, and seniors (citizens at or over the age of 59). Seniors make up a large vulnerability group in Gemeinde Fällanden since they account for 20% of the population. Seniors tend to have limited mobility, are isolated or confined, medically fragile, heavily dependent on medication, and heavily dependent on life-support systems, and they tend to be less capable in emergency situations (CVCA, 2001: p. 26). This increases the vulnerability of seniors dying in the event of a residential fire and is thus a factor that should be accounted for by the fire brigade's emergency response procedures.

Young children compose a smaller vulnerability group within Fällanden (5%). Children are generally more vulnerable because they do not have the mental capacity or physical ability to operate in many emergency situations. We noted an example of vulnerability of children in an emergency from an observation we made at a house inspection. We found that many of the houses we visited had doors that required unlocking by a key from within. In a quick evacuation situation a child would not be able to locate the key and unlock the door.

Another large vulnerability group present within Fällanden is immigrants, which make up 19.5% of the population. Immigrants may not be familiar with the lifelines within a village and can be isolated from the community. (CVCA, pg.25) Language barriers are also generally present with most immigrants due to the non-written nature of the Swiss German language. This language barrier may affect the immigrant's ability to communicate in the occurrence of a major emergency. Though foreigners live, and participate in a community, they may never be fully accepted into the community by their Swiss neighbors (Steinberg, 1994). This factor is yet another aspect of Gemeinde Fällanden that increases the community's vulnerability.

As mentioned in our context, building materials and resources also affect the vulnerability of groups. From our research we have learned that Switzerland has very strict building codes. These codes (stated in Appendix F) include many measures meant to make buildings safer in the event of a fire. Some examples of these safety measures include; the prohibition of the use of highly flammable materials in residential construction, the requirement for industrial plants to be located far enough away from other buildings so as not to promote fire transmission and the prohibition of the use of materials in roof construction that would promote fire transmission.

Most of the GVZ codes focus on making the actual building structure safer in case of a fire. From observations, however, we noted some features that if present in a house may hinder a person's ability to escape in a fire, and thus increase their vulnerability. Some of these observations are main exit doors in apartments that do not open in the direction of egress, lack of smoke alarms, and in some multi-floor apartments; the absence of secondary escape routes. These aspects are regulated by the GVZ, but there is a clause built into GVZ codes where older buildings do not need to conform to new codes unless renovations are being done. Also not all buildings are required to follow all of the

codes. The fire police determine whether some codes apply depending on the building structure, use, occupants, and size. Another feature that we noted in our house visits were doors that locked from the inside. These structural hazards would compound the level of risk experienced by the vulnerability groups previously discussed.

Due to the geographic location of the fire brigade in the community, we have identified those who live farther away from the fire brigade to be another vulnerability group. According to ENTEC (1997, p. 17), "Risk increases when response time increases" and so one can conclude that the further one lives from the fire brigade the greater the vulnerability of fire death. From our interview with the Fire chief we know that the average response time of the fire brigade to an emergency is about 12 minutes for those areas which are farther away from the fire brigade. Since the fire brigade is located in northern Fällanden, this would put those living in western Pfaffhausen, and southern Benglen into this vulnerability group.

Since response time is also important in medical emergencies we have found that the entire community is more vulnerable to a medical emergency in which the fire brigade is first to respond. This is because the fire brigade has an ambulance squad which does not have training beyond what is referred to as "First Responder" (first aid, CPR, AED) training. In our interview with the Fire Chief we learned that the nearest paramedics must come from 20 minutes away. This would mean that help would not arrive within the 8-minute time frame, which is widely considered to be the critical threshold for life threatening injuries (Schietzelt, 2002: 3).

Response time is not only related to the distance from the emergency, but also the ability to travel the distance under traffic and environmental road conditions. As before mentioned due to the geographical location of the fire brigade, as well as paramedic units, there only exists one way to enter Gemeinde Fällanden. These roads are both two lane roads which go directly through the center of village Fällanden and intersect with each other and Schwerzenbachstrasse (a major through road for traffic coming from all towns east of Gemeinde Fällanden) by means of a traffic circle. These roads have heavy traffic from outside of the Gemeinde due largely to the fact that there are no Kantonal highways that go into the city Zürich from the Fällanden area.

At the request of the citizens of Fällanden and Gemeinde president, Richard Hirt, two separate studies were done by the Kanton Zürich traffic bureau to address the traffic issue in the center of village Fällanden. One study was completed in January 1995, and the other was completed in January of 2002. From these studies we can identify peak travel times during which the community as a whole would be more vulnerable because of a possible increase in response times of both the fire brigade and paramedics.

Tables 6 a-c: number of cars traveling on the four streets in the center of Fällanden

6 a. Morning from 7 – 8 am

	1994	1997	2000	Variation
Fällanderstr.	640	586	504	- 21%
Schwerzenbachstr.	1222	1156	1020	- 17%
Dübendorfstr.	1552	1483	1623	5 %
Binzstr.	1103	1102	1258	14%

6 b. Evening from 5 – 6 pm

	1994	1997	2000	Variation
Fällanderstr.	682	704	631	- 7%
Schwerzenbachstr.	1474	1433	1485	1%
Dübendorfstr.	1533	1495	1491	- 3%
Binzstr.	1081	1123	1209	12 %

6 c. Weekday 24 total

	1994	1997	2000	Variation
Fällanderstr.	6470	6800	6080	- 6%
Schwerzenbachstr.	14910	15480	15390	3%
Dübendorfstr.	15890	16460	17960	13%
Binzstr.	11230	12240	13460	20%

Source: Regierungsrates des Kantons Zürich (153 Busbeschleunigungsprogramm in oberen Glattal), 2002

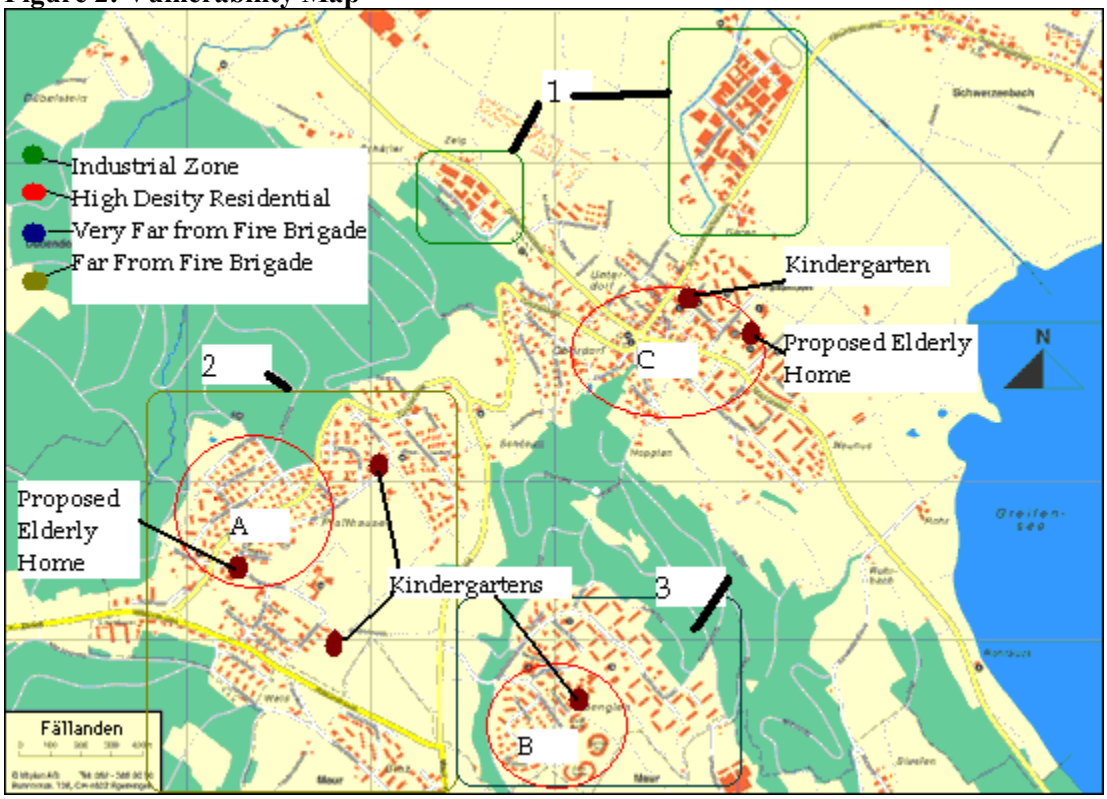
From Tables 6 a-c, we have determined that 18.7% of the traffic that comes from Fällanderstrasse in a day occurs during the two time intervals, 7-8 am and 5-6 pm. For Schwerzenbachstrasse 16.3% of traffic occurs during this time period, 17.3% for Dübendorfstrasse, and finally 18.3% for Binzstrasse. From this data we can identify that between 7 and 8 in the morning and 5 and 6 in the evening there is a significant amount of activity through that central traffic circle. Also, the greatest amount of traffic comes from Schwarzenbachstrasse and Dübendorfstrasse which are the roads that paramedics and the fire brigade must use during emergency response. The risk to the vulnerability groups from medical emergency and fire is increased during hours of heavy traffic, because they are the groups that are least resilient and have low coping abilities during an emergency situation. This is an important finding for any public protection group, and the next step would be to plan on how resources could better be allocated to vulnerability groups in an emergency situation.

It is possible for us to use this information to determine zones within the Gemeinde that are at a higher level of vulnerability than other zones (Figure 2). Although it was impossible to determine the different levels of wealth and nationality for each of these areas, it was possible to use our questionnaire data to obtain relative age distributions throughout the three different villages, and we used our observations to determine the density of residences. We used residential density information along with the age distributions and relative distance from the fire brigade in the construction of this "vulnerability map" for the Gemeinde Fällanden.

Vulnerability Map

After completing the vulnerability mapping process, we identified three zones of particularly high vulnerability. On our map (Figure 2) we have 4 different markings to denote specific areas. First, because they are not included in the following discussion, the two zones marked with a green border (and numbered 1) are the industrial areas in Gemeinde Fällanden. As stated above, these two areas are important to note, however, these two areas are a risk only to those who work in them, and thus do not increase the vulnerability of the entire community.

Figure 2: Vulnerability Map



Source: Gemeinde Fällanden webpage

On our map there are two areas (labeled number 2, and 3) that have increased vulnerability due to their geographic location within the Gemeinde. This has to do with the actual distance between the fire brigade, which is located on Dübendorfstrasse in northern Fällanden, and the village. Also considering the traffic problem that is present in the main traffic circle in Fällanden, these locations are at a higher vulnerability level.

The different zones on the map marked as red circles (labeled A, B, and C) are at higher vulnerability level because they are densely packed residential areas. What this means is that in the event of a large-scale emergencies, inside these zones more people could be affected in a shorter amount of time. Finally, also labeled on the map are areas inside the Gemeinde where the more vulnerable groups (the elderly, and children) may tend to be concentrated. This means that residents who fall into one of the groups, and attend those schools or live in the elderly housing, are at an even greater risk. Also, it is important to note that on the map that where the zones are overlapping is the most vulnerable zones because there are a variety of factors affecting resident's level of vulnerability in these spots.

The first zone we will discuss is located in the village of Pfaffhausen. This vulnerability zone is at a particularly high level of vulnerability due to its geographic distance from the fire brigade (area 2), its location (on top of a very large hill), and densely packed residential units (area A). Pfaffhausen's geographic location in the community increases response time for emergency personnel, especially considering the previously stated traffic problem. In addition the densely packed residential area on the map is at an even higher level of vulnerability because this area is located in two different

vulnerability-increasing zones. Finally, it is also important to note that the construction of a new home for the elderly has been proposed within this high vulnerability zone. The presence of this home within this high vulnerability area would raise the vulnerability of the residents to an even higher level.

The second vulnerability zone is in the village of Benglen. We consider this zone to be at a high level of vulnerability for many different reasons. The first reason for this zone having a high vulnerability is its great distance from the fire brigade (area 3), and the fact that the only route that the fire brigade can travel if they were to respond to an emergency is through the central traffic circle, which increases response time and thus vulnerability. Another reason is the presence of densely packed residential units (area B), which increases the chance of a fire spreading if it gets out of control, and thus increases vulnerability in this zone. Since this zone is located inside another zone of increased vulnerability, we can say that the high-density area is at an even higher level of vulnerability. It is also important to note that a kindergarten is present within this zone of higher vulnerability. The presence of this school within a high vulnerability zone further increases the vulnerability of the students to a higher level.

The final zone that we considered to be a high vulnerability is zone C in the center of the village Fällanden. This zone is considered to be at a high level of vulnerability due mostly to the high density of residential units. This density issue would normally be overlooked due to the closeness of this zone to the fire brigade, but it is also important to note that many of the buildings within this zone are old and some are even constructed of wood. This fact, along with the presence of an old wood mill right in the center of the zone drastically increases the vulnerability of this zone and thus should be considered as a high priority zone. It is important to note that both a kindergarten and the site of a proposed new home for the elderly are present within this high vulnerability zone. As mentioned before in the other two zones, the presence of these institutions within the high vulnerability zone further raises the vulnerability of the residents to a higher level.

This map can be important for future planning and development in the Gemeinde. By being aware of where these zones are and what makes them more vulnerable, community planners can have a better idea of locations within the community which would be more suitable, for different events, or buildings. Another important use for this map would be for public service institutions in determining where and how to allocate resources. By knowing what areas have a higher vulnerability to risks, institutions can decide how much they need to focus their time and energy on mitigation, or prevention of a risk.

Conclusions and Implications

Through the course of this study we used two popular methods to attempt to determine the actual and perceived severities of different risks to the citizens of Gemeinde Fällanden. We discovered shortcomings in the risk assessment model for application to community risk assessment. It is thus implied though our study that in order to give a more accurate representation of the risks facing a community, a better risk assessment model should either be used or developed. This model should be one that then allows public service institutions to use the findings to focus their risk reduction training.

To determine the actual risks facing Gemeinde Fällanden, we used a model that was created by the Federal Emergency Management Association (FEMA). As discussed above, FEMA is a United States emergency management organization, which deals primarily with large-scale disasters or catastrophes. This model, although useful for determining the risk of large-scale disasters to a community, is less effective for comparing small-scale risks to less common large-scale risks. This was evident in our analysis of plane crashes, which received a risk score that was almost twice as large as any of the other risks that we assessed using this model. This ineffectiveness is a direct result of the fact that the history and probability elements of this model receive weightings that are far less than the maximum threat element. The high weight of the maximum threat element thus places large-scale risks at a completely different level than smaller scale emergencies that may not have quite as severe consequences but have a much higher probability of occurring. Though out of all of the models we considered the FEMA model was most appropriate for our purposes, we have concluded that if this model had been used alone through in our study (without the consideration of perceived risks and vulnerability groups), there is a strong chance that the risk scores obtained through this assessment procedure would have led to misleading conclusions regarding the risk severities within the Gemeinde.

We determined the perceived risks to the Gemeinde by surveying the residents of the Gemeinde. This method is useful in determining what the citizens perceive to be risky, but is not without its own flaws. Many different factors can affect the validity of results received through a survey including, but not limited to, response rates, the level of the sample's representation of the entire community, and respondents not understanding or accurately answering questions. Although it is difficult to completely eliminate these factors from the survey process, this is still a good method for obtaining public perceptions. It is important to note however that even though it is important to understand what the public perceives to be risky, this information alone has only limited usefulness for planning emergency services.

Through our survey of the residents of the Gemeinde we determined that there is a gap present between what people are really concerned with and what the actual risk levels are that they face. The concept of social amplification can be applied to identify that fact that there are gaps present because of social difference but, it can do little more than simply identify the presence of these gaps because it contains no parameters that allow for insight into the cause of these gaps. However, from our study it seems that the reason for some of these differences is the FEMA model's lack of consideration of social factors. Though the FEMA model was helpful in putting the risks into a relative scale, it has serious flaws when trying to see the whole picture for risk assessment. When considering all aspects of risk in a community we can argue through our study that history and probability should be weighted more than they are in the current parameters of the FEMA model. This is because even though maximum threat is important to know about, and be aware of, it should not alter lifestyles and cause an excessive amount of concern to prepare for an even that in all likelihood will not occur.

Additional factors are also important for determining the level of risk faced by a community. Throughout this study we have made a point of showing that risk differs for different groups within the community. To truly understand all of the risks present in a community, one must also take into account those factors which make the community

more vulnerable. These would include the identification of vulnerable groups, and the location of large concentrations of these groups within the community, thus creating a vulnerability map. The FEMA model does not include any parameters that take into account the presence or concentration of high vulnerability groups or lack of vulnerable groups within the community. The vulnerability mapping process that we included in this study is a method for determining which areas within the community are at a high vulnerability to different risks that may face that community. This process should thus be considered when community planners and emergency service planners are considering how to allocate their resources throughout the community

Our analysis of the risks facing Gemeinde Fällanden has led us to one very important question. This question is, why should citizens fear an event such as a plane crash, which has a high consequence, but a probability so low that the risk seems almost negligible? Through our analysis this risk was determined to have the greatest affect on the Gemeinde and thus we would have to be led to conclude that this is something that should concern community officials. It would seem however that it would be much more beneficial for community officials to focus time and resources on the risks which occur frequently and do concern people.

In conclusion through the parameters outlined in this section we have determined the following ranking of risks is present within the Gemeinde Fällanden; automobile accidents, plane crashes, residential fires, and industrial accidents. Automobile accidents received the highest risk ranking due to the large portion of the community affected by this risk. In addition, it is an everyday occurrence and the citizens were found to be most concerned with this risk. Plane crashes were ranked second, despite the very low probability of occurrence, because of the large portion of the community affected by this risk and the high level of destruction that would be caused by its occurrence. The fact that the citizens were indecisive in their level of concern with this risk also shows a level of apprehension towards this risk, thus further supporting the ranking of second. We ranked residential fires as the third risk because despite the low rate of occurrence, when we consider the factors stated previously that increase the communities vulnerability to fire, and the residents level of concern about residential fires we have concluded this to be a greater risk than industrial accidents. While we have determined that residential fires would most likely only affect residents on an individual basis, this differs from industrial accidents in that the entire community is vulnerable to this risk, whereas only those individuals who work in the industrial sectors are affected. For this reason, and also the fact that there is a low history of occurrence industrial accidents received the lowest ranking.

Finally, it can also be concluded through our study that there is no simple method to determine the risks facing a community. It was instead necessary to include all of the factors that have been investigated throughout this study. This allows one to determine not only the actual risks facing the community, but also to determine if there are any social aspects present that are affecting the perceptions of risk. The vulnerability mapping process in addition to this information also allows high risks areas within the community to be determined and allows for action plans to be constructed with the use of this information. It is only after all of these aspects are introduced to the risk assessment method that one can truly begin to understand what level of risk a particular community is facing.

APPENDIX A:
Risk Assessments

Adapted FEMA Model

1. **History:** We will look at number of occurrences in Kanton Zürich over the past ten years for each of our hazards. We will then scale this number down according to the population size of Fällanden and look at the number of occurrences for this population size (we will scale down using a population-proportion-ratio).

If an emergency has occurred	**Evaluations**
0-1 times in the past 10 years	Low
2-3 times in the past 10 years	Medium
4 or more times in the past 10 years	High

2. **Vulnerability:** We will look at the number of citizens that would be affected in the event of one of the disasters that we have identified. This can be determined by looking at the different groups of people that may be affected by each of these disasters (or the areas within the village that may be affected by these disasters) and calculating what percentage of the population (or percentage of the Gemeinde area) that each of these vulnerability groups are a part of.

Percentage of Vulnerable Population (or Surface Area)	**Evaluations**
<1%	Low
1-10%	Medium
>10%	High

3. **Maximum Threat:** The "worst case" scenario for each of our identified disasters will be looked into. We will then determine the percentage of the area of the Gemeinde or the percentage of the total population that would be affected if this scenario were to take place. One example of a worst case scenario would be a plane crashing into the center of Fällanden.

Percentage of the Surface Area (Population) Impacted	**Evaluations**
<5%	Low
5-25%	Medium
>25%	High

4. **Probability:** To do this probability calculation we will determine the total number of citizens in Zürich that have either died or have been seriously injured in one of our identified disasters over the past ten years. We will then divide this number by ten years giving us the number of people seriously injured or killed per year for the Kanton of Switzerland. We will then use our population-proportion-ratio to give us the number of people seriously injured or killed in these disasters for the population size of Fällanden.

Probability of Death or Injury	**Evaluations**
<1 in 1000	Low

Between 1 in 1000 and 1 in 10	Medium
Greater than 1 in 10	High

Scoring and Weighting

For each evaluation score the following values:

Low	1 point
Medium	5 points
High	10 points

Weighting factors for the different categories:

History	*2
Vulnerability	*5
Max Threat	*10
Probability	*7

The total scores for each of the disasters will then be compared allowing us to be able to determine the risk level for each of the identified disasters. This will also allow us to scale the risk level for each of our disasters in respect to the other disasters (ranking).

Adapted FEMA Assessment for Ground Deaths or Injuries from Plane Crashes

1. History:

Ten-Year Period:
Crashes in Switzerland: 3
Number of Ground Deaths or Serious Injuries in Switzerland: 0
Total Occurrences in Ten year Period: 0

Information regarding the number of plane crashes in Switzerland during the ten year period 1990-2000 was obtained through the database located on www.planecrashinfo.com. Although it was found that three plane crashes had occurred in Switzerland during this ten year period, no ground deaths or serious injuries had resulted from these accidents. We are only interested in these ground deaths or serious injuries and thus the history of these occurrences in Switzerland over the ten year period would be zero.

According to the FEMA parameters the history aspect of ground deaths or injuries from plane crashes would receive a **LOW** rating.

2. Vulnerability:

Surface Area of Fällanden Falling Under New Flight Paths: 8.0325 km
Gemeinde Fällanden Surface Area: 8.0325 km
Percentage of Gemeinde Under Flight Paths: 100%

Information that maps the proposed flight paths over Gemeinde Fällanden was made available to us by Flugschneise Sued Nein and by the Unique homepage. This map

shows that the entire Gemeinde Fällanden will be located under the flight paths if the proposition is approved. It is thus concluded that the entire Gemeinde would be vulnerable to a plane crash and death or serious injury as a result of a plane crash.

According to the FEMA parameters the vulnerability aspect of ground deaths or injuries from plane crashes would receive a **HIGH** rating.

3. Maximum Threat:

It was found to be impossible to determine the exact radius that would be affected by a plane crashing into the center of a village since so many variables come into play when one is talking about this topic. It was our conclusion that the results would be devastating to the village of Fällanden if a plane were to crash into the village center. This is due mainly to the high population density of the village center and the fact that the fire brigade has no resources to deal with a jet-fuel fire. Thus a crash into the center of village would result in much of the central area of the village being destroyed and a large number of deaths.

According to the FEMA parameters the maximum threat aspect of ground deaths or injuries from plane crashes would receive a **HIGH** rating.

4. Probability:

Number of Crashes in Switzerland During Landing within Ten-Year Period: 2
Number of Crashes per Year: 0.2
Zürich Population Size: 1 228 600
Fällanden Population Size: 6 596
Fällanden: Zürich Pop. Ratio: 0.00537
Proportion of Crashes within Fällanden per Year: 0.001074
Total Number of Landings at Zürich Airport per Year: 126290
Probability of Crash upon Approach: 0.000000008504

According to the FEMA parameters the history aspect of ground deaths or injuries from plane crashes would receive a **LOW** rating.

SCORES:

History: Low→ 1 X 2 = 2
Vulnerability: High → 10 X 5 = 50
Maximum Threat: High → 10 X 10 = 100
Probability: Low → 1 X 7 = 7

TOTAL RISK SCORE: 159

Adapted FEMA Assessment for Car Accidents

1. **History:**

Ten-Year Period:

Number of Deaths or Serious Injuries in Zürich: 34413

Zürich Population Size: 1 228 600
Fällanden Population Size: 6 596
Fällanden: Zürich Pop. Ratio: 0.00537
Proportion of Accidents in Fällanden: 185

A lack of data for the occurrence of car accidents in the Gemeinde Fällanden forced a proportional approach for the history aspect of car accidents. We obtained the total number of deaths and serious injuries resulting for car crashes for the ten-year period 1990-2000 for the Kanton of Zürich. This number was then multiplied by the ratio of Fällanden's population to Kanton Zürich's population to give us an estimate as to the number of deaths or serious injuries resulting from a car accident in Gemeinde Fällanden over this ten-year period.

According to the FEMA parameters the history aspect of car accidents would receive a **HIGH** rating.

2. **Vulnerability:**

Population Group Affected: Licensed Drivers (population over the age of 18)
Population Affected: 5474
Population of Fällanden: 6 596
Percentage of Total Population: 83%

The decision to use licensed drivers as the population group affected by car crashes was made because all drivers are vulnerable to car crashes. Although it is unlikely that the entire population of Fällanden over the age of 18 are licensed drivers the over estimation allows us to account for passengers inside the vehicles that may be involved in an accident.

According to the FEMA parameters the vulnerability aspect of car accidents would receive a **HIGH** rating.

3. **Maximum Threat:**

Worst Case Scenario: 4-way intersection with 4 cars all filled with 4 people collide and all 16 people involved either receive serious injuries or die.

Population Affected: 16
Population of Fällanden: 6 596
Percentage of Total Population: 0.243%

Most deaths or serious injuries that result from car accidents occur in head on collisions at high speeds. The main intersection in Gemeinde Fällanden with the most traffic is a traffic circle which eliminates the chance of high speeds and head on collisions. All roads in Fällanden are 2 lane residential roads where speeds are kept relatively low. This allows us to say that the worst case scenario is a 4 way intersection where are 4 cars at full capacity are traveling at a relatively high rate of speed and collide simultaneously. This assumption can be made since we are dealing with the maximum threat due to this accident, it is very unlikely due to the nature of the transportation

system within Fällanden that this scenario would actually occur, it is an upper bound of sorts to the risk. We are also assuming that the full capacity for these four cars would be four people. This assumption is justified by the fact that the majority of vehicles within the Gemeinde are relatively small vehicles. It would thus be concluded that 16 people would be seriously injured or killed in the event of this accident which is a very small percentage of the entire population of Fällanden.

According to the FEMA parameters the maximum threat aspect of car accidents would receive a **LOW** rating.

4. **Probability:**

Number of Deaths or Injuries in Zürich in Ten-Year Period: 34413
Number of Deaths or Injuries in Zürich per Year: 344.13
Zürich Population Size: 1 228 600
Fällanden Population Size: 6 596
Fällanden: Zürich Pop. Ratio: 0.00537
Proportion of Accidents in Fällanden: 185
Death or Injury per Citizen (Probability): 0.028

According to the FEMA parameters the probability aspect of car accidents would receive a **LOW** rating.

SCORES:

History: High→ 10 X 2 = 20
Vulnerability: High → 10 X 5 = 50
Maximum Threat: Low → 1 X 10 = 10
Probability: Low → 1 X 7 = 7

TOTAL RISK SCORE: 87

Adapted FEMA Assessment for Industrial Accidents

1. History:

Ten-Year Period:
Number of Industrial Accidents in Fällanden: 1
Deaths or Serious Injuries within Fällanden: 1 death 0 serious injuries

Actual statistics for the number of deaths and serious injuries within the industrial section of Fällanden were obtained through the fire chief. This allowed us to use actual statistics for the ten year period that is being observed.

According to the FEMA parameters the history aspect of Industrial Accidents would receive a **LOW** rating.

2. Vulnerability:

Industrial Zone Surface Area: 0.45 km

Gemeinde Fällanden Surface Area: 8.0325 km
Percent of Gemeinde Area within Industrial Area: 5.602%

We determined that the only section of Fällanden that would be affected by industrial accidents would be the actual industrial section of the Gemeinde. It is thus possible to determine the area of the Gemeinde that is vulnerable by looking at the actual surface area of the Gemeinde that is within the industrial section. Since no extremely hazardous chemicals with the potential of becoming airborne in the event of a serious industrial accident are present it is possible to make the assumption that the only area that would be affected by an industrial accident is the industrial zone.

According to the FEMA parameters the vulnerability aspect of industrial accidents would receive a **MEDIUM** rating.

3. Maximum Threat:

Worst-Case Scenario: Large industrial accident causes a severe fire that completely destroys the entire industrial zone, killing or seriously injuring all citizens within the area. This accident occurs at the larger industrial zone off of Schwerzenbachstrasse.

Affected Industrial Zone Surface Area: 0.405 km
Gemeinde Fällanden Surface Area: 8.0325 km
Percent of Gemeinde Area within Industrial Area: 5.042%

It was determined that the worst possible industrial accident would be the complete destruction of the industrial zone. It is important to note however that the actual industrial zone is composed of two separate zones that are approximately 450 meters apart. It was thus determined that the worst case scenario would be the complete destruction of only one of these two industrial sites since a simultaneous accident, or an accident at one site causing an accident at the other site would be improbable. Since not all workers at the industrial section are citizens of Fällanden it was decided that the best way to determine the percentage of the population affected would be to determine the percentage of the area of the Gemeinde affected (this is allowed in the FEMA model's methodology).

According to the FEMA parameters the maximum threat aspect of industrial accidents would receive a **MEDIUM** rating.

4. Probability:

Number of Deaths or Serious Injuries in Fällanden During Ten-Year Period: 1
Number of Deaths or Serious Injuries per Year: 0.1
Fällanden Population Size: 6 596
Death or Injury per Citizen (Probability): 0.00001516

According to the FEMA parameters the probability aspect of industrial accidents would receive a **LOW** rating.

SCORES:

History: Low→ 1 X 2 = 2
Vulnerability: Medium → 5 X 5 = 25
Maximum Threat: Medium → 5 X 10 = 50
Probability: Low → 1 X 7 = 7

TOTAL RISK SCORE: 84

Adapted FEMA Assessment for Residential Fires

1. History:

Ten-Year Period:
Deaths or Serious Injuries within Fällanden: 0 deaths 1 serious injury

Information was available for the Gemeinde Fällanden involving the number of deaths and serious injuries resulting from residential fires within the past ten years. This information was obtained through the fire chief. It was found that no deaths had resulted from residential fires and only one serious injury had resulted from a residential fire during the past ten years.

According to the FEMA parameters the history aspect of Residential fires would receive a **LOW** rating

2. Vulnerability:

Fällanden Population Size: 6 596
Citizens Residing in Residential Areas: 6 596
Percent of Vulnerable Citizens: 100%

Although a low occurrence of fires is present within the Gemeinde of Fällanden it is important to note that every residence is vulnerable to fire regardless of its location or the habits of its inhabitants. It can thus be concluded that every residence in the Gemeinde is vulnerable to residential fire and thus the percentage of the vulnerable population would be 100%.

According to the FEMA parameters the vulnerability aspect of residential fires would receive a **HIGH** rating

3. Maximum Threat:

Worst-case Scenario: A very large fire breaks out around the traffic circle in the center of Fällanden. This area is the oldest section of the Gemeinde and most of the buildings within this area are constructed with wood. The presence of a large wood mill in the middle of the downtown section also increases the spreading potential of a large fire in this area. Thus the worst-case scenario would be a large scale residential fire occurring in the area around the traffic circle and spreading throughout the entire "old" section of the village and completely destroying the area.

Surface Area of the Spread-Zone: 0.054 km

Gemeinde Fällanden Surface Area: 8.0325 km
Percent of Gemeinde Area within Spread-Zone: 0.67%

According to the FEMA parameters the maximum threat aspect of residential fires would receive a **LOW** rating.

4. Probability:

Number of Deaths or Serious Injuries in Fällanden During Ten-Year Period: 1
Number of Deaths or Serious Injuries per Year: 0.1
Fällanden Population Size: 6 596
Death or Injury per Citizen (Probability): 0.00001516

According to the FEMA parameters the probability aspect of residential fires would receive a **LOW** rating.

SCORES:

History: Low→ 1 X 2 = 2
Vulnerability: High → 10 X 5 = 50
Maximum Threat: Low → 1 X 10 = 10
Probability: Low → 1 X 7 = 7

TOTAL RISK SCORE: 69

APPENDIX B:
Questionnaire in English and German

Q-1 On a scale from 1-5, where 1 is not at all concerned and 5 is extremely concerned, please indicate how concerned you are with each of the following risks in your everyday lives.

	NOT AT ALL CONCERNED				EXTREMELY CONCERNED
MOTOR VEHICLE ACCIDENT	1	2	3	4	5
PLANE CRASHES INTO VILLAGE	1	2	3	4	5
SINGLE HOME FIRE	1	2	3	4	5
MULTIPLE HOUSING UNIT FIRE	1	2	3	4	5
INDUSTRIAL ACCIDENT	1	2	3	4	5
HOME FLOOD	1	2	3	4	5
FOREST FIRE	1	2	3	4	5

Q-2 Please rank in order from 1 to 7, where 1 is most concerned and 7 is least concerned, each of the following risks in terms of how concerned you are with them in your everyday life.

MOTOR VEHICLE ACCIDENT _____
PLANE CRASHES INTO VILLAGE _____
SINGLE HOME FIRE _____
MULTIPLE HOUSING UNIT FIRE _____
INDUSTRIAL ACCIDENT _____
HOME FLOOD _____
FOREST FIRE _____

Q-3 Have you ever experienced any of the events listed in Q-2? If yes, please list which ones, if no please skip to Q-4.

_____

Q-3 Would you ever consider or have you ever considered joining the fire brigade?

YES_____ NO_____

Q-4 If you have not considered joining the fire brigade or have considered and decided not to join the fire brigade, why did you come to this decision (check all that apply)?

LACK OF INTERST _____
LITTLE PAY _____
DANGEROUS _____
LACK OF PHYSICAL FITNESS _____
TIME COMMITMENT TOO MUCH _____
INCONVENIENT HOURS _____
AGE _____
HEALTH CONDITIONS _____
WORK TOO FAR AWAY TO BE ON CALL _____
HAVE NEVER BEEN INFORMED ABOUT THE FIRE BRIGADE _____
FEEL THE FIRE BRIGADE HAS LITTLE IMPORTANCE _____
OTHER:_____ _____

Q-5 How long have you lived in Gemeinde Fällanden (please circle)?

1. LESS THAN 6 MONTHS
2. 6 MONTHS – 1 YEAR
3. 1-3 YEARS
4. 3-5 YEARS
5. 5+ YEARS
6. WHOLE LIFE

Q-6 What is your age (please circle)?

1. 18-25 2. 25-30 3. 31-40 4. 41-50 5. 51-60 6. 61-70 7. Over 71

Q-7 In what type of residence do you live (please circle)?

1. SINGLE FAMILY HOME 2. APARTMENT 3. MULTIPLE FAMILY HOME

Q-8 Gender (please check)?

MALE_____ FEMALE_____

Bitte beantworten Sie Fragen F-1 und F-2 im Hinblick auf Verletzungsgefahr oder einen möglichen Tod von Ihnen oder von einem Ihrer Familienmitglieder.

F-1 Worüber machen Sie sich am meisten Sorgen? Bitte beurteilen Sie eventuell mögliche Gefahren in Ihrem täglichen Leben mit einer Skala von 1 bis 5.

	keine Gefahr				sehr gefährlich
AUTOUNFALL	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
FLUGZEUGABSTURZ IN FÄLLANDEN	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
BRAND EINFAMILIENHAUS	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
BRAND MEHRFAMILIENHAUS	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
INDUSTRIEUNFALL	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WASSERSCHADEN	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

F-2 Bitte ordnen Sie jeder Gefahr eine Nummer von 1 bis 6, wobei sie 1 der Gefahr zuordnen, die sie am wenigsten kümmert, und 6 der Gefahr geben die Ihnen am meisten Sorgen bereitet. (Bitte benutzen Sie jede Nummer nur einmal.)

Autounfall _____
Flugzeugabsturz in Fällanden _____
BRAND EINFAMILIENHAUS _____
BRAND MEHRFAMILIENHAUS _____
INDUSTRIEUNFALL _____
WASSERSCHADEN _____

F-3 Haben Sie einen der Fälle von F-2 schon erlebt?

NEIN ☐ JA ☐ NÄMLICH _____

F-4 Haben Sie sich schon einmal überlegt, der Feuerwehr beizutreten?

NEIN ☐ JA ☐

F-5 Weshalb haben Sie sich entschieden, der Feuerwehr nicht beizutreten? Welche Gründe haben Sie davon abgehalten?

KEIN INTERESSE ☐
ZU WENIG LOHN ☐
ZU GEFÄHRLICH ☐
PHYSISCH NICHT FIT ☐
ZU WENIG ZEIT ☐
UNPASSENDER STUNDENPLAN ☐
ZU JUNG ODER ZU ALT ☐
GESUNDHEITLICHE GRÜNDE ☐
SIE ARBEITEN ZU WEIT WEG ☐
KEINE INFORMATION ÜBER DIE FEUERWEHR ☐
SIE FINDEN DIE FEURWEHR UNWICHTIG ☐
ANDERE GRÜNDE:_____ ☐

F-6 Wie lange leben Sie schon in der Gemeinde Fällanden?

☐ WENIGER ALS 6 MONATE ☐ 6 MONATE – 1 JAHR ☐ 1-3 JAHRE
☐ 3-5 JAHRE ☐ MEHR ALS 5 JAHRE ☐ IHR GANZES LEBEN

F-7 Wie alt sind Sie?

☐ 18-25 ☐ 26-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61-70 ☐ Über 71

F-8 Wie wohnen Sie?

1. EINFAMILIENHAUS ☐
2. WOHNUNG ☐
3. MEHRFAMILIENHAUS ☐

F-9 Ihr Geschlecht

MÄNNLICH ☐ WEIBLICH ☐

APPENDIX C:
Demographic Frequencies
Frequencies for Questionnaire Question 1, 2, 3 by village

Total Responses = 196 (31.6%)
Responses by village:
Fällanden 92 (46.9 %)
Benglen 48 (24.5 %)
Pfaffhausen 56 (28.6 %)

Age of Respondents

	18 –25	25-30	31-40	41-50	51-60	61- 70	Over 71	N
Frequency	2 (1.0%)	7 (3.6%)	23 (11.7%)	43 (21.9%)	53 (27.0%)	37 (18.9%)	31 (15.8%)	196

Fällanden

- 54.4% of respondents are over the age of 51.
- Respondents were nearly evenly split between single family, apartment, and multifamily homes.
- There is nearly a 50/ 50 male/ female ratio of respondents.
- 76.1 % of respondents have lived in Gemeinde Fällanden longer than 5 years.

Age

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
Frequency	1	6	12	23	31	8	11
Percent	1.1	6.5	13.0	25.0	33.7	8.7	12.0

Housing type

	Single Family	Apartment	Multifamily
Frequency	27	35	28
Percent	29.3	38.0	30.4

Gender

	Male	Female
Frequency	50	42
Percent	54.3	45.7

Length of Residence

	Sixmon	Sixone	Onethree	Threefive	Fiveplus	Wholelife
Frequency	2	4	6	8	62	8
Percent	2.2	4.3	6.5	8.7	67.4	8.7

Question 1

Auto

	1	2	3	4	5	Mean	Standard Deviation
Frequency	3	15	26	25	19	3.33	1.30
Percent	3.3	16.3	28.3	27.2	20.7		

Plane

	1	2	3	4	5	Mean	Standard Deviation
Frequency	19	26	23	12	8	2.48	1.13
Percent	20.7	28.3	25.0	13.0	8.7		

Single Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	27	28	18	7	0	1.79	1.13
Percent	29.3	30.4	19.6	7.6	0		

Multi Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	14	28	28	8	2	2.13	1.23
Percent	15.2	30.4	30.4	8.7	2.2		

Industrial Accident

	1	2	3	4	5	Mean	Standard Deviation
Frequency	19	31	18	13	2	2.14	1.25
Percent	20.7	33.7	19.6	14.1	2.2		

Question 2

- 25 out of the 92 questionnaires had unusable data for Question 2
    - Unusable data means that the question was answered either incorrectly by using a number more than once, not filling in all fields, or simply that the question was left blank

Automobile Accident

	1	2	3	4	5	Mean	Standard Deviation
Frequency	6	4	3	8	46	3.09	2.21
Percent	6.5	4.3	3.3	8.7	50.0		

Plane Crash

	1	2	3	4	5	Mean	Standard Deviation
Frequency	19	12	11	14	11	2.03	1.77
Percent	20.7	13.0	12.0	15.2	12.0		

Single Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	22	14	16	14	1	1.73	1.47
Percent	23.9	15.2	17.4	15.2	1.1		

Multi Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	6	19	18	19	5	2.16	1.63
Percent	6.5	20.7	19.6	20.7	5.4		

Industrial Accidents

	1	2	3	4	5	Mean	Standard Deviation
Frequency	14	18	19	12	4	1.90	1.54
Percent	15.2	19.6	20.7	13.0	4.3		

Question 3

	No	Yes
Frequency	55	37
Percent	59.8	40.2

The above chart shows the number of people who had answered yes or no to Question Number 3. For those that did answer yes to Question 3, the break up of the events that they had been involved in are listed below.

	Automobile Accident	Residential Fire	Industrial Accident
Frequency	24	11	2
Percent of all respondents	26.1	12	2.2

Benglen

- 72.9 % of respondents over 51
- Slightly more residents live in single family homes (39.6 %), than multifamily homes (33.3 %), and apartments (27.1 %)
- There is an exact 50/50 male/ female ratio of respondents
- 91.6 % of respondents have lived in Gemeinde Fällanden longer than 5 years

Age

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
Frequency	0	1	2	10	13	16	6
Percent	0	2.1	4.2	20.8	27.1	33.3	12.5

Housing type

	Single Family	Apartment	Multifamily
Frequency	19	13	16
Percent	39.6	27.1	33.3

Gender

	Male	Female
Frequency	24	24
Percent	50	50

Length of Residence

	Sixmon	Sixone	Onethree	Threefive	Fiveplus	Wholelife
Frequency	0	0	2	2	40	4
Percent	0	0	4.2	4.2	83.3	8.3

Question 1

Automobile Accident

	1	2	3	4	5	Mean	Standard Deviation
Frequency	1	4	15	13	14	3.67	1.17
Percent	2.1	8.3	31.3	27.1	29.2		

Plane Crash

	1	2	3	4	5	Mean	Standard Deviation
Frequency	6	19	9	5	5	2.42	1.37
Percent	12.5	39.6	18.8	10.4	10.4		

Single Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	7	13	12	5	2	2.06	1.41
Percent	14.6	27.1	25.0	10.4	4.2		

Multi Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	4	14	12	6	4	2.33	1.48
Percent	8.3	29.2	25.0	12.5	8.3		

Industrial Accidents

	1	2	3	4	5	Mean	Standard Deviation
Frequency	12	14	13	4	0	1.98	1.14
Percent	25.0	29.2	27.1	8.3	0		

Question 2

- 19 out of the 48 questionnaires had unusable data for Question 2
    - Unusable data means that the question was answered either incorrectly by using a number more than once, not filling in all fields, or simply that the question was left blank

Automobile Accident

	1	2	3	4	5	Mean	Standard Deviation
Frequency	3	0	1	1	24	2.71	2.42
Percent	6.3	0	2.1	2.1	24		

Plane Crash

	1	2	3	4	5	Mean	Standard Deviation
Frequency	3	10	8	6	2	1.69	1.62
Percent	6.3	20.8	16.7	12.5	4.2		

Single Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	6	5	9	8	1	1.67	1.64
Percent	12.5	10.4	18.8	16.7	2.1		

Multi Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation

Frequency	5	6	8	8	2	1.73	1.70
Percent	10.4	12.5	16.7	16.7	4.2		

Industrial Accidents

	1	2	3	4	5	Mean	Standard Deviation
Frequency	12	8	3	6	0	1.27	1.38
Percent	25.0	16.7	6.3	12.5	0		

Question 3

	No	Yes
Frequency	22	26
Percent	45.8	54.2

The above chart shows the number of people who had answered yes or no to Question Number 3. For those that did answer yes to Question 3, the break up of the events that they had been involved in are listed below.

	Automobile Accident	Residential Fire	Industrial Accident
Frequency	21	3	0
Percent of all respondents	43.8	6.3	0

Pfaffhausen

- 62.5 % of residents in Pfaffhausen are over the age of 51
- 50 % of respondents live in single family houses. The other 50 % are split up nearly 50/ 50 between apartments and multifamily homes.
- Almost exactly a 50/ 50 male/ female ratio of respondents
- 80.4 % of respondents lived in Gemeinde Fällanden longer than 5 years.

Age

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
Frequency	1	0	9	10	9	12	14
Percent	1.8	0	16.1	17.9	16.1	21.4	25.0

Housing type

	Single Family	Apartment	Multifamily
Frequency	29	13	14
Percent	51.8	23.2	25.0

Gender

	Male	Female
Frequency	29	27
Percent	51.8	48.2

Length of Residence

	Sixmon	Sixone	Onethree	Threefive	Fiveplus	Wholelife
Frequency	1	2	5	2	43	2
Percent	1.8	3.6	8.9	3.6	76.8	3.6

Question 1

Automobile Accident

	1	2	3	4	5	Mean	Standard Deviation
Frequency	2	7	17	10	18	3.52	1.35
Percent	3.6	12.5	30.4	17.9	32.1		

Plane Crash

	1	2	3	4	5	Mean	Standard Deviation
Frequency	13	23	6	4	8	2.38	1.40
Percent	23.2	41.1	10.7	7.1	14.3		

Single Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	14	16	14	6	0	2.00	1.18
Percent	25.0	28.6	25.0	10.7	0		

Multi Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	13	11	16	4	2	1.95	1.37
Percent	23.2	19.6	28.6	7.1	3.6		

Industrial Accidents

	1	2	3	4	5	Mean	Standard Deviation
Frequency	23	16	9	2	1	1.70	1.08
Percent	41.1	28.6	16.1	3.6	1.8		

Question 2

- 21 out of the 56 questionnaires had unusable data for Question 2
    - Unusable data means that the question was answered either incorrectly by using a number more than once, not filling in all fields, or simply that the question was left blank

Automobile Accident

	1	2	3	4	5	Mean	Standard Deviation
Frequency	1	1	3	2	28	2.86	2.36
Percent	1.8	1.8	5.4	3.6	50.0		

Plane Crash

	1	2	3	4	5	Mean	Standard Deviation
Frequency	15	5	8	4	3	1.43	1.55
Percent	26.8	8.9	14.3	7.1	5.4		

Single Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	5	5	11	12	1	1.80	1.70
Percent	8.9	8.9	19.6	21.4	1.8		

Multi Family Residential Fire

	1	2	3	4	5	Mean	Standard Deviation
Frequency	6	7	9	11	2	1.80	1.70
Percent	10.7	12.5	16.1	19.6	3.6		

Industrial Accidents

	1	2	3	4	5	Mean	Standard Deviation
Frequency	8	17	4	6	0	1.39	1.34
Percent	14.3	30.4	7.1	10.7	0		

Question 3

	No	Yes
Frequency	38	18
Percent	67.9	32.1

The above chart shows the number of people who had answered yes or no to Question Number 3. For those that did answer yes to Question 3, the break up of the events that they had been involved in are listed below.

	Automobile Accident	Residential Fire	Industrial Accident
Frequency	13	2	0
Percent of all respondents	23.2	3.6	0

APPENDIX D:
Questionnaire Distribution Methods

On Thursday November 14, 2002 we distributed 620 questionnaires throughout Gemeinde Fällanden. For our study it was important that we collected results that reflected the opinion of the entire Gemeinde. To do this we had to carefully select a sample population that would not only be statistically accurate, but would also represent all three villages of the Gemeinde equally. To do this we first determined the number of questionnaires that we would need returned from the entire Gemeinde to have a statistically accurate sample. Our first goal was to get back 370 questionnaires; this would allow us to say with 99% certainty the opinion of the community within plus or minus 5 percent. Our second goal was around 95 questionnaires; this would allow us to say will 99% accuracy the opinion of the community within plus or minus 10 percent of the population. Our actual return rate of 196 questionnaires gave us a confidence interval of 6.9%. This means that for each question on the questionnaire we can say that the answers given are accurate within plus or minus 6.9% of the population.

The next step in our distribution process was to determine how many questionnaires to distribute throughout the Gemeinde. According to Don Dillman, who is considered an expert on survey techniques, depending on who is surveyed and what method is used, any return rate under 60-70 percent should send up a red flag. If the red flag goes up, one should then find out whether the people who didn't respond are different from those who did in ways that matter to the study. We chose to distribute 620 questionnaires because 60 percent of 620 is 370, our desired return rate. We had however, a return rate of 31.6%, but few 'red-flags' were raised in our heads for a few important reasons. According to a Swiss insurance agent, the normal return rate for surveys in Switzerland is around 5% or less for mail surveys. In this respect alone our response rate seems impressive. Not only this but the method described in Dillman's book is an eight step process involving multiple mailings of the questionnaire and reminders. Though a 60% return would have been ideal, due to a lack of a budget we were unable to go through the 8-step process described by Dillman to get a return rate of that size. Also since we are our questionnaire deal only with gaining a general perspective of the entire Gemeinde, we were not looking for responses from any particular group. Therefore, we consider our return rate of 31.6% sufficient for our study.

The next important consideration that we had to make, was being sure that all three villages in the Gemeinde were represented evenly. To do this we determined proportional number of questionnaires out of the total 620 that would be equal to the proportion of the entire Gemeinde that each village made up. We distributed 270 questionnaires to village Fällanden which makes up 43.5% of the population, 186 to village Benglen which makes up 29.9% of the population, and 164 to village Pfaffhausen makes up 26.5%. We were fortunate to get a nearly representative return from each village. Out of the 196 questionnaires received; 46.9% came back from Fällanden, 24.5% were returned from Benglen, and 28.6% were returned from Pfaffhausen. This supports the fact that our survey results are representative for the entire Gemeinde Fällanden.

One of the most difficult steps in determining our sample was trying to determine the addresses to which we would distribute. Due to privacy laws in Switzerland we were unable to acquire a listing of addresses in the Gemeinde. The most complete listing of

addresses that we could get was from the Swisscomm telephone book, so therefore our sample population came from the phone book. To determine the addresses we were going to use we entered all of the addresses from each village into an excel spreadsheet and then used a random number generator to select the addresses. Since residents in Switzerland do have the option of having an unlisted telephone number, we attempted to determine the amount of numbers that were not listed in Gemeinde Fällanden. A representative from Swisscomm, however, informed us that this information was unavailable.

APPENDIX E:
A look into the Recruiting problem in Gemeinde Fällanden

This section is describes the results from our inquiry into the recruiting challenge in Gemeinde Fällanden. First we describe the results from our questionnaire which asked citizens first whether they had ever considered joining the fire brigade, and second what reasons some of the reasons may have been for them not joining. Next, we examine other methods used by fire brigades around the world to promote community relations, and recruiting. These methods are suggestions to the fire brigade chief on ways that he could promote community understanding of the fire brigade and fire safety in the community as well as possible ways in which he could endorse the fire brigade in the community to get more members.

The number one reason why respondents of our survey did not join the fire brigade was that they were too old (41.3%). Pearson Correlations showed significance in that residents in Pfaffhausen were more likely to reply that they were too old than in members from other villages, and also a significant negative correlation in that residents of Fällanden were less likely to answer that they were too old as compared with the other villages. This implies that residents in Fällanden may have a slightly larger base of residents who are of an appropriate age to join the fire brigade than Pfaffhausen.

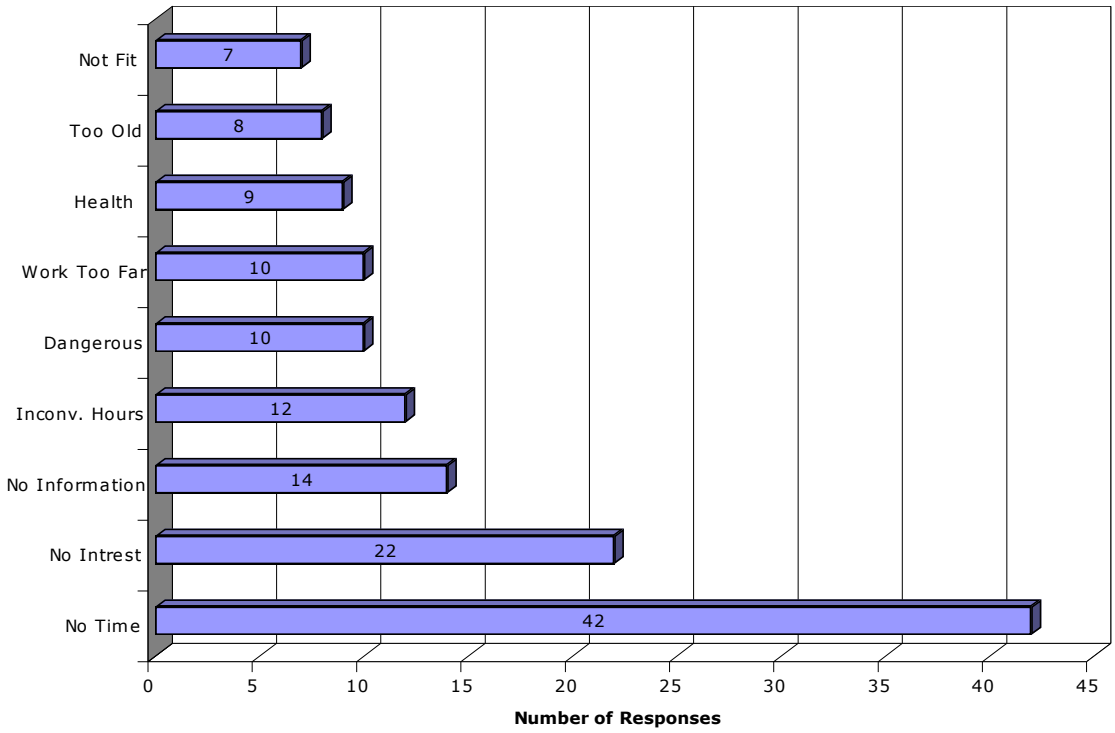
An explanation for this answer comes from the fact that out of the 196 respondents who answered our questionnaire, only 37.8% (or 74 people) were between the ages of 18 and 50. We determined this age range to be the optimal target group for recruits, since average age of fire brigade members is 40, and once over the age of 50 fire brigade members are required to have more physical checkups than those who are under the age of 50. Therefore the results of this section are presented for those questionnaire respondents who are under the age of 51.

Results of Recruiting Inquiry

Table E-1 shows the reasons why members of the community under the age of 51 have not joined the fire brigade. This inquiry was preceded on the questionnaire by another question asking whether or not respondents had considered joining the fire brigade or not. 33.7% of respondents said that they had considered joining the fire brigade.

The most popular reason why residents said they did not join the fire brigade was that they did not have enough time (58.6%). And, in a similar context, 13.5% of the residents replied that they worked too far away to be involved in the fire brigade, and another 16.2% said that the hours were too inconvenient for them. Also 4.1% of people responded to our ‘other’ option in question 5, and replied that they could not join because of their profession. A possible explanation for this come from Herzog, who notes that few people who live in small rural communities work there.

Table E-1: Reasons why Residents Have not Joined the Fire Brigade



Source: mail survey

It is important to note that recruiting problems are not localized to Fällanden or even to Switzerland, but instead are a worldwide problem. As training procedures become more complex due to new equipment and the development of new procedures, fewer people are able to spend the amount of time required by the fire brigade (Mann, Herzog). This fact as well as the fact that some companies hesitate to employ fire brigade members leads one to speculate as to whether or not a major restructuring of the volunteer fire brigade system in Fällanden and the surrounding areas is necessary.

Joining the fire brigade is not for everyone, and it is natural that there will be a group of citizens that have not considered joining the fire brigade because of different personal reasons. 29.7% of respondents answered that they simply had no interest in joining the fire brigade. While 9.4% said that they were not physically fit enough to join, another 12.2% said that they could not join because of a medical condition. And another perspective altogether is 13.5% of respondents who replied that joining the fire brigade was too dangerous for them. For these groups of the population there is little that can be done to change the fact that they have not considered joining the fire brigade because their reasons for not joining are either personal beliefs or limitations.

Another reason that people listed in question 5's 'other' option is that 4.1% of respondents responded that they had other priorities. We used the category 'other

priorities' most frequently to describe those who said they would not join because of their family. This is another example of a group of people who may be hard to get to change their feelings on joining the fire brigade, again because of personal beliefs.

Possibly one of the most important results for the fire brigade on the topic of recruiting is that 18.9% of people replied that they had no information about the fire brigade. Also another 2.0% of respondents listed the fact that they were foreign as an 'other' reason why they had not joined the fire brigade. This result indicates that there is a group of residents who may be interested in joining the fire brigade if they were better informed. When other communities used techniques to inform the residences in their community of the importance of the service the fire brigade provides recruiting numbers went up. A volunteer Fire Chief Greg Tauer voiced his concern by saying, "They maybe didn't realize what was going on, and the fact that there was a definite need, and that we are a very valuable service to the community."(Herzog)

Since our finding showed that the fire brigade had little actual contact with the residents in Fällanden, it is implied that some of Fällanden's recruiting troubles may in-fact be linked to this finding. By informing the community about what the fire brigade does, and also who is allowed to join (everyone) there may have more success in getting new members to join. Listed below are some suggested methods for informing residents about the fire brigade that come from other fire brigades around the world. Though all of the practices may not be applicable in Fällanden the focus of our study has not been entirely on this aspect and we would like to give the fire brigade chief the opportunity to identify those practices which may work better for him in his community.

Suggested Practices

One practice being used in Bloomington and Eagen, Minnesota is every year fire fighters will go through out the community knocking on each. This technique allows the fire fighters to not only meet new residents and make the people aware of the fire department, but it also serves as a recruiting tool to interest new members (Herzog, 1998). Another method being used in Belle Plain, Minnesota is aimed at high school students who would then hopefully continue on in the fire department after they graduate. High school seniors that are 18 or older are allowed to respond to fires during school hours if they meet a certain grade point average. (Herzog, 1998) Some fire brigades are sponsoring billboards that advertise the fire brigade and have a phone number to call for details on how to join.

In some circumstances, the local government has actually become involved in the fire brigade. For example some locals offer the volunteer fire fighters pensions or medical insurance. In other communities volunteers are supplemented by reduced property tax or building permits. Though this would be helpful for Fällanden, because of the set up of government in Switzerland, this may not be a plausible idea.

Although the nearby town of Greifensee is experiencing the same recruitment problems, they are currently using some interesting methods to spread themselves throughout the community. According to GVZ records Greifensee also has fewer fires than Fällanden, so their programs could be having a positive aspect of fire prevention. The fire chief, Daniel Rigling writes a newspaper article every couple of weeks that contains tips on fire prevention, education material, and information on activities of the fire brigade.

Another technique used by the Greifensee fire brigade is visiting the primary schools to teach the children not only what to do in an emergency and how to call the fire brigade, but what happens once the call comes into the fire brigade. The students also get to use the equipment, climb the ladders, and work with the pioneer machine. This allows the students to see what is happening on both ends and may spark an early interest in joining once they are older.

An open house is a possibility that the Fällanden fire brigade has already explored with mixed results. Residents did attend the event, but it was mostly family and friends of the members of the fire brigade. An open house can be a useful tool in recruitment and education because it allows the fire brigade to meet members of the community and also allows the attendees to see what they would actually be doing if they did join. A modification of this idea is to offer small refreshments at a booth or a table at a fair or popular area in the community. Residents who were interested in the fire brigade could stop by to talk to someone, and it would also make the fire brigade more present in the community for those who did not have enough information.

Education is an important tool in reducing risk. If people are aware of the risks they face and how to reduce their vulnerability to them or what to do in an emergency, it is likely that the number of emergencies the fire brigade would need to respond to would be lowered. Informational pamphlets are an easy and inexpensive way to spread what the fire brigade is about and what the duties and responsibilities of the fire brigade are. These could be placed in mailboxes so that everyone gets one, or could be posted on bulletin boards and bus stops so that people would stop and read them. These pamphlets could also contain information on fire prevention, safety tips, and common risks that are present in the community. The Winterthur fire brigade has posters available on their web page that explain exactly what to do in the case of an emergency. The posters are easy to understand and are illustrated so all age levels can learn from them.

Coloring books are a way to get children educated at an early age. It is a fun and a creative method to get children's attention about what to do in an emergency (get out of a burning building, not hide), tell them who to call and what the phone number is, and it could interest the children in the fire brigade at an early age. Stickers or small toys that relate to the fire brigade is also a popular method in the United States to teach children and make them remember what the fire department is and what it is about.

One of the most popular methods that is fairly new because of technology, is other fire brigades throughout Switzerland, and the world are using web pages to advertise the fire brigade. This allows people to access information about the fire brigade at any time, which is good for recruiting if the fire brigade does not always have someone on duty. Many of these web pages also have the incident reports so that anyone can see what emergencies the fire brigade responded to and when and where it happened. Some even contain pictures of the incidents.

A web page would also be useful in allowing the residents to see the fire brigade on a more personal level. Several of the web pages that we researched had a list of the fire brigade members along with pictures of the officers. Posting pictures of events the fire brigade has attended or hosted shows the fire brigade is involved in the community and cares about the residents. Putting pictures of socials or trips the fire brigade takes together on the web page shows the camaraderie between the members and may make people think about wanting to be a part of it.

Offering a first aid or CPR class to the public allows the people to see what the fire brigade actually does and the some of the emergencies they respond to. This class would not only benefit the fire brigade but the people taking the course. The fire brigade might have fewer emergencies to respond to if more people know what to do in small situations. Also, once people are trained in these techniques, they may be interested in using their skills while in the fire brigade. The people would benefit because they would have new skills that could help them deal with small emergencies.

One large-scale idea that would promote the fire brigade is having a Fire Prevention Day or Week. This could even be expanded to a Safety Day where the Fällanden police department and other groups could be included. The United States has one of these where the fire department chooses a common them and publicizes safety tips wherever they can. The local fire departments will remind you to change the batteries in your smoke alarm and frequently give out free smoke alarms and batteries. Another thing they promote is forming an escape plan with your family so that everyone knows what to do and where to go if a fire were to happen. Many times there are events at the fire stations where free material is given out to promote fire safety. This technique makes people aware of the fire brigade and its presence within the community.

In Conclusion

As mentioned previously, difficulty in attracting new recruits is not a problem that is specific to Fällanden. Many communities around Fällanden as well as rural communities in other countries are having a problem with finding new recruits to join the fire brigade. In order to offer suggestions to the fire chief in Fällanden we explored reasons for recruiting troubles around the world, and what sorts of methods similar communities were using to address this problem. As shown above, there are many parallels that can be drawn between the recruiting problem in Fällanden and the international problem. This leads us to believe that another study could be conducted on a broader level of the recruiting problem that faces small rural communities in general.

APPENDIX F:
GVZ Building Codes

-For decorations in areas with public traffic, easy-inflammable materials may not be used. They should not be attached in such a way that additional fire risks develop. They may not endanger persons and may not impair exit by escape routes in the case of fire.

-Stairways, passages, exits, and escape routes must be able to be opened from the inside at any time without strange aid. Owners and users of buildings and plants are responsible for providing emergency exit signage, if the building is frequented by persons who are not familiar with surroundings.

-Sufficient escape and emergency routes are to be provided and kept free constantly.

-Large accumulations of flammable material are to be avoided; building debris should be periodically removed.

-Emergency escape routes are to be kept clear at all times , fire announcing and fire fighting mechanisms are examined and in working order and ready for use, the personnel are instructed on alerting of the fire-brigade and on how to act in a fire emergency..

-Highly combustible materials are stored in free standing structures far enough from the building as to eliminate endangerment by fire.

-Inflammable wastes, like saegemehl, wood chips, paper, textile, foam material remainders, prints, used packing material, oil-soaked metal chips and dust deposits, are removed to eliminate accumulation in the workspaces and kept separate in fire-resistant areas, in silos or at suitable places outside of the buildings.

-Materials, which can react in dangerous ways with one another, materials with special behavior in the case of fires, or materials which endangers the fire-brigade by their characteristics in the case of fire, are accommodated in separate storage, according to developed fire compartments.

-Large quantities of combustible and explosive materials are stored in free standing, single-story, non-combustible and no other purposes buildings, in tanks buried under ground with sufficient protection distance to neighboring objects.

-Doors open in escape direction, excluded for doors to areas with small person allocation and without special fire risk.

-Buildings and plants are equipped depending upon design, size and use with sufficiently dimensioned mechanisms for the technical fire protection such as delete devices, delete installations, fire and gas alarm systems, fire extinguishing systems, smoke and heat departures, emergency lighting and safety current supplies, fire

brigade elevators and explosion prevention precautions.

-Rapidly burning materials are inadmissible as building materials.

-The protection distance between individual buildings and plants is measured in such a way that these are not endangered by direct fire transmission.

-Thermal expansion and their handicap may not impair construction security.

-Hall ways which require fire resistance are measure in such a way and provided that their stability under fire demand remains keeping sufficient.

-Materials and building materials for roofs should not promote the spread of fires

-Fire walls with appropriate fire rating are between single family homes and homes and commercial buildings.

APPENDIX G:
Observation Checklists

Home Fire Inspection Checklist

Exits

- Two ways out
- exits not blocked
- locks and latches open easilly from inside
- doors open readily
- hinges not damaged

Early Warnings

- working smoke detectors in appropriate locations

Common Fire and (CO) Hazards

- ash trays
- proper location of candles
- matches and lighters stored away from children
- improper use of extension cords
- additional electrical receptacles when needed
- no build up of lint in dryer lint filter
- overfused circuits in electrical panel

Kitchen and cooking

- location of combustables away from cooking devices
- unattended cooking equipment left on
- dirty oven
- gas oven left on for heating
- use of a charcoal or gas grill inside

Heating Equipment

- not near combustibles
- properly maintained
- exhaust from heating system is vented
- space heaters are kept away from combustibles

School Inspection Guidlines

Life Safety

exits not blocked on interior or exterior
at least two ways out
exits and egress routes properly marked
all exit doors readilly open from the inside and open outwards
no storage in paths of egress
trained in evacuation procedures
fire drills conducted
procedures for accounting for students
fire allarms present
pre planned procedures for notifying the fire department
emergency lights
fire pulls

Fire Alarm Detection, Alarm Systems,
and Suppression Systems

fire detection and alarm system
sprinkler system (optional)

Limiting Spread of Fire and Smoke

fire doors not proped open
no unprotected floor openings

Storage & Trash

dumpster kept outside away from building
no storage of flammable liquids or gasses inside the building
combustibles kept away from heat produceing machinery
proper disposal of smoking materials

Miscellaneous

no combustible decorations in egress areas
limited combustible decorations in classrooms

Industrial Building Inspection Checklist

Life Safety

- exits not blocked
- at least two ways out
- exit doors and egress paths clearly marked
- all exit doors readilly open from the inside and open by swinging outwards
- no storage in paths of egress includeing halls and stairwells
- staff trained in evacuation procedures (assembly points...exc)
- fire alarms, horns, and strobes properly located so all occupants are alerted
- emergency lights along egress paths

Fire Detection & Alarm Systems &
Fire Supression Systems

- fire detection and alarm system
- sprinkler and standpipes
- adequate water suply
- specialized fire supression systems for areas with highly flammable materials
- systems maintained and checked

Limited Spread of Fire and Smoke

- fire doors no propped open
- fire walls
- no unporotected opening in floors, shafts for ducts, pipes...

Process Equipment Safety

- properly located and clearly labelled emergency shut offs
- combustible materials kept away from heat generating equipment
- placards showing process hazards clearly placed at entrances to process a
- hazardous equipment fire detection and suppression systems housed in fire compa

Storage and Trash

- dumpster kept away from building
- proper disposal containers for hazerdous waste
- proper storage of hazerdous materials
- segregation of reactive materials
- MSDS's readilly available

APPENDIX H:
Note on Observation

Observation of Fire Brigade Building

Equipment

- Not enough SCBA's for every fire fighter.
- One pump truck
- One ambulance
- Three personnel carriers
- Chemical clean up trailer
- Pump trailer
- Ladder trailer
- One pioneer
- hoses in storage
- PPE (helmets, gloves, boots, pants, jackets, and undergarments)

Condition and storage

- trucks did not always start cleanly
- equipment appeared to be well maintained , though we need further observation to be sure since we can not operate and test the equipment.
- Equipment neatly stored (orderly storage allows for fast access)
- Fire brigade training and emergency response reports are only kept for a year and then destroyed. Reports are not detailed and are hard to read because of hand writing.

House Inspections November 19th and 26th , 2002

Visited:

12 houses

Benglen: 2
Fällanden: 5
Paffhausen: 5

Apartments: 7
Houses: 4
Multifamily house: 1

Frequently Observed Hazards

- doors had to be unlocked with a key from the inside, preventing a quick escape
- several apartments had no 2nd exit
- no smoke alarms anywhere, with the exception of one located in a child's room
- Highly combustible materials stored within dwellings.
- Old multifamily home had a chimney running in close proximity to a wooden wall without fire wall which could result in fire and spread to other homes.

Good Practices

- most candles were safely used and stored
- coals from fireplaces were carefully disposed of (waited until they were completely burned out)
- Most dwellings were either new or recently renovated so materials used in construction are very fire resistant (as required by GVZ).
- Many homes did not have driers
- Many homes had central heating (safer since it is only hot water that is being pumped in)
- At least two ways out of homes
- Exits not blocked
- Most homes had protected fire places

School House Observation November 26th, 2002

Schools Visited

- Pfaffhausen Lower/Middle School
- Benglen Upper School

Frequently Observed Hazards

- No fire drills, students not trained in evacuation procedures
- No way to account for all students if evacuated, no attendance taken
- Alarm present in only one building, because it was just built
- No fire pulls
- No emergency lights

Good practices

- exits not blocked
- limited combustible decorations
- concrete and other non combustible building material

Industrial Observations November 7th and 26th, 2002

Industries Visited

- Bruker
- Bodycote
- Stoop
- Ventura

Frequently Observed Hazards

- most companies did not have fire alarms or smoke alarms
- no emergency lights along exit ways
- no sprinkler systems
- some companies did not have any protective storage area for flammable chemicals
- exits not clearly marked
- not all exit doors opened in direction of egress

Good Practices

- fire hoses
- buildings made of out concrete
- dumpsters stored away from buildings
- MSDS sheets readily available
- Emergency shut offs for machinery present
- Some had floor plans available to personnel that showed location of fire suppression devices
- At least two exits in all companies
- Exits not blocked

APPENDIX I:
Notes on Interviews

Ruedi Maurer Interview October 21st and 22nd, 2002

Important information gained from Mr. Maurer

Division of Fire Brigade

- commander group consists of officers, they go to scene and decide whether more help is needed
- two main groups, one during the day (11 & 21) and one night (12 & 22)
- special interest groups (traffic, electrical/gas/elevator, ambulance) get extra training

Training

- fire fighters must go through 30 hours of training
- 14 training sessions are planned for Fällanden
- Ruedi trains officer and KPLs (group leaders), they in turn train groups
- Special training to drive the fire trucks
- Training sessions include: oil & chemi, ladders, communication, pioneer, extrication tools, foam, traffic control, fire suppression, debris removal, and breathing apparatus (but not enough for everyone, only 16)
- no special operations (i.e. ropes training or water rescue)
- first aid training
- no physical requirements- officers know strengths of each member
- if under 40 need to go to doctor every 5 years, once a year after 50

Payment

- officers get a flat rate plus every emergency they respond to or training session they attend
- fire fighters get paid for each emergency or training session

Equipment and Maintenance

- no full chemical suits
- every fire fighter has their own fire safety suit and is in charge of maintenance of it
- personal equipment is checked once a year, but owner will look at it at every training session and notice if something needs to be fixed
- siren and blue lights do not give special traffic privileges
- trucks do not beep in reverse
- Bert maintains trucks, if a fire fighter notices something is wrong during or after an emergency, they write it on board and he will fix it

Outside help

- there is a help network in place similar to mutual aid. If fire chief/officers decide brigade can not handle task, they will call in another fire brigade to help
- Within the community, the whole brigade can be called to duty.
- The police are trained in water rescue and have a boat
- Actual ambulance service takes 20+ min to respond
- Do not know how to handle chemical problems, work with nearby towns

Miscellaneous

- By law, the industrial companies are required to give the fire chief a packet of the dangerous chemicals they have, where they are located in the plant, and the floor plan of the plant was frequently included

Fire Brigade Interview

- the whole fire brigade is divided into groups/sections
  - commander group is first, all the officers
    - they go immediately to scene and decide if more are needed and what equipment/trucks should come
    - decide if they can handle this emergency or is it too big
  - special interest groups that get extra training
    - traffic, electrical/gas/elevator, ambulance
  - two main groups according to availability
    - one during day (11 & 21) and one during night (12 & 22)
- by law, the industrial companies are required to give Ruedi a list of all the dangerous chemicals they have and they also had floor plans of the plants in these books. Pictures of where drains were, etc, was in at least one book
- don't really know how to handle chemical problems, work with nearby communitiess for this problem
- no full chemical suits
- every fire fighter has their own fire safety suit
- separate numbers to call for police, medical, fire
- special training to drive trucks, not everyone knows how
- soldiers must go through 30 hours of training
  - officers and special groups must go through 16 extra
- siren and blue lights do not give special privileges
  - they can drive on sidewalks or dirt roads, etc
  - people will pull over and stop, but not required to
- trucks do not beep when in reverse, but new one probably will
- soldier gets trained 14 times a year
- Ruedi trains officers and KPL (group leaders)
- Officers train their groups
- Personal equipment is checked once a year officially, but also every training session or emergency, the owner will look at it and notice if something needs to be fixed and will get it done
- Bert maintains trucks etc. if they come back from an emergency and notice something is wrong they write it on board, so he can fix it
- Soldiers have OC training (oil, chemi) and they train with all the material on the truck
- Have a training session on communication
- They do have an "open house" where they show fire brigade to everyone
  - Not too many people come, but kids, like US, love coming and playing on trucks, etc
- one training session consists of going somewhere where they can set fires and have soldiers work with them
- do have foam training
- not everyone trained in CPR, only certain group, have to be recertified every 2 years
- Executive from Zürich city makes laws, but GVZ says a lot too
- Payment
  - Officers get a flat rate plus every emergency or training session get paid for

    - Soldiers get paid for each emergency or training session
- they don't do special operations- don't have training for ropes or water or confined space
    - they try to handle every call, then decide whether they might need specialists
- the police department has trained divers and a boat for water emergencies
- all soldiers trained on breathing apparatus, but only have 16
- if under 40, have to go to doctor every 5 years, after 50 every year
- no real physical requirements, but officers know strengths of each member and know when to use them to best advantage
- 3 professional fire departments in Zürich area- city, airport, and one other
- first aid training given, not required by law, all should know it
- schools
    - teachers don't know how to evacuate
    - schools don't have alarms
    - only some exit signs
    - don't have drills
- bedroom community
    - only there to sleep
    - everyone commutes
    - live only for a few years here

Flugschneise Süd Nein Interview October 29th, 2002

Important Information gained from Urban Scherrer

- The organizations goal is no airplanes in the South
- Houses under the flight paths have to have roofs reinforced because of the draft from the planes, so not all paths are opened until this happens
- The current landing pattern for the planes flies over very few people and according to study done, this is the safest and most popular plan, but patterns will still change. When patterns change, will fly over the area that has the highest rate of people living per sq. kilometer in Switzerland
- Have had 2 crashes over last 10 years

60% of crashes occur at landing

- Flugscheise Sud Nein
- The organizations goal is no airplanes in the south
- military and rescue planes are already allowed to fly over the south, but civil airplanes are forbidden
- rules change 10/27/02 and one path will be open, the other paths cannot be opened yet because the roofs under the flight area have to be reinforced. It is too dangerous right now because the roofs could just fly off
- usually there is a 2.5-3.5 degree of landing, when commercial jets take off they rise at a steeper angle.
- right now the noise stops *→| but with change, noise will expand*→→→→|
- the military is flying over the south so they did not disturb the civil airplanes
- south has military planes north/east has civil planes
- have good living quality-no noise
- usually have military planes Tues and Thurs but during certain times
- Germany cancelled the contract with Switzerland for Swiss planes to be flying over their area
- right now, the landing over the last 10 km, you can't see houses and very few people
- with the changes, the area the planes will be flying over has the highest rate of people living per square km. in Switzerland
- switching to weekend rules for now
    - this means from 6-9 AM and 8-10 PM, there will now be planes flying over the south, plus military planes from 9 AM- 6 PM
- idea to switch to flying over south was from round table discussion. The table had communities from all around the airport (these are the communities that already have planes/noise there) the south only had 3 or 4 representatives out of 50. the majority of the round table (the north) didn't want to take on more noise, voted to change flight patterns
- the area that the planes fly over now has few communities and little people
- there is a substantially larger population that will in danger in the south

- north has no mountains, however south has hills, etc. and the planes will be coming in very low (on diagram, the planes would be flying lower than the height of the Eiffel Tower)
- risks to people/area were ignored in decision
- "only a political decision"
- have had 2 crashes over last 10 years (not a very good rate, 1 every 5 yrs)
- from the north, the planes crash into forest, from the south, the planes will crash into people
- originally 4 different possibilities (variants), the most secure way to fly is how it is now
- 2.4 to 2.6 times the current risk if flight paths are changed to the south.
- in this southern region, the people don't know, they think they can't change anything
- the region where the roofs have to be secured starts in Pfaffhausen
- Dept. of Civil Airplanes released study on plane crashes and it concluded that the biggest problem with crashes is that the planes are not flying where they are should be- puts a larger area at risk
    - 80% of crashes are at start or landing
        - Cross Air was a pilot mistake
        - Another crash was 300-400 meters too low, flew right into hill
- the organization started in July
    - 800 members now
        - Fallanden, Pfaffhausen, Benglen, Maur See, . . .
- Reasons against
    - Noise
    - Security (not clear whether this way is safe yet, if something happens it will be horrific)
    - Money- houses prices will go down with noise because living quality goes down
        - Group calculated 30-50% loss of value of houses
        - Total loss in area will be 2-3 billion francs
        - Won't be able to pay bills, etc. so will be forced to move
        - Rich people will move because they can
            - Taxes will rise
    - not necessary to change flight patterns
        - even with contract changes, can still keep flights the same
        - are changing plans because there is an estimated large increase in use of airport, but this was in 2000, and 9/11 changed everything
        - capacity airport is 420,000 flights a year, only using 300,000 now
        - also it is possible to come on borders of Switzerland then turn and can avoid German borders
        - with existing contract, allowed 100,000 flights over borders, only taking 60,000 now, so don't even use capacity, why change?

- feels group is having influence, but legally no influence
    - 49% of airport belongs to Kanton Zürich, but no chance of having impact

        - gov. asked people- people disagreed on the 4 variants, but the current system had the least opposition
    - need to let gov. officials know that people don't want changes
- getting new members
    - in July, flyers and form to fill out to become member of organization
    - then organized info booths in front of stores to talk with people and inform them
        - showed maps/diagrams and people were shocked, didn't realize impact
    - biggest amt of new members came from info evening that 450 people came to
        - only expected 100-250 people
        - people do not know the facts
        - had demo of noise from CD player, compared now to a boeing 767 flying overhead- huge difference
    - get new members also by word of mouth
- Urban shocked at how people just accepted changes and didn't think they could do anything, he knew he had to fight because he wanted to keep his house where it is
- Swiss people can make a difference, over the long period. Can stop voting for politicians, etc., but this is a short term problem
- 3 people are on the board of the airport where there main goal is to make lots of money but they are also politicians for Zürich
    - who knows what hat they are wearing at what time
- fighting changes in 2 ways
    - political/legal
        - laws, etc
    - bring people on road- demonstrations
- if they get 10,000 signatures, can get iniative so that all people can vote on changes
    - to get vote will take 2-5 years
- want to change all plans by 2005
- "Swiss democracy" doesn't work for short term
- Kanton Zürich has a zoning law for 1995 that says the airplanes in north, and none in south. These laws are usually for 20 years so that there is security so the people can plan future, roads, buildings, cities and decide how to plan them
    - this rule ignored in decision because it has only been 7 years
- if Bern (north) changes their rules, Zürich has to changes theirs too, vice versa
    - hasn't been decided yet who has to change first
- for greater good, can ignore Kanton laws
- usually have a voters right, where you have 30 days to fight a law and the law gets put on hold until goes through legal system
    - this flight pattern change was only announced last week and goes into affect sun, which is only 2 weeks
    - gov. said even if opposition, law is still going into affect now
    - loss of power of opposition

Richard Hirt Interview October 31st, 2002

Important information gained from Mr. Hirt

- over 100 community groups present in Fällanden
- traffic situation
    - study done by Kanton of Zürich found number of cars that travel on main roads through Fällanden at different points throughout day
    - gave us traffic data for the town
    - study done because so much traffic that they want a separate bus lane because buses are delayed so often
    - "traffic is terrible"
- Flug.
    - Brought them into community meeting because felt people should know about it
    - He is not associated with group, has to remain unbiased
    - "everyone fears change in flight paths"
- risks
    - "really don't have risks"
    - no big chemical plants or really dangerous industries
    - military flights over the community

Interview with Daniel Rigling November 20, 2002

Public relations and recruitment for the fire brigade

- Are under the required number of fire fighters by GVZ.
- submits an article for the newspaper every few weeks that gives safety tips for the people, keeps people updated on events of the fire brigade, and helps in general recruitment for the fire brigade
- has a weekend trip just for the fire brigade members
- at community Christmas market, have a stand where they give out coffee and fire blankets
- open houses for community and school classes
- Believes recruiting is getting more difficult because people don't feel it is worth the time and effort to go through so much training when there are fiew emergencies to respond to.

Education

- visit school and have students call fire brigade so that they can see exactly what occurs on the fire brigade side in the case of an emergency
- Students learn how to react in a fire situation, and learn how to contact the fire brigade

Capabilities

- Have two EMTs on the ambulance staff and others have first responders training.
- Fire chief prepares a checklist for an emergency action plan in the school.
- Fire chief is planning training drills and procedures for schools

Planning education for teachers, take them to an academy and train them to escape from a fire in a burn building

APPENDIX J:
Compilation of Statistics

Traffic Data

Traffic Accidents in Kanton Zürich

	Total	injuries	deaths
1990	3960	3859	101
1992	3727	3637	90
1994	3711	3620	91
1995	3714	3639	75
1996	3798	3419	79
1997	3727	3659	68
1998	3723	3655	68
1999	3964	3910	54
2000	4089	3991	98

Deaths in Traffic Accidents in Kanton Zürich (1998)

Total	Men	Women
78	53	25

Statistisches Jahrbuch des Kantons Zürich 2002

Statistics on Road Accidents for Switzerland

	Total	Deaths	Injuries
1970	28651	1694	18314
1980	25649	1246	14782
1990	23834	954	11182
1998	22232	597	6213
1999	23434	583	6299
2000	23737	592	6191
2001	23896	544	6194

Swiss Federal Statistics Office, 2002

Fire Data

Fire Deaths

	1997	1998	1999
Switz.	62	41	40
USA	4,400	4,400	39,000

Population Comparison for Fire Deaths (1997-1999)

Deaths per 100,000 persons

Singapore:	0.18
Switzerland:	0.62
Spain:	0.64
Netherlands:	0.68
Italy:	0.77 (1996-1998)
Germany:	0.82
France:	0.95
U.K.:	1.18
Canada:	1.38
U.S.A.:	1.56
Japan:	1.69
Hungary:	2.14

Cost of Indirect Fire Losses

Average percentage of GDP (1997-1999)

U.S.A.:	0.009
Italy:	0.014 (1993-1994)
Japan:	0.016 (1985-1986)
U.K.:	0.016
France:	0.018
Canada:	0.022 (1991)
Germany:	0.026
Netherlands:	0.027 (1995-1996)

Hungary:	0.029 (1992-1993)
Switzerland:	0.095 (1989)

The Geneva Association: World Fire Statistics Oct, 2002

In Switzerland, possible major events with a great number of patients were evaluated in a pragmatic way and possible effects were assessed:

	Persons Involved	Deaths to be expected	patients to be expected
Big fire	50 x 10^2	10-100	up to 10^2

The Internet Journal of Disaster Medicine, 1997

Plane Crash Data

In Switzerland, possible major events with a great number of patients were evaluated in a pragmatic way and possible effects were assessed:

	Persons Involved	Deaths to be expected	patients to be expected
Airplane Crash near Airport	100-350	50-350	30-150

The Internet Journal of Disaster Medicine, 1997

number of planes flying a year	**number of years/crash**
250000	12.8
320000	10
420000	7.6

Unique Airport and government advice

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