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Abstract

This report`s focus was to investigate legislation regarding evacuation of public schools according to emergency preparedness and building regulation as well as improving communication strategy.

Our problem statement is structured based on these questions:
How is the protocol of evacuation currently implemented at the Vita school Bohr in Esbjerg? How is risk communication strategy and emergency protocol currently structured? What are the risks associated with evacuation? Building a knowledge about FRAM and simulation – (Pathfinder) of evacuation of primary school.

This topic includes various aspects such as the social and cultural condition in the public school, theoretical perspective when it comes to the communication barriers and essentials to creating a better risk communication for informing the employees, children and parents. Main focus is oriented towards qualities of risk, such as probabilities and consequences, enabling are rational formulation of which risks to undertake.

Attention will also be given into ways of improving, efficiency to the formative influences of culturally understandings and social practice. To create a path for innovative perspectives on the conduct of communication strategy.

Preface

Our theoretical approach is deliberately interpretative and based on the theory of constrictive legislation, communication strategy and risk perception. Our main purpose with this assignment is to use our findings and knowledge to build up a solid fundamental frame of risk communication and strategy including objectivities, associated by specific purpose of evaluating likely outcomes of a risk, that exist under condition of contingent uncertainty in Vita school Bohr in Esbjerg.

Continuing with the objectivity of unintended consequences based on risk communication, which can be intended or unintended part of the constructive activation, using the simulation software such as Pathfinder, will provides an overview of the theoretical mechanism that may be beneficial in the future regarding evacuation protocol.

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Peter Hartvigsen - Municipal Assistant Department Children &Culture

John Andersen – Department manager at the Vita school Bohr

Lars Hammer -Bek – Technical service at the Vita school Bohr

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Elvin Bubalo **Christina Buchwald**

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1

Introduction

According to Carl Philipp Gottlieb von Clausewitz, (who was Prussian General and the military theorist in the early 18th century), his communication strategy, tactics and philosophy influenced the development of war art. Clausewitz analyzed the conflicts of his time based on a connection between objectives, goals and means. Aspects of how information is delivered to avoid negligence or misunderstandings and progress to achieve the potential goal by strategy plan, which can consist of different actions.[1] Today, it is more of visual expressions to focus on the subject because of the digital globalization. However, the purpose is to gather the essentials, knowledge and resources precisely where they will give the greatest effect. Communication is important in most of life's situations for the best results to be achieved. Communication is an ability we use from earlier age and continue to use for everyday purpose. Consequently, we receive an objective understanding of a formal perception that we are good at communicating. Another tendency is belief in technological development department that creates a safety factor where we believe that the technique works and has a firm belief that it will do it in all type of situations. However, a conventional understanding was established in the (risk) communication research where people tend to over or underestimate communication, owning to qualitative framing in terms of parameters such as perceived control, voluntariness, consequences and benefits.[2]

To make an example: World Trade Center in New York, Tokyo`s subway station, suicide bomber in Israel, attack on rail traffic in Madrid, the first terror attack in London UK, July 7. 2005 and the latest that happened on March 2017, in where a recent report shows that the police and rescue force used different radio systems and frequencies, which meant they could not connect with each other. That was the reason, of misunderstanding and a huge delay in the act of saving people's lives. The report showed that a thorough planning, including communication strategy and joint exercises, could have revealed this problem.[3] Technology provides security in the form of high-wire installation, access control, fire and smoke detector and video surveillance. It can complement the planning, but it cannot replace it. Safety without planning methods are worthless. The overall work and the impact of communication strategy and planning is to avoid the consequences of the loss of human life, material and organizational image, which is very important in the world of digitization. Another example is organizational disaster planning, which often contains a telephone list of key numbers, that the organization’s internal communication and safety group

[1] Quote from the book Take disasters seriously before they happen by Christian Leth 1. Edition 2012 page 9.

[2] Quote from the book Effective Risk Communication page 6. Edited by Joseph Arvai and Louie Rivers III. First published 2014 by Routledge 711 Third Avenue, New York

[3] www.tv2.dk ,www.dr.dk Book Take disasters seriously before they happen by Christian Leth 1. Edition 2012 page 119.

seems to be a priority. The external part on the other hand, seems to be downgraded. In line with the other planning, the communication plan should be carefully examined, tested and possibly expanded. Alternative communication options should be added. Understand that the plan is routinely updated each year, but any recognized change should be introduced when it is current. Organization builds up its communication plan and strategy by carefully reviewing all stakeholders and considering how they will communicate with each one during the crises. What priority should be given in information and communication concept, who is responsible for the occurrence and the form in which it should be. To make an example: The owners are called for briefing at the company, or the press, by telephone, or by press releases. Relatives overall orientation about situation, single or group. The orientation must be accompanied by prepared letter on insurance terms economic condition. By e-mail orientation it is convenient to have addressing groups prepared. In crisis situations (risk) communication as well as information is of outmost important source, especially in the crisis such as fire, earthquake, terror or simple recordable accidents at work.

Each organization has its own system and protocol in the event of an accident. The sequence of information routing starts from the person closest to the person who has experienced the accident. The evacuation protocol is reduced to procedure where is necessary to inform the deputy leader who will give the crisis staff a true and fair view of the situation in, giving the crisis staff the best possible basis for decision making. It is expected that the phone and other signal means will be heavily charged, therefore, signals must be given in a concise and rational form. Using example to illustrate communication planning and reporting as seen in figure 1.[4] A worker was injured relating to prescription changes, where the knife leaves were to be adjusted. He has lost two fingers on his right arm. A procedure that is subdivided into categories

Stakeholders	Contact/alternative	Priority	Responsible	Form
Owners		4	The owner informs by accident.	
Safety org.		2	Safety operating the situation by efforts of leadership.	
Employees		1	Coworkers contact ambulance and informed them about accident. Relatives are informed of the situation.	
Relatives		3	Accompanied by prepared letter on insurance terms, economic conditions etc.	
Insurance		5		
Local community		8		
Customers				
Suppliers		6		
		7		

Figure 1. Communication plan: Case where an accident has occurred (recordable)

[4] Take disasters seriously before they happen by Christian Leth 1. Edition 2012 page 120 and 121.

Organization builds its communication plan by carefully reviewing all stakeholders and considering how they will communicate with each stakeholder during the crisis. A plan must be drawn up on the priority to be followed in terms of information and communication. It is to be designated who is responsible for the occurrence and the type of protocol that will take place during the crisis.

1.2 Problem description

The master thesis project was initially introduced as an opportunity to do a project in cooperation with Esbjerg municipality, which sounded interesting because there was no directly thesis statement. We would therefore have an opportunity to be involved in the decision making of what the thesis statement should be. There was an introduction to the project on august 8. 2017, where the first meeting took place with our adviser Anders Schmidt Kristensen and Peter Hartvigsen from Esbjerg municipality. The conversation was based on the establishment of cooperation between the two institutions, Aalborg university Esbjerg and Esbjerg municipality, creating an objective structure of competitive situation and technological trends without involving financial performance. The project focuses on evacuation strategies for the Vita school Bohr, which is a primary school in Esbjerg. This project involves overall risk communication strategy, effectiveness of the evacuation planning and requires that communication concerning evacuation strategies should be transferred to a pedagogical level, because the project involves children from age 6 to 16. The Vita school Bohr, is a primary school in Esbjerg, located in the district of Gjesing in northern Esbjerg and the school was taken into service from 1 August 2014 after it was renovated. The Vita school Bohr, is part of the school district Bohr school, which also consists of Fourfeldt and Ådal. The Vita school Bohr, is the largest department with approximately 1200 students. The school has classes from grade 0 to 9th grade. The Vita school has several guidelines regarding educational structure. In the 7th to 9th grade, the school offers different educational lines. Among others Da Vinci line for the most talented, Hands On line for those who have a finger on the pulse and want to keep up with technological developments and ordinary for those who haven't determined their future. In addition, the school is a home to the municipality's elite sports class.[5] The goal of the current protocol is to suggest several ways of risk communication researchers and practitioners, seeking to better understanding of stakeholders' engagement, improvement and even might adopt recent insights form research on fairness into their work. Specifically, our approach has three aims. (**1)** to describe the nature of stakeholders' involvement and provide an overview of how involvement has been incorporated into previous risk communication research; (**2)** to review recent risk communication structure which related to uncertainty and identity they might relate to risk; (**3)** to discuss how the concept of framing (tools) can advance review into risk communication strategy. This finale section emphasizes the potential value of trying to better understand the communicative segment, whether in the form of psychological determination of outcomes or based on previous experience which reflect to efforts to communicative process of decision-making. Focusing on how communication may influence stakeholders' perception and engagement process. Much of the research on framing seeks to examine and determine individuals respond to a message, when they perceive that message as coming from a source with whom they identify. It should be noted that this emphasis on framing is consistent with the idea that is relevant, both in direct or interceded between decision-makers and the public (stakeholders). Today risk perception and communication strategy embrace the challenges associated with seeking to understanding ``audience``

[5] http://bohrskolen.esbjergkommune.dk/om-bohrskolen/vitaskolen-bohr.aspx

as active participant in the risk communication process. The world is constantly changing, and new threats are emerging every day. In the recent years there has been a larger focus on terror attacks, school shootings and arsons in the media. In the years between 2009-2014 the number of school fires pr. year have fluctuated between 100 to 240. The numbers cover all types of schools from elementary school to higher education institutions. In 2014 there was 69 building fires and 16 of them was registered as arsons. By one third of the fires, the cause is unknown. There are a lot of school's construction fires, this is typically due to lightning strikes, or when the school have craftsmen to renovate the buildings. The same applies to faults or carelessness with the school's electrical installations, which have caused fire approximately 12 times in 2014. [6] Between the year of 2016 and 2017 there has been made two bomb threats against schools in Esbjerg[7] and one threat of a school shooting[8]. Statistic also shows that Denmark is affected by more than one bomb threat per week, the survey was made by the National Police for TV2, the highest number was in 2008 where there were 81 bomb threats were made[9] towards public places and institutions such as schools, train stations and airports.

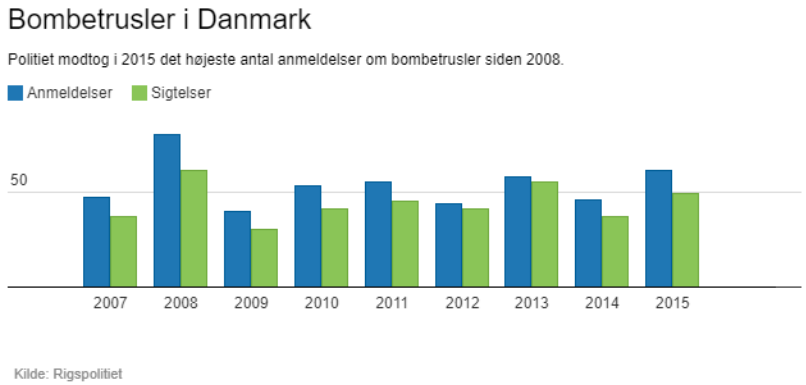


Figure 1.1 overview of bomb threats in Denmark in period from 2007-2015

Consequently, it is important for the Vita school to be able to conduct a Swift evacuation of the school buildings if one of this mentioned accident should happens. The focus of this project will be on how we can evacuate the students within a safely manner and how the knowledge about simulation can be implemented as a tool for evacuation purposes. Based on this initiating problem the first step would be to make a simulation to create an overview over the evacuation process, and to figure out if the students can be evacuated safely with in the time limit. Due to the different age range in the students attending the school we want to analyze some behavioral patterns of how the students might react in case of emergency and evacuation protocol. The simulation in pathfinder will be based on the evacuation from the 1`st floor in the section H, because every classroom in the ground level has few emergencies exits. The 1`floor consist of 11 classrooms with a total of 271 students in the age range between 13 to 14 years old and 12 teachers. It is the teacher's occupation to evacuate students safely in the case of emergency. However, crucial to a good fit between message and audience (students) is therefore an understanding of information-seeking and processing behaviors. Risk message can be informative and effective, only when students intercept them and encode them in some way. According to Lars Hammer Bek, (Technical service at the Vita school Bohr), the tendency of sending the message can be issue and matters of individual´s values based on the relevant expectations. Occasionally it happens that teachers don't have their work phone on or with them

[6] https://www.godtskolebyggeri.dk/inspiration/tema-skolen-braender!/hver-anden-dag-er-der-brand-paa-en-dansk-skole
[7] https://www.jv.dk/esbjerg/Bombetrussel-paa-skole-i-Esbjerg/artikel/2251214 and http://nyheder.tv2.dk/krimi/2016-05-03-bombetrussel-mod-skole-i-esbjerg-ingen-bomber-fundet
[8] https://www.tvsyd.dk/artikel/en-person-har-truet-med-skoleskyderi
[9] http://nyheder.tv2.dk/krimi/2016-03-28-danmark-rammes-af-mere-end-en-bombetrussel-om-ugen

because of the phones constrictive ability and options. The technological updating is needed as an objective suggestion.

The school also have special educational groups, there are 38 students with special needs in total. These students need to be taken in to consideration when being evacuated. they might panic a lot easier than others. To reduce the effect of formative discounting is to design communication effort to bring these individuals closer to the risk by explaining the evacuation process. By getting them to think abstractly a risk communicator can help them transcend that psychological distance and close the gap between the condition of risk and panic. When considering the aspects of this group based on decision-making subject it is essential to consider implementation of practical drills presenting techniques, activities of alarm system and sounds and developing of a deliberative risk communication framework. The Vita school is getting their venting system update, this means that there are builders at the school and that some of the students will be relocated for a while. When getting a tour of the school there was some tables that was stacked outside a door which where an emergency exit. This was due to the renovations, nothing that was there otherwise but could have been a problem if there was an evacuation. We want to describe and analyze the physical framework to identify the building facilities and the impact it might have on the evacuation. Our theoretical approach is deliberately interpretative and based on the theory of constrictive legislation, communication strategy and risk perception. Some of the models and analysis there will be used in this project are: Bow-tie, SWIFT, SWOT, FRAM, Stakeholder analysis and Risk Management plans. The final step in a methodology framework is for a member of the intended audience (students and teachers), to be evaluated for their risk communication and effectiveness based on assessing the strategy in case of evacuation. Our main purpose with this assignment is to use our findings and knowledge to build up a solid fundamental frame of risk communication and strategy including objectives, associated by specific purpose of evaluating likely outcomes of a risk, that exist under condition of contingent uncertainty in the school. [10]

1.3 Problem formulation:

A technique and theoretical approaches that retains our attention in this segment is based on risk communication. The subject of risk communication in highly susceptible to arguments based on scientific findings through research. The second element of the theory of risk communication is the risk object which referred to as a potential hazard. However, the mechanism that creates risk potential is associating and it is somehow bounded by a socially acknowledged to which people might respond. Grounded on this initiating problem and results of the presented (risk) communication as well as culture analysis, has been used to reflect on a serval sub- questions such as:

1. How is risk communication currently structured?
2. How is the protocol of evacuation currently structured in organization to deal with emergencies?
3. What are the risk associated with evacuation?
4. Is it possible to use simulation software to aid and improve focus in the case of fire or evacuation?

From our perspective, these questions deal with an overview of current situation, as well as identification of the different elements involving organization structure, stakeholders and their roles. Risk

[10] https://www.godtskolebyggeri.dk/inspiration/tema-skolen-braender!/hver-anden-dag-er-der-brand-paa-en-dansk-skole
https://www.folkeskolen.dk/44331/skolebrande-skyldes-ofte-drengestreger

communication in the process of decisions making that are socially complex require considerable motivation or entail processes of changing the risk perception based on communication strategy.

1.4 Problem analysis:

The Danish primary school has been in the median of a value struggle for the last 30-40 years and has become the obvious battlefield for society's discussion of values. Globalization where modernity is part of the decoding of the traditional aspect, as well as the dissolution of large subcultures in subcultures and increased proactivity in the population, has meant that there is no longer any awareness of which communication attitude or culture the school should represent. Today we are experiencing a constant debate about the process, content and shape of elementary school.[11] Back in 2004, the three largest Danish daily newspapers wrote about 3000 articles that deal with what values, competencies and the constructive handling of various risk perceptions in primary school.[12]

The crime prevention project ``school social life`` has created constructive conflict management, communication and cultural change in primary school. Organization's goal is to change the standards regarding building regulations, especially in new buildings, so the fuse of doors and windows complies with fire standards, as well as reducing burglary by focusing on alarm systems and cybercrime. [13]

Communication and cultural analysis are obtained in this context as results from a qualitative interview survey as well as risk analyzes based on theory that relate to or can be relegated to school's situation and conditions. Based on the investigation, commonly the root of the problem is the failure to distinguish between operational effectiveness and strategy.

Primary focus will be based on theoretical angles from the emergency management distinct type create by manmade. We will try to come with suggestions based on changing human behavior and risk perception by establishing process of preparation, Emergency management planning, Risk communication strategy, Analyzing data, Cultural aspects and Language. Our visions are to develop plan followed by phase of imperative communication structure, where position and frame of behavioral guidelines throughout education and practical exercise using Pathfinder simulation software, to create visual aspects of what to do and how to react in hazards situation to avoid probability of loss of life. To achieve all this, it is necessary to pay attention to technical things such as: Validation data, Drawings and current evacuation plan including instructions for fire doors and windows, Specific set up including inventory in relation to fire doors and windows and Selection of a class room for measurement, which are limited due to the time we have available.

1.5 Problem delimitation

The scope of the thesis does not cover an entire school, but only a part of the school because of the time limit we had with us. Our intention is based on the theoretical study of the functionality, technical details and evacuation planning process in the event of fire or terror at the Vita school in Esbjerg. The method is to be prepared through statistics, data and interviews from the employees. Furthermore, the legislation will be limited to emergency preparedness, building regulations and emergency management plan. Focus has also been on communication rallied factors and strategies that have created better understanding and

[11] Quote from the book: Formidling til folkeskolen culture analysis as a means of information planning by Malene Gronemann Giorgi nr.152/2005
[12] search for primary school in Jylland Posten, Berlinske Tidende, and Politiken
[13] http://www.dkr.dk/om-os/dkrs-mission-og-maal/

cooperation between the Vita school and Alborg University. Emergency scenario setup is based up on man-made disasters categorized as unintentional or intentional.

1.6 Outline

Approach is deliberately interpretative based on concept of risk perception, risk assessment, communication strategy, emergency management, stakeholder's analysis and simulation to access possible outcomes of risk that exist under condition of contingent uncertainty.

Chapter 2. cover the technical detail´s frameworks such as organizational structure, legislation including Emergency preparedness process for evacuation of schools, emergency management plans and risk analysis.

Chapter 3. is analyzing cultural behavior and risk communication aspects which is the key of psychological finding that lay people understanding of risk perception.

Chapter 4. is based on technical approach using Pathfinder framework to create a view and analyzing efficiency of emergency protocol, create a relational definition of contingency plan and provide a new angle of innovative understanding of simulation.

Chapter 5 and 6 is related to discussion and conclusion based on technical and theoretical approaches compering the results regarding the questions defined in the problem formulation.

Chapter 7. Recommendation

2

Technical analysis

Emergency Management framework

2.1. Legislation

The Danish system is divided into three levels. Firstly, the central level is where the framework legislation and the order are governed by the directorate of the management of offensive situations involving the ministry of defense, which the law came into force with the Emergency Act. This type of protocol encompasses several guidelines when it comes to the competent authority responsible for the accident and making communication planning decisions, whether to mitigate or reduce the risk when it comes to people, property or the environment. The main and responsible authority in terms of power under the Ministry of Defense is national emergency management agency. Authorities in the ministry have the power to communicate with other organizations or individuals to coordinate aid with fire and rescue service. Supplemented and reinforced by the regional that is under the central level. Regarding the local level municipalities such as Esbjerg, the task of emergency management relies on the municipal Fire service and Rescue service, which is the part of the municipal council as illustrated in figure 2.1

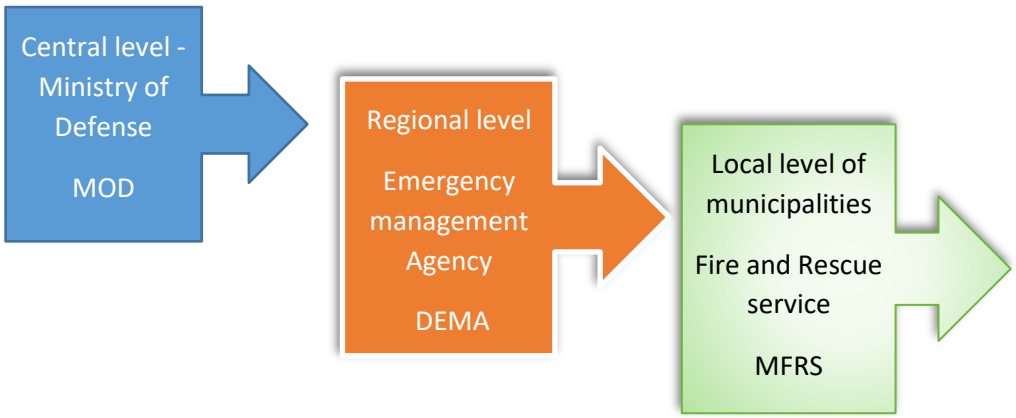


Figure 2.1 Organization structure regarding division of the political system and distribution of authority

Particulars:

According to the Danish Emergency Management Agency there are 120 fire alarms every year in schools around the country. One of the biggest causes of fire is a human factor and human perception regarding risk. Most fires are extinguished before they develop, but large fires occur in schools both in and outside school time. The school has a great responsibility to take care of the safety of students and staff. The Danish Emergency, in cooperation with the responsible emergency preparedness managers, has prepared material on the fire and evacuation plans and fire tests to help schools to comply with this requirement.

The material itself is structured so that the schools themselves can edit and adapt plans to the local relationship, as each school is structured differently. One of the high requirements for operating regulations is that the staff must be thoroughly instructed about the different rules and use and location of the fire extinguishing material. They should also be able to follow instructions on warning and the tasks involved in evacuating fire-fired classrooms.[14]

Example regarding fire or evacuation:

If there is fire or similar where it is necessary to evacuate the school, the warning goes away: Over the speaker's message to all classes that follow:

- An emergency has occurred.
- Everyone must quietly set the rooms at the nearest exit.
- Remember to close all doors and windows.
- Stay together and go to the asphalt courts at the sports ground together with the teacher, and stand by your class mark.

The watch then rings 3 times for 10 seconds at intervals of 5 seconds. Only when the fire inspector allows for it, the lanes must be left.[15]

Comment to this example of evacuation strategy

The schools have decided to make very short plans in this regard, and in many cases this plan is not sufficient to provide a safe form of emergency evacuation. Formative protocol established in the so-called policy structure where schools use these materials believing that they are sufficient because they are relevant to the core of the process and the rules. However, schools should add more aspects, such as templates, fire exercises, and evacuation missions to develop a locally adapted plan.

For all schools, provision is made for the municipal council through the local building authority and fire authority. The school's daily leader is the main character who is responsible for compliance with the operational regulations. All employees must be thoroughly instructed in regulations such as rules of procedure. school extraordinary events camp schools etc. Where special fire considerations are required and location of fire extinguishing material. Notification instruction content and regulations regarding evacuation. The fire safety conditions in schools depend on when the school is built. The safety level as building regulations BR15 and Executive Order No. 212 of 27 March 2008 on operating regulations for hotels, etc. care facilities, meeting rooms, teaching rooms daycare centers and shops indicate must be considered as a current standard and should therefore, from a safety point of view, also be sought in older buildings. Fire protection of a building must not be impaired either daily or regarding maintenance. [16]

School Operational Requirements, guidance regarding fire and evacuation is given on how to deal with critical situations. Among others the staff must be thoroughly informed about the rules of procedure and the use and location of the fire extinguishing material including equipment. The staff should be able to

[14] http://www.kl.dk/ImageVaultFiles/id_29012/cf_202/Forebyggelse_af_brand_p-_skoler.PDF

[15] Materiale: Evakuering af skoler ifølge Beredskabsstyrelsen page.6-7

[16] https://www.arbejdsmiljoweb.dk/media/4113101/om-brandforhold-paa-skoler_net.pdf

carry out the tasks involved in evacuating the fire-fighting classroom. Basic course where they are instructed on alert instruction regarding evacuation is part of the exercise process. The Preparedness Act §36 has changed since 01 July 2003, where municipal councils have been asked once a year to decide whether fire and evacuation exercises will be held in buildings, which are subject to operating regulations. It has been given that the individual municipal council may require all schools with more than 150 persons in the municipality to conduct fire and evacuation exercise.[17] On behalf of the municipal council, fire inspectorate may issue injunctions for remedies in violation of regulations in contingency legislation. In case of special defects, the use of sections or premises may be prohibited. As a rule, fire detection must be notified in writing with at least 14 days' notice. Legal basis for fire conditions at schools is based on the framework for emergency management and the standardization of regulations. The relevance to the structure of the working environment is perceived by guidelines to prevent misunderstandings that could lead to problems or incidents. Building Regulations (BR 2010/14) "Building Regulations for Business and Floor Building Chapter 5 Fire Conditions" (BR applies to all schools listed, remodeled or changed after 1/4 2010). Aulaer, dining room, meeting rooms, gymnastics etc. to more than 150 people are covered by "Operating Regulations for Meeting Rooms" [18] For SFO, "Operating Regulations for Day Care Centers" apply.[19] For public schools, the Emergency Board regulation applies and in case of overnight stay, also apply operating regulations for hotels (section on temporary accommodation rooms section 8). [20]

2.1.2 Sub-conclusion

Unfortunately lack of knowledge about safety at school, increased risk of fire prevention, control and fire related accidents. Paul Slovic (1987) has said ``Most people when it comes to risk judgments rely on their intuitive divided into the two segment of row information and perceived knowledge`` that create a formative picture of individual facts and believes knowing about risk and sense to react to the current risk based on knowledge. Which means our perceptions shape our reality of risk judgments. Furthermore, understanding risk perception, reveal the most significant aspects that it is necessary to the influences that shape a human competition, creating a starting point for developing strategy which plays a significant role in event of fire accidents. Transforming passive fear of risk uncertainties into the statement that reflects and provide dedication to avoiding certain outcomes. Focusing on the rational theoretical aspects of risk perception, provides subjective approaches that it is important to the staff and management to be proactive in the critical situations caused by risk hazard such as fire. Situation which involves risk based decision making process, reducing damage to the people, prevent the spread of fire, saving buildings and equipment as much as possible.

[17] Danish Emergency Management agency evacuation of school's page 3.
[18] http://www.brs.dk/fagomraade/tilsyn/forbyg/forsamlingslokaler.htm

[19] http://www.brs.dk/fagomraade/tilsyn/forbyg/daginstitutioner.htm

[20] http://www.brs.dk/fagomraade/tilsyn/forbyg skole.htm http://www.brs.dk/fagomraade/tilsyn/forbyg/hoteller.htm

2.2 Emergency Management

Developing a framework for evaluation, creating the platform of transparence between functionality and practices response process of capabilities, by simulating an event to which responsible officials must respond. Applying to the strategy of the emergency management begins with analyzing source of impact, using a comprehensive set of measures. The emergency management cycle as seen in figure 2.2. covers all four phases of an emergency scenario and details.

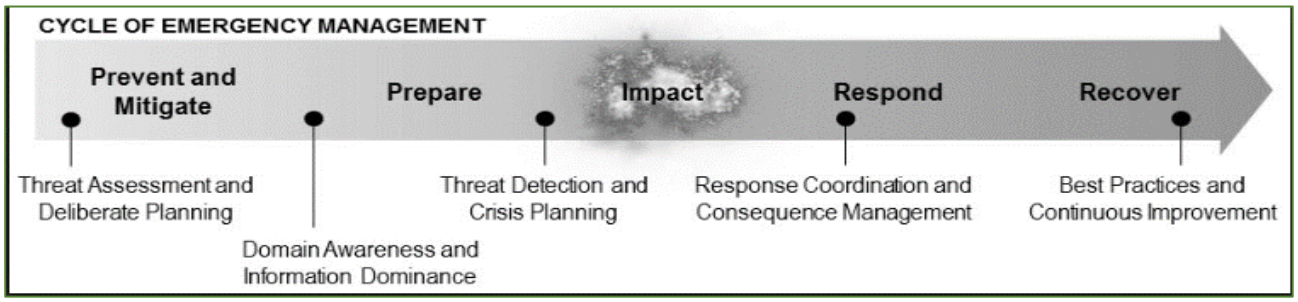


Figure 2.2. Emergency Management cycle

After the four phases of the emergency, the cycle continues with mitigation again based on summary from the previous event. Decision criteria analysis revile two distinct types of disasters. Natural and man-made disaster. The natural disaster involves everything from earthquakes, fires, floods to eruption of volcano. Natural disasters behaviors cannot be controlled, however examining the outcomes of potential disaster by monitoring the frequency about subjective risk probabilities, can create an acknowledged theory and prediction. Man-made disaster is categorized as unintentional and intentional disaster, meaning that segment of the events can be coast by accident such as fires or collisions or accident based on social psychological radicalism such as terrorism. Facts that terror is man-made disaster, creates a question in the context of social- psychological behavior: *What is goal and purpose of terrorism?* Well the purpose of terrorism can be raising awareness of the problems in the society, gaining some form of economic power or to destabilize society creating panic, insecurity, confusion or chaos.

Motivation can be revenge, envy or reward depending on the very purpose of terror. The terrorists and their organization are often professional and well-versed. Planning is done after a careful analysis where they can perform most efficient action with the least cost. Basically, the goal of terror is to gain power over an area or community. Attacks on civilian have existed throughout all ages, but are actualized by the development of new means and methods as well as their frequency. If the terrorist knows, believes or can only hope that they sacrifice is less than what they can achieve, they will use terror as a source of integrity. Unfortunately, in our society terror will be a problem for many future generations.

PET (Police Intelligence Services), in cooperation with NATO and the United Nations, has formed the framework for global action against terrorism, and provides the basis for Denmark to use the necessary funds for concrete threats. This applies to diplomacy, development assistance, police efforts, intelligence and prosecution or in extreme cases means military. Back in 2003 The EU adopted a security strategy that contains preventive engagement. This kind of security strategy involves economic as well as technical assistance and long-term tasks that make functionalist radical recruitment of terrorists.[21]

[21] https://www.consilium.europa.eu/uedocs/cmsUpload/78367.pdf

Our decision -making process is grounded on the conception which relies on the ability to reduce risk through the efficiency of risk communication efforts. Analyzing the rational theory of risk communication will determent values and perspective and hopefully benefit the Vita school, to develop an innovative understanding of risk communication in form of sense -making establishment by social and cultural contexts.

2.3 Organizational Structure

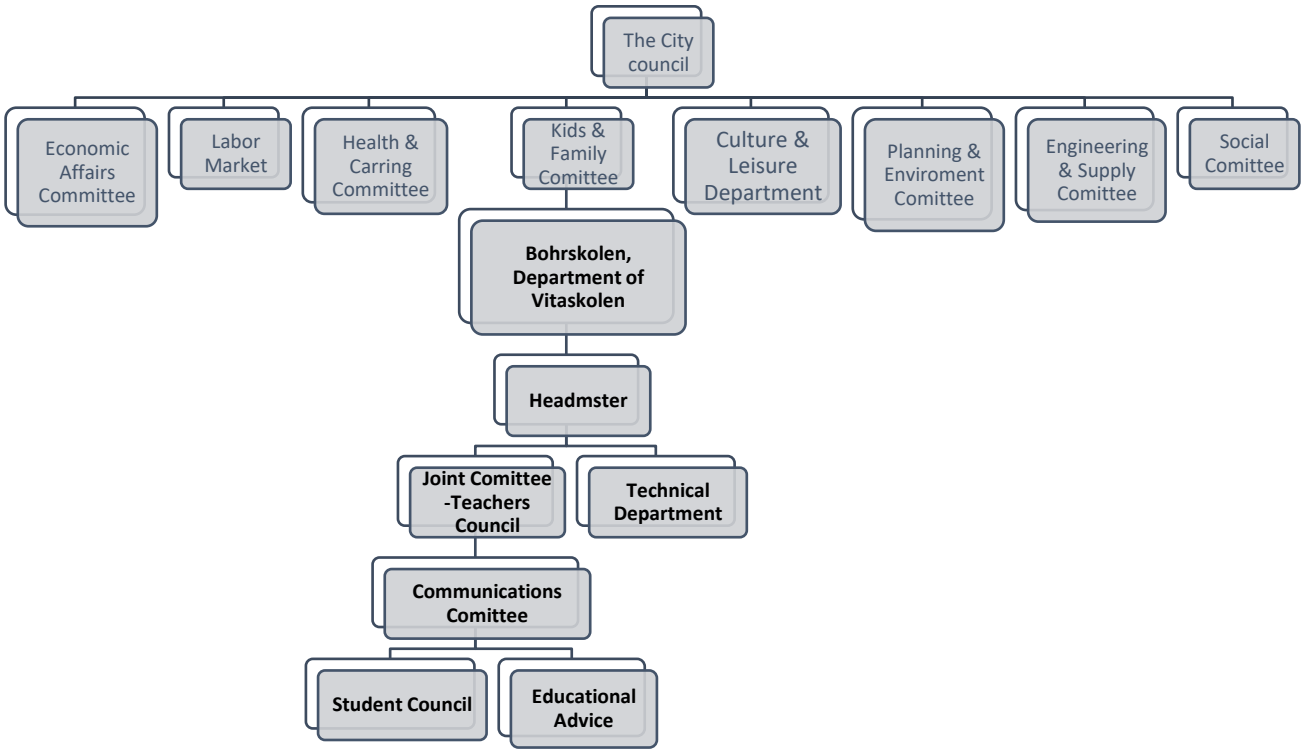


Figure 2.3. Present structure at the Vita school Bohr in Esbjerg Municipality

Organization of all sizes and types face internal or external factor of risk where uncertainty create obstruction whether and when they will achieve their objectives. Creating the structure of an organization defines framework of controlling act which is processing system developed based on leadership, organizations design, communication strategic, human resources, decision making objectivities and motivation. However, all activities of an organization involve risk. Organizations manage risk by identifying it, analyzing it by assessing uncertainties beyond expected values and then evaluating whether the risk should be modified by risk treatment to satisfy their risk criteria.[22] School as an organization strives to be appropriate in terms of developing competencies in the society in which it is located, it must be structurally organized as a modern workplace where adults as well as children are mentally oriented to seeking, learning, and cooperating within a security scale to be organized and aware of the evacuation protocol in the event of crisis. The size of the company is decisive for how large an organization needs to be. It is necessary to be expressed to the prevention of all functions in case of crises situation.

[22] DS/ISO 31000:2009 (E). Risk management - Principles guidelines https://webshop.ds.dk/da-dk/standard/ds-iso-310002009

A responsibility benefit plan is developed and mentioned on the effort that leads to a coalition and categories focusing on some of the practical issues typically faced by risk perception, in decision process about the uncertainty associated with the outcomes of proposed assessment. Present emergency protocol for Vita school, is structure of relevance to crisis and risk communication based on research framing and creating multiple levels of the decision process in an emergency. However, it is very important to establish decision criteria to clarified and defined different mechanisms for assessment in processes of decision making. A well organization structure with defined roles, can summarize decision-relevant information about process that create a solid platform for the best response actions under an emergency scenario. The model of the response can be developing in the form of an influence diagram which has nodes referring to the different tools, basic ideas, principles and methods.

2.3.1Sub-conclusion

The idea is to create or present a risk picture, highlighting uncertainties beyond expected values and probabilities. Imperative for a successful organization is making process through the establishing crisis group, focusing on some of the practical issues typically faced by risk or crisis communication seeking to communicate clearly with participants, delivering a massage to the public in the decision process about the uncertainty associated with the outcomes of intended event.

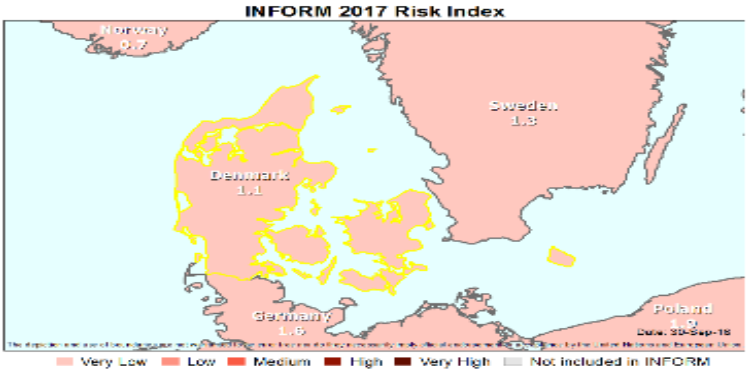
2.4 Emergency management plan

The segment of investigation reflects on Vita school Bohr, presenting an informative finding that create lay of understanding of risk, based on the qualitative framing in terms of parameters such as understanding the probabilities and consequences, describing risk and perceiving control by reflecting on an analysis - historical data or through risk management by measuring activities carried out to manage risk potential.

Since Denmark is a relatively safe country to live and according to the 2017 World Peace Index Denmark is 5´th safest country (combined major factors at the socio-economic development) out of 163 countries in the world. There are still possibility of natural disaster, fire, evacuation or manmade disaster which can be categorized as unintentional such as collisions, or intentional such as terror are presents factor in our society.[23] *So how to deal with these obstructions.? What needs to be done to develop a plan and what to anticipate regarding the probabilities of expected consequences?* Well one of the many issues that needs to be aware of is based on prevention, plans, education and drills. Awareness that disaster cannot be controlled but it can be reduced through preparedness. Another value is approach for selecting risk methods which realign on subjects based on the three aspects: expected consequences, uncertainties and frame condition.

According to the Prevention Organization, which contains information on the needs of the disaster reduction and processing concerning annual loss of natural disasters, Denmark categorizes within the reach of low outcomes. Additional part of this model is create based on the three aspects of vulnerability. The aspects of physical exposure and physical vulnerability are based on research which is integrated in the hazard. The aspect of fragility of the socio-economic system becomes INFORM's vulnerability frame of dimension, while lack of resilience to manage and recover is treated under the lack of managing volume as seen in figure 2.4[24]

[23] http://visionofhumanity.org/indexes/global-peace-index/
[24] http://www.preventionweb.net/countries/dnk/data/



	Value	Rank	Trend
INFORM	1.10	184	EQUAL
Hazard	0.50	184	EQUAL
Vulnerability	1.70	150	EQUAL
Coping Capacity	1.40	184	EQUAL

Figure 2.4 INFORM (Inter-Agency Standing Committee Task Team for Preparedness and Resilience of the European Commission).

The Average Annual Loss is the expected loss per annum associated to the occurrence of future perils assuming a very long observation timeframe.

Hazard	Absolute [Million US$]	Capital stock [%]	GFCF [%]	Social exp [%]	Total Reserves [%]	Gross Savings [%]
Earthquake	3.01	0.000	0.005	0.002	0.003	0.004
Flood	27.85	0.002	0.049	0.022	0.032	0.035
Multi-Hazard	30.86	0.002	0.054	0.024	0.036	0.039

Figure 2.4.1 Average Annual Loss by natural disasters[25]

Hazard*	20	50	100	250	500	1000	1500
Earthquake	12	28	49	90	134	193	228
Wind	0	0	0	0	0	0	0
Storm Surge	0	0	0	0	0	0	0
Tsunami	0	0	0	0	0	0	0

Figure 2.4.2 The Probable Maximum Loss by natural disasters[26]

The Probable Maximum Loss is a risk metric that categorize the maximum loss that could be expected, on average, within a given number of years. The system is using mathematical models to combine any likely future hazard scenarios. Data about the exposed assets and the vulnerability, to provide results of an estimate of probable loss levels in a region of interest. [27]

[25] http://www.preventionweb.net/countries/dnk/data/
[26] http://www.preventionweb.net/countries/dnk/data/
[27] http://www.preventionweb.net/countries/dnk/data/

Thought survey based on information gathering from INFORM we can conclude that the probability of Denmark being hit by natural disaster is relatively small, which leaves us to focus on disasters such as terror or fire evacuation. As we mention throughout technical analysis The Danish Fire and Rescue Service on the national level are divided into the act of terms and definition, where objective goals are to assign values by action taken to reduce risk. Coordinate an event or activities in the organization is a process of implementational measures as well as forecasting regarding probabilities and consequence of a risk perception. Theoretical approaches of interconnected stages of anticipation, avoidance and adjustment regarding risk. Companies may, according to section § 28 of the Danish Emergency Planning Act, be obliged to prepare plans, as they may be assigned tasks for the emergency preparedness under section §57 of the Preparedness Act. Other companies discuss the need, and, like any other discussion, arguments can be put forward.[28]

According to the Decree of the Law on Regions and the Decommissioning of Counties, The Capital Development Council and the Capital Hospital of the Capital (Regional Law)

The responsibility of the municipality council is to create an emergency management commission. General provisions - Committee Section 13, paragraphs § 4 and § 7 In addition, the Regional Council elect's members of the committee's boards and similarities in which the regional council must be represented under other provisions. Members of the regional council are obliged to receive elections to committees, commissions, boards and similar bodies as well as to perform other duties which the regional council may award. Emergency management commission regularly consist of a few members including the mayors of the municipalities and police commissioner. Essentiality the emergency management commission task is to develop ideas and strategy working together with the fire and rescues service on emergency procedure. All assignment relates to the allocation of infrastructure tasks where the basis for improvement of structural units is sought in such a way as to isolate or reduce the risk that may be caused by negligence. The current emergency commission of Esbjerg municipality is operating together with Varde and Fanø community, residing of 6 members and 3 volunteers as seen in Figure 2.4.3

Municipality Esbjerg:	**Name:**	***Title:***
	Johnny Søtrup	*Mayor*
	Jørgen Ahlquist	*Member*
	Bent Kristensen	*Volunteers*
Municipality Varde:	Erik Buhl	*Mayor*
	Kjeld Anker Espersen	*2 vice mayors*
	Kim Aasted	*Volunteers*
Municipality Fanø:	Erik Nørreby	*Mayor*
	Kristine Kaas Krog	*Member*
	Christian Mortensen	*Volunteers*

Figure 2.4.3 Emergency Management Commission members

[28] https://www.retsinformation.dk/forms/R0710.aspx?id=123670#K9

Besides the emergency management commission, Esbjerg municipality has also develop evaluating emergency preparedness plan relating to risk and crisis intervention in schools. The objective purpose of establishing a crisis team consisting of 2 to 4 psychologists who can be involved in the event of risk accident or another traumatic event. The purposes are to have qualify and professional network at school so that children in case of traumatic events receive the necessary help and support. In their educational approach, contingency plan comprises three main tools that are keywords when children and adolescents are exposed to potentially traumatic events. It is about structure, care and information. Structure that involves creating an overview of the situation, compile a plan (evacuation plan) so that a coordinated effort can be implemented. Care that can reflect in the everyday concept and has the potential understanding of different content depending on the context in which it occurs. The last term is perhaps the most important as it can be planned at an early stage and make sure that children and adults are informed of the factual events, to ensure that there are no trends of misunderstanding. The method of emergency preparedness relating to emergency intervention in relation to children and youth in schools is structural in the figure 2.4.4 below. [29]

Crisis where the team can be involved:
○ Special violent episodes, such as physical violence, terror, threats etc. ○ Accident which may also be associated with fire ○ Death at school or relating to school. ○ Target audience of children and young people from school to age 18
Contact to the crisis team:
○ Psychologists in the crisis team are equipped with a crisis phone ○ Crisis phone may only be used for calls in case of acute crisis ○ School leader, if the crisis team wishes to be involved in an emergency crisis, contact the emergency team on the telephone 27741377 ○ Crisis phone is open on all school days between 8:00 and 16:00 ○ Outside the emergency telephone opening hours, schools should use agreements with Prescriba in case of acute crisis.

Figure 2.4.4 The method of emergency preparedness

The meeting that took place in September 28.2017 with Peter Hartvigsen (Municipal Assistant Department Children &Culture) and John Andersen (Department manager at the Vita school Bohr), was successful in terms of the potential values where we understood that most successful change efforts start when some individuals or some groups begin to look at the organizational performance, technological trends and infrastructural situation. Their efforts to look at the current situation was motivating, and simultaneously great opportunities arose for us to integrate risk communication throughout the risk management process, so that the values of risk communication can inform and have influence on the determining risk management strategies. This is probably the way of creating a fundamental change, focusing on risk communication effects to determent the communication formative term of processing and analyzing the risk area. Good risk communication requires first and foremost the capacity to see what is happening and based on the intuitive create a dialog between authorities and organization and the stakeholders to

[29] http://www.esbjergkommune.dk/Files/Filer/Borger/Familie,%20b%C3%B8rn,%20unge/B%C3%B8rn%20og%20unge/PaedagogikogUV/Beredskabsplan_kriseintervention.pdf

exchange all types of information, knowledge and experience. The school has developed their own emergency plan in case of traumatic events. Explanation lies in so-called decisive educative or more habitual features such as socialization at school also means increasing expectations for subjects such as the fire and terror, that the school should deal with beyond the general school programs. Each scenario has its own protocol. Clarification regarding emergency plan in case of natural disasters, exposures, poison or gas spillage as well as bomb threats is based on informative protocol and evaluating the potential of hazard. There are few steps in the protocol which school staff must follow as seen in figure 2.4.5

In case of natural disasters, exposures, poison or gas emissions as well as bomb threats

Step 1.	The staff brings the students inside the doors and closes the windows and doors.
Step 2.	The pedal / technical service worker switches off ventilation systems, etc.
Step 3.	The office keeps informed in the media and provides information to everyone via mobile and school intra
Step 4.	If the circumstances require the buildings to be abandoned, everyone walks to the nearest free escape route (installation like fire)
Step 5.	Everyone stays in the place until the police or manager gives notice

Figure 2.4.5 Current protocol for Vita school in case of natural disasters, exposures, poison or gas emissions as well as bomb threats

Figure 2.4.6 is Emergency Management Plan for Vita school Bohr. It is basically processing the knowledge of informative framework based on hazard/risk assessment. The contexts of information are concept of underlying systematically reviews based on the historical data.

When	What	Who
Immediately	❖ Stop the accident Help the injured person Call 112 Inform the nearest manager Call necessary help	All
Immediately after the accident and during the day	❖ Give psychological first aid to the victims. It can be both injured witnesses or involved ❖ Consider the need for emergency aid for the vulnerable (within 24 hours) possibly. can the crisis therapist team be contacted. The team moves out if there has been a traumatic incident on a workplace. It can help with debriefing and emergency medical treatment. ❖ *Crisis therapeutic team can be contacted at tel. 27241179/40183184 or Preciba 70221266* ***Make sure it is in crisis:*** ❖ Will certainly come home Do not transport yourself Not alone is the first day and receives the necessary help ***Make sure that the injured relatives are informed*** ❖ Please contact. The phycologist has an agreement with, ❖ Inform colleagues and others concerned about: ❖ The occurrence of the condition of the injured person If the injured person has been hospitalized and the injured person is not informed by a police or hospital, then: ❖ inform relatives by telephone or personally.	All Leader Colleagues Leader Leader

Follow-up Day 1-5	❖ Report the accident to the Labor Inspectorate and the Occupational ❖ Injury Board via the A-damage system ❖ Include the work environment organization ❖ Use if necessary. care crisis plan	Leader
Follow -up 1-20 or later	❖ Follow up on the crisis and others involved Be aware of the signs of crisis action at the employee and yourself Help with return with adaptation and openness about it	Leader
Emergency management plan covers all employees on the county council		

Figure 2.4.6 Emergency Management Plan for Vita school Bohr

Figure 2.5.7 justify the protocol in case of the penetration of an armed person.

- Notify everybody around you the threat. do not use alarm.
- Alarm police call 112
- Alerts the office at number 76166461
- Bring you and the others to safety. Walk into the nearest local and barricades entrance.
- Close the windows
- Place you so that you are not visible
- Be quiet
- Do not contact the promoter even if it is a known person
- Stay in the room until a known person or phone calls you out

Figure 2.4.7 The protocol in case of the penetration of an armed person

In case of fire, there are specific procedure where the class teacher briefs at least once a year about how to deal with fire. The focus of this procedure is on safety for persons, mainly against risk of fire that can cause a large number of injuries and sometimes fatalities. To be able to identify events it is necessary to establish a procedure, analyzing uncertainties and consequences. The Vita school Bohr, has developed a locally adapted plan based on their facilities.

- In case of fire call 112.
- Contact the office to trigger the alarm.
- The Administration activates the alarm and sends an alarm by SMS to the staff.
- The teacher / teacher who has the class must ensure that all the students are taken on the course.
- You leave the class through the doorway or out of the hallway and out of the nearest outside door.
- If there is a fire in the hallway next to the class, you must either go to the yard and out another exit or out of the window.
- Keep the door open until the hall is closed.
- Go the fastest way to the ball field. Students find their teacher / educator and gather classically. Here the teacher / educator registers that all students are present. This is reported to management.
- Adults who do not have classes help to get all students away from indoor shared areas.
- All employers must be familiar with the location of fire extinguishing equipment.

2.4.8 Sub-conclusion

Managing risk and uncertainties associated with value of judgments and communication challenges cannot be answered by science or technology. It can only be answered by assessing the expected probabilities of human values and perceptions regarding risk assessment. One of the greatest success stories in the public education domain is the growing network of communication emergency response phase, based on Emergency management process CERC and CERT (community emergency response programs), functioning around the country developed to provide guidance and standardization to the exercise efforts of emergency management organizations. The exercises contain two aspect of drill process. The first one is based on functional exercise which means using and testing the practical response capabilities by simulating an event. The second one is full-scale exercise which is a scenario based event that seek to establish an atmosphere almost to an actual disaster. The so-called adaptive technical exercises can be a barrier in the implementation structure whose formulas in terms of the explanatory method are not sufficiently formulated.

To give an example:

The Vita school Bohr, has decided to perform an exercise in the event of terror. Based on that the school has written an informative letter, informing students' parents that the exercise will take place in the segment because of the consequences of terrorism. The purpose of the event was to develop strategy, evaluation of planning and response frameworks under the protocol to engage students to understand the risk, making the decision based on knowledge and safety improvements through the exercise. However, the formulation of the letter has caused panic, and the parents have suspected the worst, and there were convinced that the exercise was only an excuse for justifying facts in case which already exist. Few parents have even decided to keep their children away from school that day and the following days until the school gave up the assignment. Communication as a formative goals of sharing information under the condition of social behavior is always follow by uncertainties. It creates an emotional and an ethnical challenge, where segment of communication should be clear about the task, choosing the precision and format that allows the ``need to know`` information to be evaluated as easily as possible. Meaning that it can be very challenge to think if there are many sources of uncertainty and different outcomes.[30] Which prefer to a model of decision- making, based on the elements presented in this context. The school didn't have a set of alternatives communicative strategy, and in the early phase of the process they didn't defined contents of the letter. Various forms of analyses provide a basis ground of choosing which strategy are to be processed. Based on the uncertainty decision – making strategy must perform a review as well as judgment of the various risk communication alternatives, taking into the account advantages and disadvantages of the various aspects of alternatives. To demonstrate how the communication strategy should be develop and evaluate based on the decision -making factors. Analyzing risk communication alternatives, create a format that provides the answers to the decision -maker as seen in figure 2.4.9

[30] Effective Risk Communication *Edited by Joseph Arvai and Louie Rivers III. First published 2014 by Routledge 711 Third Avenue, New York* page.69.

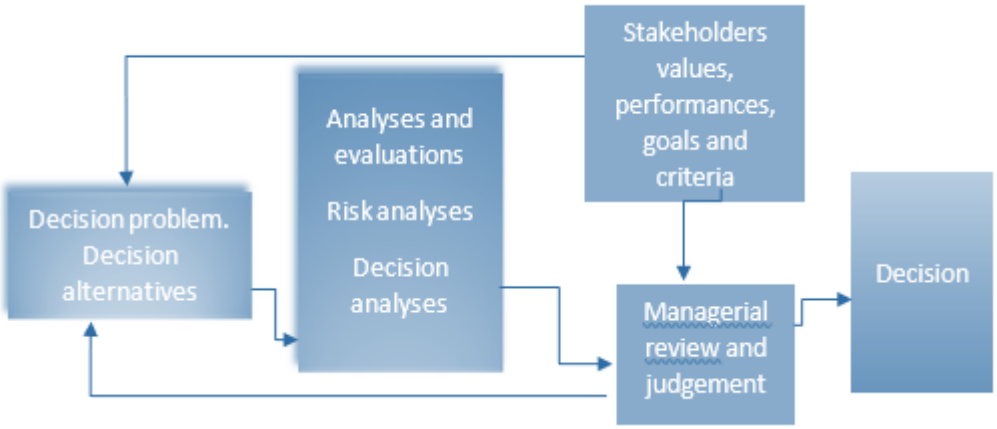


Figure 2.4.9 A model for decision-making under uncertainty[31] [xx]

Essentially various decision-making strategies can form the basis knowledge for the decision criteria, since each decision is underlying thinking of the group or individual. The principles are to be provided when making the decision, creating the terms of the process priority of who will be involved and what types of analysis to use.[32]

2.5 Risk communication plans

The concept of theory of risk communication is regarded as a formal frame of the construction of networks of dissimilar objects and categories, associated by known or supposed contingent casual source of inflicted hazard.[33]

Organization size and structure are limited by the extent of the task in scope and the number of employees involved. The other thing is what resource is available and what kind of implementation structures are involved in case of an emergency. The essential of progress from a social perspective is categorized according to the level of education. The Vita school Bohr, planning structure is based on the extent of allocation of resources, clarification of responsibility and decision-making power. The prerequisite for these criteria constitutes a solid planning framework. In addition to the emergency plan, public schools, must have alert plans, terror plan as well as evacuation plans, etc.

The increased emphasis on risk and public awareness of risk conflicts has stimulated the importance in developing a strategy of a risk communication between those who make decisions and manage risks and those who are exposed to it. Throughout this connection, the Danish Technological Council purposes out, that risk communication can have three major reasons that reflect or cover three phases in the history of risk communication: The first one is to ensure that all who are informed of a risk can understand the

[31] Aven 2003 - Risk Analysis by Terje Aven Assessing Uncertainties beyond Expectation Values and Probabilities 2008 University of Stavanger, Norway Publication page 10.

[32] Aven 2003 - Risk Analysis by Terje Aven Assessing Uncertainties beyond Expectation Values and Probabilities 2008 University of Stavanger, Norway Publication page 10.

[33] *Effective Risk Communication page 7. Edited by Joseph Arvai and Louie Rivers III. First published 2014 by Routledge 711 Third Avenue, New York*

meaning of the information they receive. The second one is to persuade information about the risk of changing attitude or behavior and accepting to be exposed to a given risk. And the third one is to create conditions for dialogue on risk issues, so that all stakeholders can participate in a process.

A growing interest in how to characterize and summarize evidence, so they can be understood by various stakeholders, helps to make a better judgment and decision in the process of identification of a hazard which will later reflects on prevention and mitigation phase in the process of risk assessment. However, for risk communication the key issue is to develop a solid summary of evidence that in the way highlights the fundamental and critical theory of the assessment. So, to do that it is essentially develop a process of evidence reporting as part of risk communication as seen in figure 2.5[34]

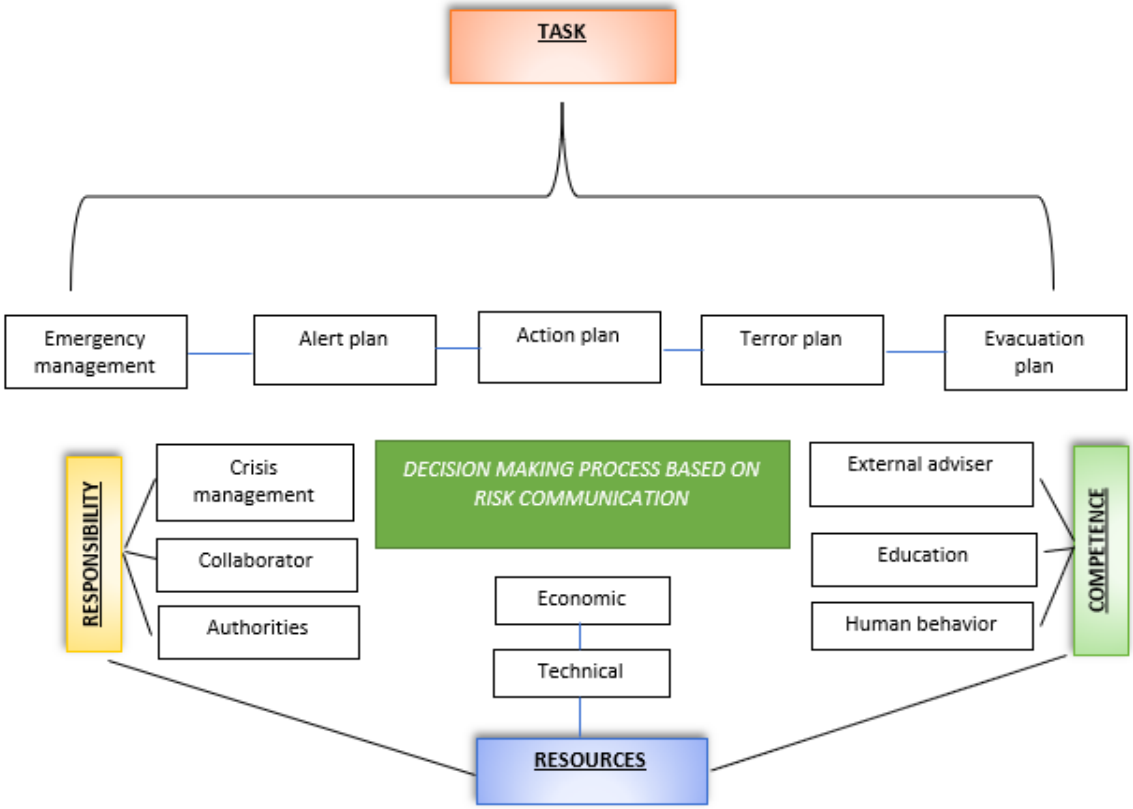


Figure 2.5. The concept of a planning framework at the Vita school

To demonstrate how current process of emergency planning works according to figure 14, this requires sufficient understanding regarding the options that are available. Making an informative decision based on the risk communication. The technical part as mention throughout the management plan in case of fire or terror, has systematically methods that those who are responsible should respond to. When it comes to competence, human perception on risk can have influence on decision acceptance and cooperation. A noticeable view of risk communication at the school is through the lens of risk information, that is as a

[34] http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2004/87-7614-132-2/html/kap04.htm

process during which people exchange information about risk and risk perception. These types of communication structure are typically involving the transfer of information regarding risk from experts to non-experts and back again. The objectivities of the risk communication have focused on managing the process across two dimensions which is process of delivering and content of the massages. The perceptivity of the process generally takes the form of hypotheses about the level of risk creating a focus on the theoretical assumptions which reflects on risk communication strategy. Although this plan is almost perfect, there are still some obstacles that needs to be changed. In fact, this procedure is developed without educational exercises increases the limitation of uncertainty, where in case of an accident the psychological factor, of students and the stuff will be followed by ``mental models` (the concept of mental models was developed to understand how individuals react to risk communication and decision-making process), creating the people's intuitive theories and perception on risk which will reflect on their process of the decision and procedure. The mental modes are relaying on the segment of systematic methods for developing communication to inform people´s risk related decision.

Execution in case of fire or terror is based on suggestions and logical intuitions of people without any structural procedure directed at the rulebook. Establishment or follow-up of a procedure according to the Danish Security Agency is a matter of motivation factor, encouragement and empowerment as well as impact on people's resources to ensure that they have the ability to understand, assess and act based on risk information. First step is processing and sharing (risk) information in ways that are understandable, appropriate and available at any time to all interest groups (stakeholders).[35] However, the fact is that frequency and adequate information remains one of the main challenges to effective risk communication shaped the value of engaging the influence and predictions of human perception associate with psychological vulnerabilities.[36]

This means that with a formal understanding of risk assessment, individuals can establish a type of mechanism for improving the constructive risk perspective and risk-related actions. This can be achieved by regulatory exercises where the process itself can be structured based on their input and feedback as shown in Figure 2.5.1

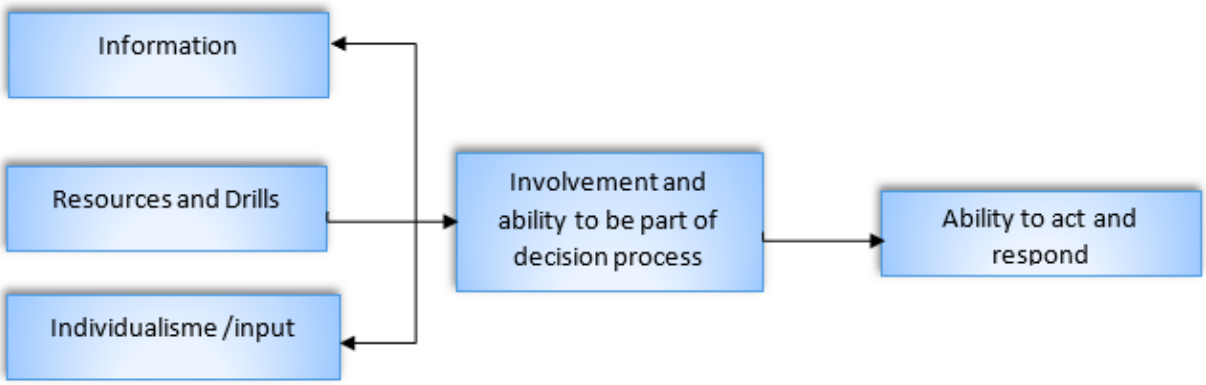


Figure 2.5.1 Mechanism of engagement in risk communication[37] [xx]

[35] Effective Risk Communication page.191. Edited by Joseph Arvai and Louie Rivers III first published 2014

[36] Effective Risk Communication page. 263 - Slovic 1986

[37] Aven 2003 - Risk Analysis by Terje Aven Assessing Uncertainties beyond Expectation Values and Probabilities 2008 University of Stavanger, Norway Publication page 11.

Information that provide a segment of inducement that has a meaning in context of processing a message in terms of data which can be fact or row material. Essentially information is processing as well as clarifying the data where the roll of speaker is to evaluate the objectivities of risk. Individualism in terms of ideological understanding defines a risk aspect that can provide an innovative theory of what is the objectivity of risk and the process of how this risk can be diminished or retained. Drills and resource as a view of theoretical advantage create operational effectivities, focusing on strategic position lowering the cost. Involvement and ability, to be part of decision process create ability to understand the risk perception and practical produces condition to act and respond.

However, another segment which has concerning aspect is approaches to risk assessment and risk management in general, relating to almost every activities, condition and event that can affect organization. Basically, the present system of emergency protocol at the Vita school Bohr, is based on Safety 1 structure where an important underlying assumption according to system is to make sure that the number of outcomes is kept as low as possible and hypothesis of different causes. (assumption of reasons why things go wrong are different than reasons why things go right). To illustrate the consequences of looking what goes wrong rather than right, consider and seen in figure 2.5.2 which has been borrowed from the article`` A Tale of Tow Safeties``[38]

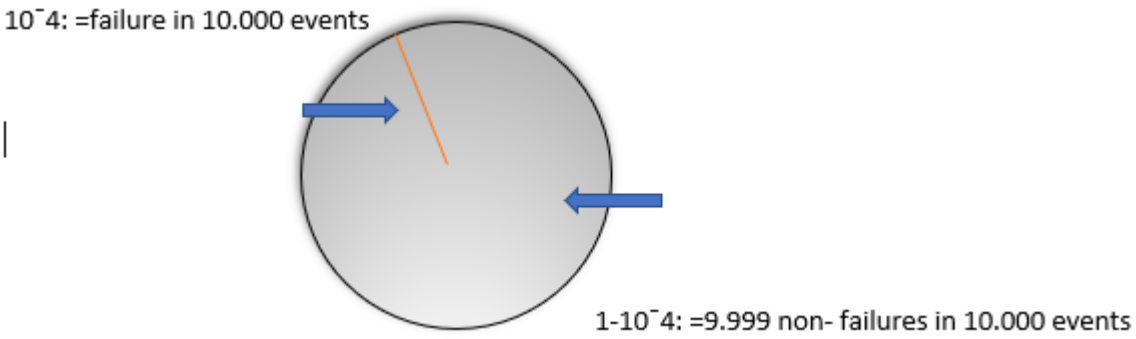


Figure 2.5.2 The imbalance between things that go right and things that go wrong [xx] A Tale of Two Safeties [38]

Statistically the probabilities of failure are 1 out of 10.000 (technically written 10¯4). Explanation is that for every time we expect that something will go wrong, there are 9,999 times where we should expect things to go right, and lead to grey area as seen in figure 2.5.2 (the outcome we are counting on). Focusing on the aspect of failure conforms our perception and understanding regarding what safety is, and how should be managed. The tendency is focused on security regarding business opportunities, implementation of financial investments, which demand time and resource, therefore it is difficult to justify or maintain. In this case, the issues are about transparency and communication barriers, which are formulated and presented in the wrong way. Another thing which is considering as issue from the Safety 1 is a formative reactive safety management also known as WHO cycle. This type of theory and act to respond is based on the steps that begins first when something has gone wrong or someone has been harmed. Response typically involves finding the way to eliminate the cause or to control the risk, by finding the source that cost the risk or identifying, creating the options for findings and recovery as seen in figure 2.5.3 below. In general perspective of a Safety 1. and the propose of safety management is basically is to keep the outcomes numbers of risk accident low as possible using the WHO cycle. This can be only done if event of risk does not occur so often, or otherwise it will become difficult to manage the actual work of the activities.

[38] A Tale of Tow Safeties - page 4 and 7 written by Erik Hollnagel in 2012 (Professor, University of Southern Denmark Chief Consultant, Center for Quality Improvement, Region of Southern Denmark Industrial Safety Chair, Mines ParisTech, France).

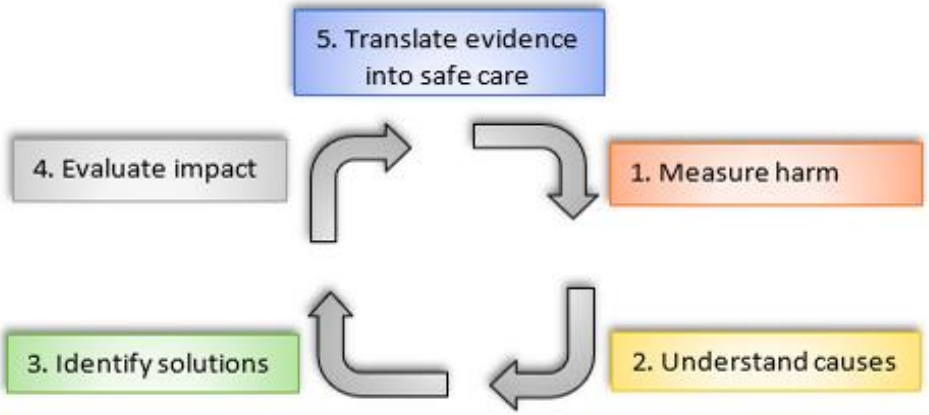


Figure 2.5.3 Reactive safety management cycle (WHO) [xx]

To conclude risk communication plans, it is necessary to provide a kind of theoretical and analytical model for understanding risk communication that contains the positions values for different stakeholders. Understanding of potential hazards and education exercises is a matter of providing or interpreting the message by deconstructing the analytical segments of the evaluation of the importance of communicative meaning in an informative whole explaining the motivation and performance of the protocols in the educational practice.

2.6 Stakeholders analysis – identification, power and interest

Stakeholder Analysis

According to Freeman a stakeholder analysis or stakeholder mapping is a process of identifying the individuals or groups that are likely to affect or be affected by a proposed action, and then sorting them according to their impact on the action and the impact the action will have on them and to analyses the stakeholders' expectations towards the project. (Freeman, R.E. Strategic Management: A Stakeholder Approach, 1st ed.; Pitman Publishing: Boston, MA, USA, 1984; pp. 24–25). This information can be used to assess how the interests of those stakeholders should be addresses in the project plan. Initially, the primary stakeholders need to be identified. Which parties might have an interest in the project? Primary stakeholders are those who are affected, either positively or negatively by the project usually external stakeholders, are those who – although they do not engage in direct economic exchange with the business – are affected by or can affect its actions (for example the public, communities, activist groups, business support groups, and the media). Furthermore, the secondary stakeholders need to be identified. Secondary stakeholders are the intermediaries, that could be a person or an organization which are indirectly affected by an organizations actions. Key stakeholders also need to be identified. Key

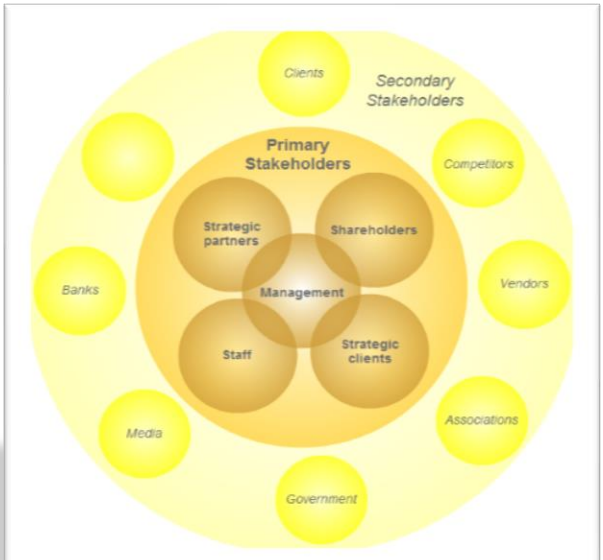


Figure 1 http://www.comindwork.com/weekly/2017-01-30/productivity/primary-and-secondary-stakeholders-of-

stakeholders can also be persons or organizations who also may belong to multiple stakeholder groups. Stakeholder groups are not homogeneous, and they might have their own agenda which can create conflicts within the project. Key stakeholders have a considerable influence upon or importance within an organization. The first thing is to create a stakeholder map by developing a categorized list of members who are involved in the project. When the list is almost finalized, it is possible to assign priorities, according to relevance, from the highest priority to the lowest, into a table or a picture. This will establish an overview of expectation and credibility to understand picture of the stakeholders. Some of the commonly used dimensions used for the stakeholder mapping is:

High power, interested people: these are the people we want to fully engage and satisfy. This group of people should be managed closely, and the best way is trough status meetings, phone calls and personal meetings.

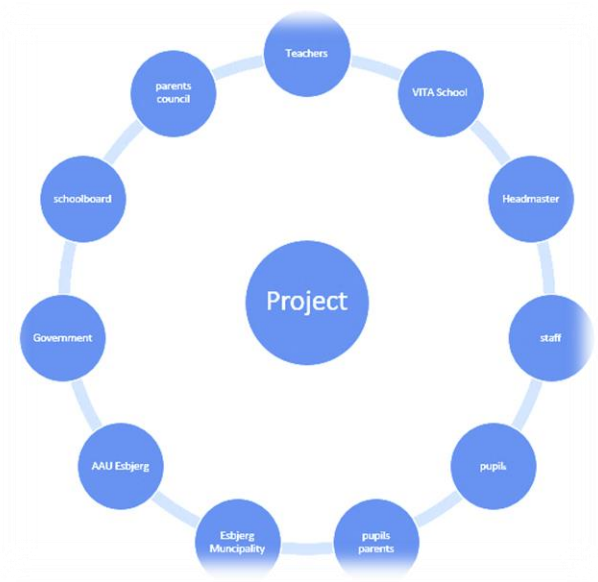
High power, less interested people: here we must put enough work to keep them satisfied, but not so much that they get bored.

Low power, interested people: these people must keep sufficiently informed so that no significant issues are arising. These people will often be helpful with the details of the project. To keep them informed by using e-mail, video chats or face to face communication.

Low power, less interested people: we should monitor these people, but don't bore them with excessive communication. Sharing the information by e-mail and status reports.

Stakeholder for this project are:

- VITA school
- Teachers
- Staff
- Headmaster
- Pupils attending the school
- The Pupils parents
- Esbjerg municipality
- AAU Esbjerg
- Government
- Parents council
- Schoolboard



Using the power/ interest grid we can clarify which stakeholders might have an interest in helping to developing the protocols of evacuation strategy based on risk communication aspects. One of the segment in this concept is transparency as a tool in the form of discussion and exchanging the information which is important for risk communication process. Another ting which may be implemented in research regarding the stakeholder analysis is motivation statement, clarification to uncover what types of issues there are

concerned about and interest of outcomes. The context of influential impact and option which reflect on decision-making process and expectation. The best way of getting these questions answered is to talk to stakeholders directly. People are quite often open about their views, and asking people's opinions is often a god way in building relationship. In addition to clarify and to understand our stakeholders we must shape the distance (indirect relations) in-between, by choosing the right approach of communication values and create the condition by which stakeholders with various aspects or conflicting preference can collaborate to manage risk. Figure below show power/interest grid.

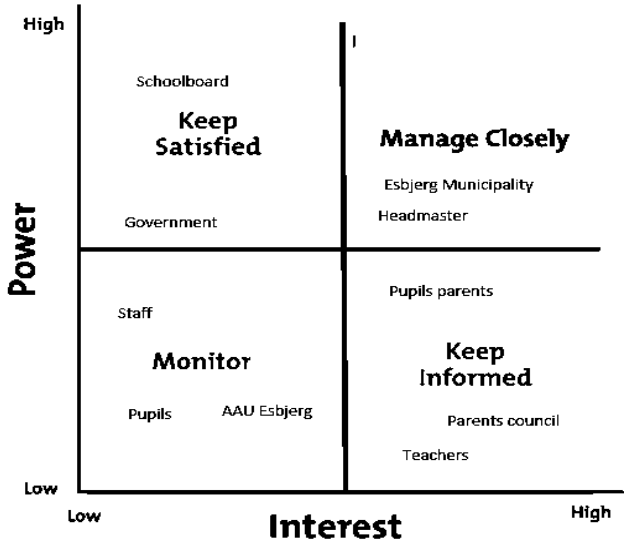


Figure 2.6.1 Power/ interest grid of Stakeholder of Vita school

Headmaster and Esbjerg Municipality have a high interest and high power in the project and therefore they need to be managed closely. This is done by having personal meetings and e-mail correspondents with John Andersen, headmaster of Vita school and Peter Hartvigsen from Esbjerg municipality. During the researcher we contacted supervisor from AAU Esbjerg, to obtain support and guidance to make sure that we are on the right path. The key stakeholders in this context are: teachers, staff, pupils, parents and AAU Esbjerg. They need to be informed and engage in risk communication efforts to understand and to be influenced by the various methods. The protocol of our research had to be confirmed and accepted by different stakeholders to sustain their understanding and to gain trustworthiness. It was significant that the parents and students don't get intimidated by the risk -assessment based on risk communication and evacuation procedure. Regarding the process of evacuation strategy, the number of the stakeholders is increasing because of involvement of media. In relation to that it is important to consider the impact of media coverage to decision-making frame and influence the public interest and engagement. The power/interest grid shows that there is a different stake in the distribution of the stakeholders' power and interest. To inform the stakeholders about the situation and context of developing the evacuation protocol, will substantial increase involvement and create a layer of acceptancy and understanding. To understand the students and teachers experience as well as knowledge regarding the evacuation procedure, they have received a questionnaire, which are made based on regulation according to the Danish Emergency Management Agency. We wanted to see if the new what to do, how to react and behave in a situation of evacuation procedure. Figure below show the power and interest of Vita school when involving evacuation procedure.

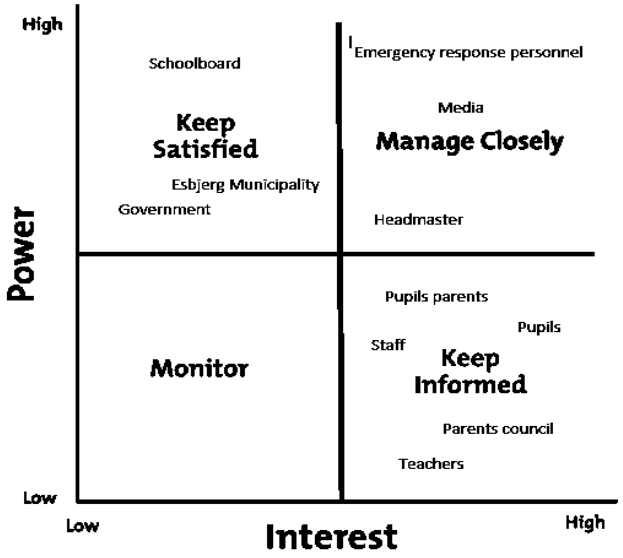


Figure 2.6.2 - Power and interest of Vita school when involving evacuation procedure.

2.6.3 Risk Analysis

Our theoretical approach is deliberately interpretative and based on the theory of constrictive legislation, communication strategy and risk perception. some of the models and analysis there will be used in this project are bow-tie, SWIFT, SWOT, FRAM, stakeholder analysis and risk management plans. The objective of a risk analysis is to describe risk, and this can for example be done by an informative risk picture like a Bowtie analysis. The purpose of risk analysis is to identify all the potential risks there might be for a given project. This gives us the possibility to see all the risk factors there might be and how we can prevent or mitigate them. When all the relevant initiating events that could or might be a threat are detected, you are able to develop a consequence picture. How you develop your consequence picture depends on which method is chosen and how the results are to be used, but the purpose is always the same: to describe the risk. There are three different risk analysis methods: simplified risk analysis, standard risk analysis and model-based risk analysis. Simplified risk analysis: Is an informal method to create a risk picture. This method is based on thoughts, ideas and individual opinions on the subject. The risk picture is also defined in an informal way and can be described in terms such as low, moderate or large. Standard risk analysis: is a formalized procedure method where the most common risk analysis methods such as HAZOP and coarse risk analysis are used. Risk matrices are applied to show the result more precisely. Model based risk analysis: is a quantitative method based on techniques such as event tree analysis and fault tree analysis, where the risk is calculated instead of presumptions.[39] Why should companies and institutions make use of risk analysis? Risk analysis gives an opportunity to map out the risk picture and to define the risk factors. Hereby it is possible to prevent inexpedient incidents and accidents and furthermore to reduce eventual side-effects. Risk analysis provides us with predictions about possible outcomes. It is then possible to choose among different solutions and activities throughout a process. In the process of risk analysis, it is

[39] Aven,2008, Risk Analysis by Terje Aven Assessing Uncertainties beyond Expectation Values and Probabilities 2008. University of Stavanger, Norway Publication page 4.

important to have legislation and other requirements in mind. This provides a base for documenting the acceptable safety and risk level, that the school can and will allow.[40]

2.6.4 SWOT Analysis

A SWOT analysis is an acronym for strengths, weaknesses, opportunities and threats and it is a structured planning method that evaluates the mentioned four elements of an organization, project, evacuation etc. The SWOT analysis is a useful tool for understanding the strengths, weaknesses and for identifying the opportunities and threats which may face in a project. Strengths and weaknesses are internal to the school this could for example be the reputation of the school, building features etc. Here they can influence the strengths and weaknesses for the giving situation, they can change them over time but not without some work. Opportunities and threats are external, and the school don't have an impact over them, they must accept them as they are. The best way of getting an objective result of SWOT analysis is to use people with different perspectives and stake in the project. The SWOT analysis starts with having a good brainstorm where all four categories are identified then you make a final prioritized version of your SWOT analysis.[41] As mentioned earlier in the project there are 1200 students attending the Vita school. With that many pupils there need to be a protocol for how the school safely can evacuate the pupils in case of evacuation emergency. However, it is important to know what kind of weaknesses, threats, strengths and opportunities there might be for the evacuation process. The Vita school strengths are internal, positive factors where describe all the positive qualities, tangible and intangible for evacuation process within control. The school weaknesses are internal, negative factors that will affect the evacuation process. The opportunities of the school are external positive factors that will insure the likelihood of a safe evacuation. The threats are all the external negative factors beyond their control that will affect the evacuation process. To ensure the evacuation process, the school will benefit by having a contingency plan to address them if they should occur. The SWOT analyses below shows the strengths, weaknesses, opportunities and threats for the evacuation process of the students in an emergency.

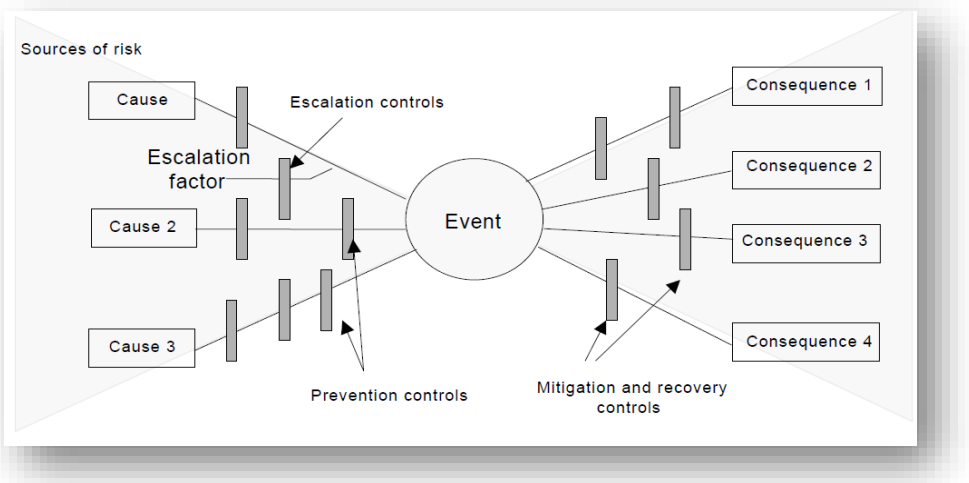
[40] Risk Analysis by Terje Aven Assessing Uncertainties beyond Expectation Values and Probabilities 2008. University of Stavanger, Norway Publication page 5.
[41] http://articles.bplans.com/how-to-perform-swot-analysis/

Helpful for the objective	Harmful for the objective
Internal Origin	
Strengths	**Weaknesses**
Propper signage	Building fetures
Basic fire extinguishing equpiment	age (undergrades)
A yealy check from the fire Department	peopel panicking
prior instruction	geogrephy
Non smoking area	accessibility
staff know what to do in an emergency	Hazzardes materials
Alarms systems	Blocked emergency exits
Building fetures	Saff not having their work phone on
accessibility	Not having evacuation drills
Alarm test every month	
written emergency plans	
common collection point	
external origin	
Opportunities	**Threats**
fire and building regulations	natural disasters
New Technology	Govermental Funding
	legislation
	arsonist
	weather conditions

Figure 2.6.4 SWOT Analysis -Objectivity and the process of evacuation

2.6.5 Bow-tie Analysis

A Bowtie Analysis Is a useful tool for risk assessment it gives an easy to understand risk picture. The picture below I shaped like a bow-tie, where you can see a clear variation between proactive and mitigation controls. A bow-tie gives a visual summary of all plausible accident scenarios that could exist around a certain hazard, but it also shows what the VITA school does to control those scenarios.[42]



The bow-tie consist of causes, prevention controls, Event, mitigation and recovery controls and consequences. For the VITA school bow-tie mode would look like this.

[42] https://www.convencionminera.com/perumin31/encuentros/tecnologia/jueves19/0910-Paulo-Rheinbolt.pdf

http://saisa.eu/blogs/Guidance/wp-content/uploads/2015/06/bowtie-in-iso-310101.png

Potential cause:	Prevention controls	Event	Mitigation controls	*Consequences*
Fault in electrical equipment	Yearly checks from the fire department	Top event in this case would be a fire evacuation	Notification on teachers work phone	*People dies*
Pyromaniac	Alarm test every month		Fire extinguishing equipment	*People gets injured*
Smokers	Emergency plans		Fire alarm system	*Loss of building*
Accidentally accident	Fire drills with staff and students		Fire doors	*Low and short term of trauma*
Terror	Educational books		Fire cells	*Environment*
Natural disaster			Window with at least 2 GBS	*Everyone gets evacuated.*
			Evacuation	

Figure 2.6.5 Example of Bow-tie main categories of risk analysis methods

2.6.6 SWIFT Analysis

A SWIFT analysis is a structured What-If technique where the leading question for making the risk analysis is what if. It is a structured brainstorming method for analyzing process or a system. It is usually applied to systems or processes not deemed to be safety critical, but which do have safety related failure modes. SWIFT relies on expert input from the team to identify and evaluate hazards. There is no single standard approach to SWIFT as seen in a figure 2.6.6 Analysis example for Vita School

Advantage	**Disadvantage**	***SWIFT approach Prepare the Guide Words ("What if?")***
Flexible, and can be modified to suit each individual application *Creates a detailed and auditable record of the hazards identification process* *Is less time consuming than other systematic techniques such as HAZOP*	Careful thought is required in preparation for the application of the technique Relies heavily on the expertise and experience of the team member Relies heavily on the skills of the chairmen	*Assemble the team* *Background* *Articulate the purpose* *Define the requirements* *Describe the system* *Identify the risk/hazard* *Assess the risk* *Propose actions* *Review the process* *Overview/ Additional risk assessment*

SWIFT Suggested Protocol:

- Define the systems/processes being analyzed.
- Brainstorm possible hazards. List but do not discuss hazards yet.
- Structure the hazards into a logical sequence for discussion.
- Start with the major ones, and priorities selection of others
- Consider each hazard in turn
    - Consider probable causes of the event.
    - Consider safeguards that are planned to be in place to prevent the event occurring.
    - Consider frequency and consequence.
    - Record discussion on SWIFT log sheets
- Reconsider whether any hazards have been omitted
    - Use checklists and where available previous accident experience to check for completeness.[43]

Below is a SWIFT analysis of the Vita school in Esbjerg. The analysis can be more comprehensive, but this is just an example of how the SWIFT analysis can be done. The SWIFT analysis also made from the evacuation perspective.

Question Categories	What if	Examples	Consequences	Recommendations
Material problems	Equipment fails	fire alarms, fire hoses, fire doors etc.	injuries, fatality or loss of buliding	yearly or monthely check
	Material problems	building constructions	injuries, fatality or loss of buliding	Make a risk analysis to see if the building livs up to the requriments
	Auxiliary sysem fail	water supply, fire fighting , ventalation	injuries, fatality or loss of buliding	yearly or monthely check
Operating errors and other human factors	Failure to follow procedures or procedures followed incorrectly	People dont care or dont know what to do or havent read the evacuation plans	injuries, fatality or loss of buliding	make all new students and staff read the evacuation plans. Make a yearly drill
	Miss communication	It can effect the evacuation process because people have	injuries, fatality or loss of buliding	Having evacuation drils for pupils and staff
	studenst and staff dont hear the alarm	do to noise, or the alarm sound is to low.	injuries or fatality	Having a test of the fire alarm every week so the students get famillure with the sound of the alarm.
	External effects/impacts	man-madeefffects is divide into intentionally (terror) and unintentionally (firre), Natural effects	injuries, fatality or loss of buliding	Traning so pupils and staff know what to do incase of an emergency. Yearly tjek of the school buildings
	Operational failures/ human errors	preception of human behaviour regarding drills	injuries, fatality or loss of buliding	Having evacuation drils for pupils and staff

[43] Risk Assessment: A Practical Guide to Assessing Operational Risk

Figure 2.6.6 SWIFT Analysis example for Vita school

2.7 Cultural Analysis

Before analyzing the structure of risk communication, it is necessary to determent cultural behavior at school. This part deals with the complexity that characterizes the practice segments in the class numbers and seeks to capture the dynamic aspect of how to see and understand the culture and identity of the teaching that includes more understanding contexts. You can ask questions at all times if it is necessary to focus on culture and identity when dealing with communication and analysis. In a way culture is the blind passenger in the planning, execution and evaluation of this technical interpretation. Culture and identity are a key concept of the purpose school of the primary school. Through school, students will become familiar with Danish culture and history as well as develop understanding for other countries and cultures. There are many ways to define culture. Danish culture from 1916 to 2017 has changed dynamically in the light of globalization and the technological possibilities associated with (according to Giddens 2003; Robertson 1993) new types of texts and other understanding contexts must be considered. At the same time, increasing migration and refugees are changing our ideas of Danish, European and global culture. Thus, how culture is defined depends on the historical context according to (Perkins 2005). i.e. understanding of culture depends not only on where we are located purely historically. It is also an education policy question whether culture should be understood as a particular way of organizing society in resolving conflicts focusing on the concept of cultural aspects or interpretation and perception of meaning in the curriculum as a form of positioning and separating personal identity with common culture.

The primary school task is to form and educate students both as individuals and as citizens in a democratic society. Parents today make demands and expectations for the school with greater argument than before. The change in school law's requirements for cooperation between school and home and the desire for engaging and active parents sometimes has consequences for the teacher role. That is, the parents' views and their expectations do not necessarily harmonize with the school's common exclusion structure or who is responsible for the child's socialization. Ziehe once said that the school today has lost its aura and all that comes after the cultural change processes. It is the responsibility of the teacher to through his own personal effort to deliver the aura that once was part of the school.[44] The teacher should be able to create a form of personal and pedagogical framework about his professionalism while developing an act through personal involvement in order to assist students in the need for their personal identity formation. Therefore, it is important to ask the question: *How should the school relate to the consequences of a globalized world and how to define identities and form cultural communities? And what is culture in general and how to define it?* Culture can define in many ways. However, if we roughly describe a concept of culture, it is an index of something one is or has, and a perspective on something one does and creates through a practice. It is also the way to describe dynamics, a complexity in the interaction of communication in the classroom while allowing both culture and formulation of culture aspects as a form of abstract of a national community. A society between two cultures. Danish and Iranian to see the class's concrete interpretation, where different students, together with the teacher, explore subjects relating to cultural diversity.[45] Based on its productivity, it becomes possible to follow how they create concepts of different contexts of understanding in their interpretation work. The school has no problems with cultural

[44] Formidling til folkeskolen culture analysis of information planning by Malene Gronemann Giorgi nr.152/2005 - Ziehe og Stubenrauch 1983 page 117-119

[45] Mellem Tekster culture and identity in the classroom by Helle Rørbech 1. Edition 2016 page.16

differences when all the children of other ethnic background were born and raised in Denmark. Their identity formation is reflected in Danish culture.

2.8 Human behavior during the evacuation caused by fire

Fundamental aspects in this context is based on human physical and physiological response. Although the subject has been significantly studied, the human psychological factors have not yet been incorporated into guidelines and standards. Basis physiological factors have profound influence on how people react. Individuals reply differently to the same fire-(alarms) and may have another physical response to the procedure of evacuation. According to a British study (Bryan, Behavioral Response to Fire and Smoke), it acknowledges that people not always respond as desired to normal fire alarms that are without a voice message. The emphasis of human uncertainties during the research had showed that the response to ringing alarms and sirens tends to be far from optimal. The longest time of responder to an emergency was when ringing alarms were used. Part of the problem was uncertainties of what the alarm means. Human behavior draws throughout key of psychological findings that lay people´s understanding of risk and indicate an uncertainty which reflect to response on fire -alarm and assessment during the evacuation. Which means that basis physiological factors have a huge influence on how people react. Ability to distinguish segment of the physical attack form the accident cost by fire or diverse types of hazard, are dependent on a combination of human condition, age, size, and mobility. Basically, human behavior during a fire is a complex issue and in the way dynamic as the fire itself. According to a British study (Bryan, Behavioral Response to Fire and Smoke), has exposed reaction of the occupant's response during the evacuation and it was divided into the following phases:

Recognition: investigation based on techniques in the decision-making process when deciding what to do during a fire. Seeking for information as well as recognition of a different signs of fire. (*Serval people tended not to recognize the fire until they see smoke or flames*).

Confirmation: is elaborated by people believing that the signs are false, and they seem to be seeking a reassurance that the threat does not mean anything. Typical seeking or confirmation are supported by skeptical questions such as Why do we have to evacuate? Can you smell the smoke? Do you really think that we must evacuate building?

Explanation: people usually always tends to seek explanation for what happen and through an explanation they can relate and develop structure or even try to assess the level of danger.

Assessment: is a decision which people tends to make very quickly under great stress factor and fear. It is a phase where people decide whether they want to stay and fight the fire or to evacuate. Assessment process depend on people's action.

Duty: this phase relates to the assessment phase. People follow the decision process taken during the phase of assessment.

Reassessment: when previous decision related protocol does not seem to work, person who is exposed to the fire becomes frustrated and often a new decision appears to be irrational increasing the potential of injury.

Complexity of socio-psychological concepts of human behavior during the fire – evacuation is understanding how people behave through their actions and their competence in process of decision

making. Figure 2.8.1 illustrate human behavior, response, socio-psychological impact, evacuation decision and strategy based on assumptions[46].

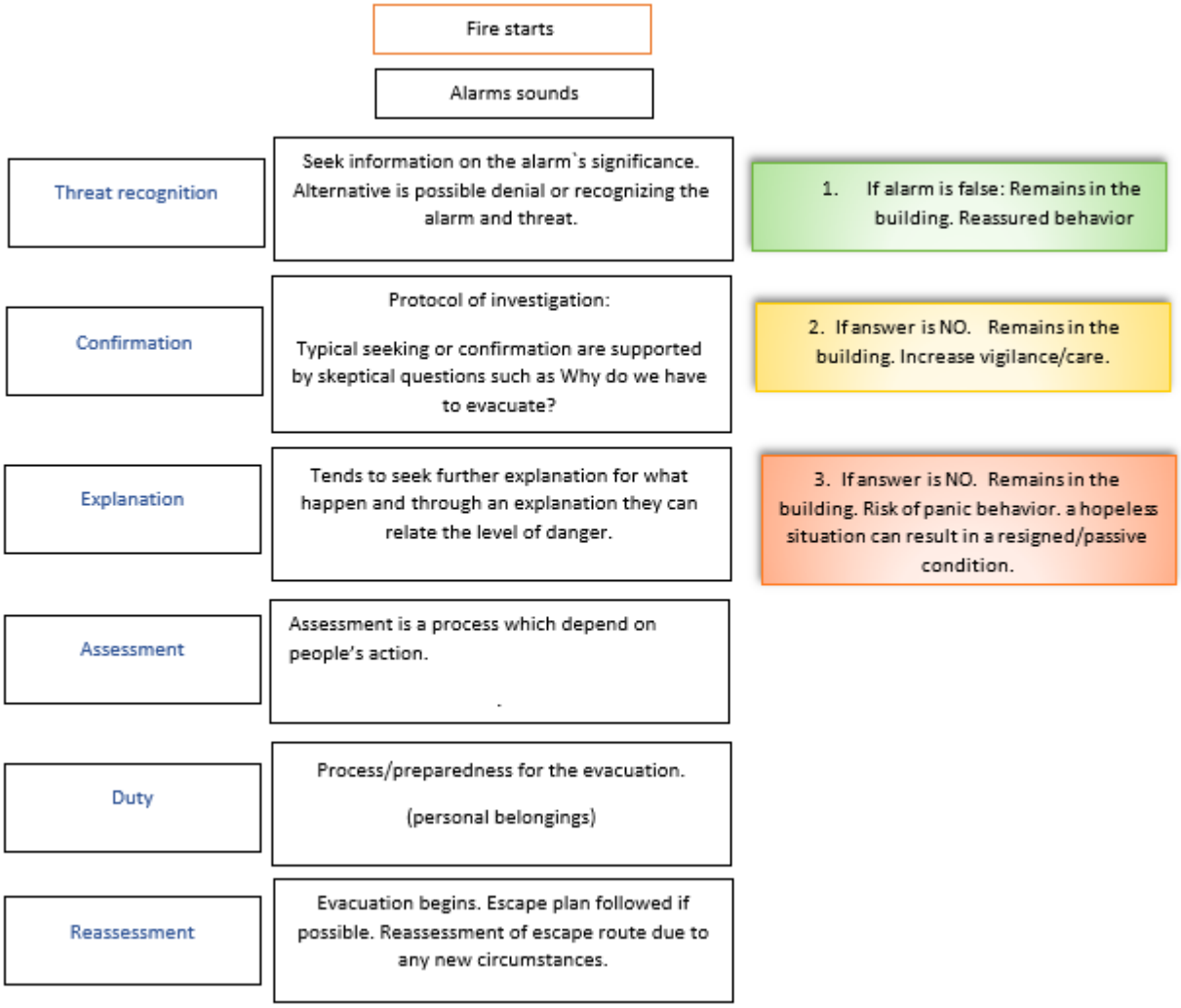


Figure 2.8.1 Model of human behavior and socio-psychological impact during the evacuation[47].

2.8.1.1 Sub-conclusion

Human behavior during the stage of fire is the study of human response, including the process of decision, motivation factors, attitudes, coordinating the strategy and reaction to fire or other similar emergencies in buildings. The study of human behavior in incident cause by fire is a segment of multiplying factors involving fields of engineering, building construction/architecture, regulation, aspects of science/simulation, psychological human factors and communication strategy. Usually the focus of human behavior is analyzing the importance of the decision contexts of communication uncertainty, procedural-

[46] Fire -Safety Engineering page 470 - 475 by Larsen Schiøtt Sørensen 1 edition 2014.

[47] Fire -Safety Engineering page 475 by Larsen Schiøtt Sørensen 1 edition 2014.

strategy and its conversion into practice to reduce the risk to people from fire. This term of theoretical and methodological elements can be realized by generating and collecting both quantitative and qualitative data on human behavior and response, which can be implemented to develop human fire response theory. The structure of evidence maps is the key to create theory of human response, improving or disapproving current fire safety engineering design. Summarizing and evaluating scientific evidence is to develop a comprehensive theory of human fire response. Because of investigation, human response is categorized into two main periods pre-evacuation and the movement period. The pre-evacuation period estimates the time of recognition, confirmation and explanation. Ignition begins from the point when individual or group begins to evaluate evacuation strategy to a place of safety. Movement period on the other hand is the time in which movement to safety location occurs and implementation begins. Although the logical structure of pre-evacuation and movement period phase are objective and contains terms of frequencies and relate to the concept of decision making strategy, it also consist of additional sub-phases that the engineer should understand. Within the pre-evacuation period there are least three sub-phases. The first one is pre-alarm phase, which is consume time from the point when fire begins until the point when fire-alarm initiates building occupants. Exposing to the fire, looking for the information regarding the event, processing the information and deciding whether is necessary or not to protect themselves is the second pre-phase. The third phase is protective action phase where individuals engage in certain actions, or assisting the others to prepare for evacuation. These phases are important to understand or estimate consequences of action, because sometimes in certain types of buildings the pre-evacuation period can longer than the movement period. Figure 2.8.2 explain the timeline of a human response during the evacuation.

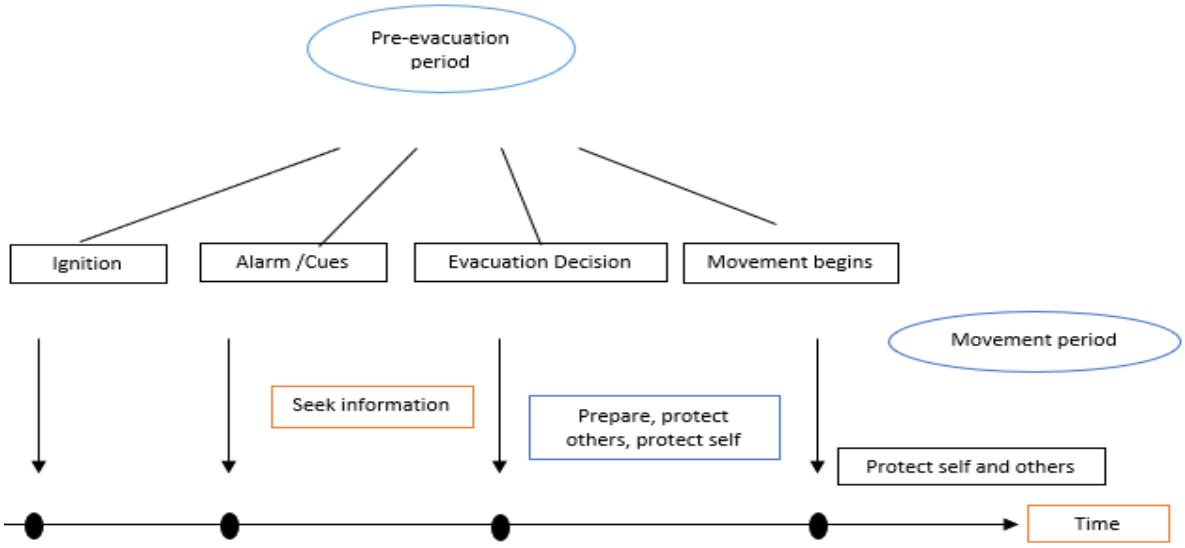


Figure 2.8.2 explain the timeline of a human response[48]

As mentioned, the evacuation time depends on many factors, including building design, buildings height, number of floors and escape routes. Awareness which must observe especially for tall buildings is the fact that the rescue team are not able to perform rescue of persons by using ladders, which is possible for lower buildings. Constricting the evacuation strategy is clarifying and dividing into areas with different warning signs. This refers to optional alternatives of audible warning (voice message, live communication instruction

[48] Fire -Safety Engineering page 477 by Larsen Schiøtt Sørensen 1 edition 2014.

or siren) and if possible supplemented by visual effect such as flashing light, etc. All this equipment can be significant to motivate people to move towards escape routes and can save lives in critical situation.

2.9 Strategy for evacuation

However, when it comes to evacuation strategy it can be distinguish in between three types:

1) Total evacuation: means that the entire building is evacuated. Advantage is that it is the easiest form of evacuation, and when it is completed, the building will be empty of people. Disadvantage is in the process of the total evacuation is how to handle the progress of managing the people who are in the movement looking for the safety zone and those who are already outside. This create a huge demand on the capacity of the escape routes to serve all individuals simultaneously, increasing the need for having the large amount of the building escape corridors. This type of evacuation relates to a category 2 according to a (BR2017) buildings regulation 2017, which refer to public school, where is a desire to evacuate the entire building or in practice only possible solution to applied evacuation strategy*. This type of evacuation process is implemented in Vita school strategy for evacuation.*

2) Phase evacuation: relates to the pre-selected parts of the building are evacuated, depending on where the incident occurred. By warning a selected area, refer only to a group of people who will react and go toward escape corridors with the purpose to reach safety place. Advantages of this phase is evacuating a small proportion of people. However, disadvantages are that requires that the evacuation is activated by an automatic fire alarm system, which is connected to a warning system to ensure that only effected area must be notified. It is also necessary to inform and train people in the building, so they understand and accept this type of strategy. This type of evacuation strategy can be implemented in the parts of buildings with a several floors e.g. hospitals and large office buildings which is category 6.

3) Stay- in- place: is a strategy that alarm all or parts of the building, letting people be in the respective units in which they are staying. Protocol of this type is referring to buildings which consist small fire unites with a limited number of people. The advantage of this type of evacuation is that others remain where they are and in a calm familiar environment. Rescue service doesn't have to deal with many moving people but just few. To ensure that people understand the procedure and protocol as well as strategy it is necessary to keep them informed what is happening, while giving them opportunities to contact the emergency if they feel the need for it. It can be time demanding to create interactive process of exchanging the information throughout communication strategy between the individual fire units and the emergency service. This type of evacuation strategy is usually applicated in housing which is category 4.[49]

[49] Fire-safety engineering by Lars Schiøtt Sørensen page.481-482. 1. Edition, 2014

3

Questionnaire

Data collection of sensitive analysis

3.1 Analysis of questionnaire data

The questionnaire is developed around social conditions and contexts of uncertainties about the intention of the parties involved with the process of human perception, social variables, psychological impact and roles in the process of evacuation. With the help of analysis and relational theory as a part of informational planning, this part is aiming to demonstrate how communication articulations of what establishes a risk object and relationship of perception regarding risk are implanted in patterns of decision- making structure shaped by social and cultural contexts. There were conduct descriptive research to examine the beliefs of the intended audience (students and teachers), using a mixed-mode approach that involves both interviews and surveys. Our interview was based on general question, asking headmaster to share `what he know` about the topic, followed by encouragements to provide more detailed information (e.g. can you tell us more about evacuation drills?). As a result, these types of informative structure allow individuals to share their intuitive theories and experience in their own words.

However, the interview with the headmaster tend to be small sample to provide the statistical power needed to conduct analyses or associations between beliefs and behaviors, the subsequent step is to use surveys, which are more cost-effective for use with larger samples. Based on these facts there were implemented two surveys, one for the students and the other for the teachers. There were 271 questionnaires handed out for the students and 14 questionnaires to the teachers. However, only 190 out of the 271 questionnaires were able to be used. Several of the questionnaires were not filled out properly and the rest was not answered because the students were not in school that day. There are 11 classrooms on the first floor with 12 teachers and 271 students. It is distributed as seen in table below.

Class Total number of students

7. u H18	23
7.y H17	21
7.x H14	24
7.y H13	25
8.a H17	25
8.b H15	27
8.c H08	26
8.u H11	26
8.v H10	23
8.x H09	25
8.y H16	26

Results of the survey for the students:

In this phase of the study, a survey of 190 occupants were 49,5% male and 50,5% female has been conducted. The average age of the students is 13,7 years. Respondents of the survey have some of the characteristics that was need for the simulation part of the project. We needed students who had their classroom placed on the first floor to answer the questionnaire. This was due to the evacuation simulation we want to make in Pathfinder. The population characteristics are defined in the following table below.

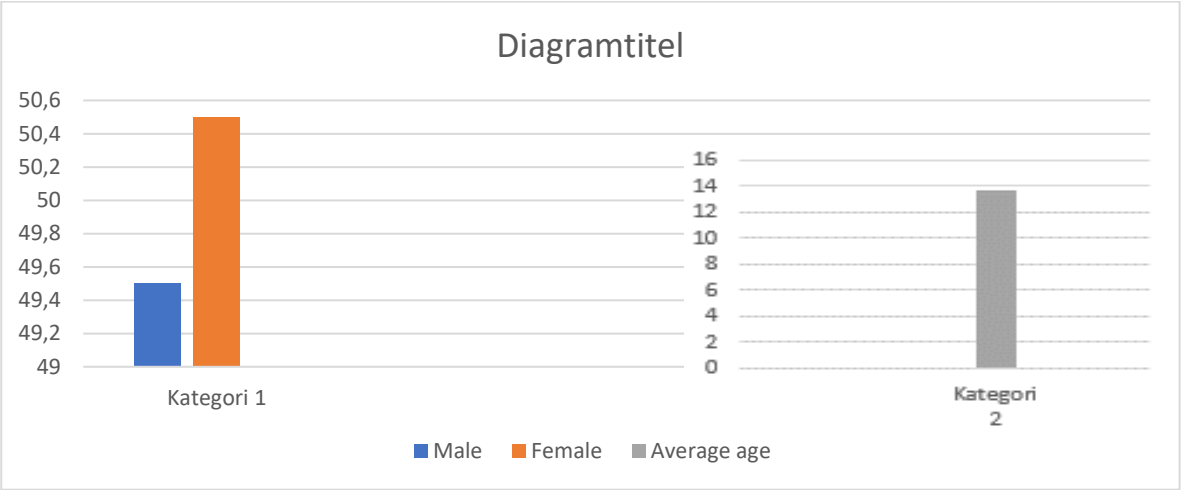


Figure 3.1.1 Diagram of population of male and female students

This section is spilt into 10 different questions. The purpose of the survey it to figure out the students experience and knowledge regarding evacuation strategy as well as policy.

1. *Have you ever been in a critical situation (e.g. car accident, fire, evacuation etc.)?*
2. *(If yes to question 1) How did you react?*
3. *Do you know if there is an evacuation plan at school?*
4. *Have you received instructions on what to do in case of evacuation?*
5. *Do you know what to do in case of fire?*
6. *Do you know where the assembly point is, in the event of an evacuation?*
7. *Have you been attended a first aid course?*
8. *Have you participated in a fire drill at school?*
9. *Do you know how the fire alarm sounds?*
10. *Do you know the difference between fire alarm and gas alarm?*

Question 1 and 2 is connected, we wanted to know if the students had been in a pressured situation before and how they reacted in the situation. 39% of the respondents said that they had been in situation like this and 61 said no. the majority of 15% of the respondents who had been in a pressured situation stated that they were the ones who received the help. 13% observed the incident and 3% ran away from the scene and 9% stayed and helped.

In question 3 we wanted to know if the respondents knew about the evacuation plans. 33% have never heard about these plans and 38% have heard about the evacuation plan but never read it. Only 18% have read the evacuation plan and 12% don't think they need to read them because they have the basic knowledge about evacuation.

Question 4 and 5 was designed to figure out if they had received any evacuation instructions and what they do in case of an evacuation. The majority of 51% had received instructions and only 32% had not. 71% of

the respondents would evacuate and leave the room, 5% would help others and 7% would contact the fire department and 8% would contact the teacher.

Question 6 there are 62% of the students know where the assembly point is in case of an evacuation this is good because there might not always be a teacher around to guide them.

In question 7 we wanted to know if they had any first aid course and if not, would they be interested in one. 47% had a first aid course and 37% had none and 16% would like to get the opportunity to take a first aid course.

If we take look at question 8, it shows that the students never have attended a fire drill before. 75% of the pupils stated that they had not attended a fire drill at school and 24% would like a fire drill to be carried out only 23% have attended a fire drill at school. Class 7.x and 7.u is the only ones who said they have had fire drills at school. However, one of the students had written that it was not an actual fire drill, only a practice how to turn off fire for a day". To present more actually picture distributed in the percentage related to question 8 see below in the diagram.

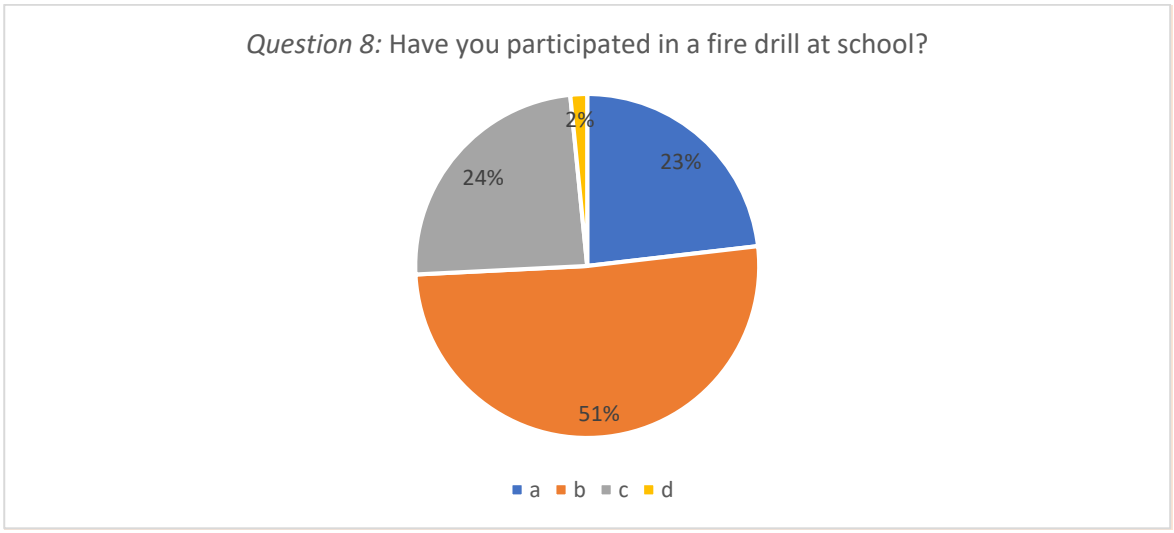


Figure 3.1.2 Distribution in percentage regarding participation in a fire drill at school.

In question 9 and 10 we wanted to know if the respondents know how the fire alarm sounds and if they could hear the differences between the gas alarm and the fire alarm. 57% did not know how the fire alarm sounds like this could have an impact on the detection time for the evacuation process. This number should be a lot better, but it is an easy problem to fix. The school could have a test drill of the fire alarms once a month, so the students get familiar with the sound. 87% don't know the difference between the gas alarm and the fire alarm.

- Results of the survey for the teachers

The population characteristics are defined in the following table.

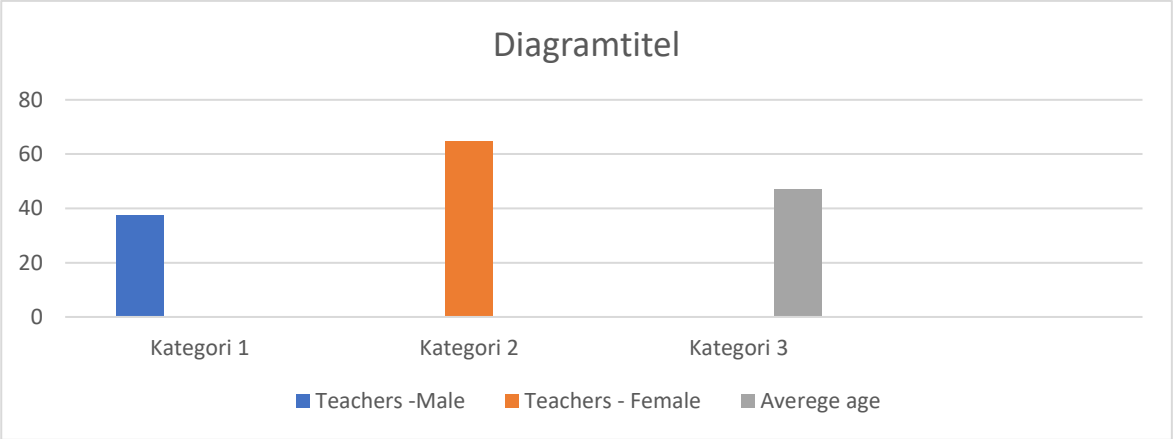


Figure 3.1.3 Diagram of population and distribution in percentage

Teachers	14	
Gender	35,7% Male	64,3% Female
Average age	47 Years	

This section is spilt into 13 different questions, aimed to figure out how much experience the teachers have involving evacuation. The Question where:

1. *Have you ever been in a pressured situation (e.g. car accident, fire, evacuation etc.)?*
2. *(If yes to question 1) How did you react?*
3. *Do you know if there is an evacuation plan at school?*
4. *Have you received instructions on what to do in case of evacuation?*
5. *Do you know what to do in case of fire?*
6. *Do you know where the assembly point is, in the event of an evacuation?*
7. *Do you know what to do when everyone is gathered at the assembly point?*
8. *Do you have your work mobiles turned on and with you all the time?*
9. *Have you attended a first aid course?*
10. Do you know how to use fire extinguishing equipment?
11. Have you participated in a fire drill at school?
12. Do you know how the fire alarm sounds?
13. Do you know the difference between fire alarm and gas alarm?

The results of the questions are shown in the following table:

Question:	a) Yes	B) no	C) don't know
1. Have you ever been in a pressured situation (e.g. car accident, fire, evacuation etc.)?	36%	64%	0
4. Have you received instructions on what to do in case of evacuation?	86%	14%	0
6. Do you know where the assembly point is, in the event of an evacuation?	100%	0	0

7. Do you know what to do when everyone is gathered at the assembly point?	79%	21%	
9. Have you attended a first aid course?	100%	0	0
10. Do you know how to use fire extinguishing equipment?	50%	43%	7%
11. Have you participated in a fire drill at school?	14%	85%	0
12. Do you know how the fire alarm sounds?	57%	36%	7%
13. Do you know the difference between fire alarm and gas alarm?	14%	57%	29%

Figure 3.1.4. Distribution of the questionnaire

The most interesting question we wanted the teachers to answer was question number 8. The headmaster of the VITA school stated in a meeting, that they had a problem with teachers not using their work mobile. Therefore, we wanted to ask the teachers about this to see if there was a real problem. It is important that they have the mobile on them because if an incident should happen they would receive a text if they needed to evacuate the school. Statistically, 64% of the teachers have their mobile with them at all time and 14% are not aware if it is on or off. 21% don't have their mobile with them all the time.

In question three we wanted to know if the teachers have heard about the evacuation plans and if they have read them. 93% of all the teachers have read the evacuation plans and 7% have heard about them but not read them. Question five show that all the teachers knows what to do in case of an evacuation 79% would evacuate and leave the building and 21% would help their colleagues with the evacuation process. Overall the survey shows us that the teachers are well prepared if there should ever be an emergency or an accident in the school.

4

FRAM

The Functional Resonance Analysis Method

This handbook was developed by three authors Lacey Colligan[xx], Jeanette Hounsgaard[xx] and Erik Hollnagel[xx]. FRAM is based on the relational theory of the emergency management system, an analytical model to analyze and understand the values at stake, potential hazards and complexity of processes in an emergency management scenario. The first involvement of FRAM was developed for the purpose for the medical industry to analyze the potential elements of working accident by considering the working environment, human behavior and the process of how work is done. The core of challenge of creating a FRAM intervention is managing the tension between analyzing the working procedures and improving the design of system to create knowledge about the conceptual framework of hazard/working accident. Improving the safety by the strength of the evidence on which the hazard assessment might cause working accident. The method consists of four steps[xx][50]

- Identify and describe the important system function and characterize each function.
- Characterize the potential variability of the function in the FRAM model, as well as the possible actual variability in one or more implementations of the model.
- Determine the possibility of functional resonance based on dependencies /couplings among functions given their potential / actual variability.
- Develop recommendations on how to monitor and influence the variability

FRAM is a method for analyzing or modeling socio -technical system, looking for the functions failures.

4.1 The basic principles of the FRAM

FRAM is based on four basic principles[xx]:[51]

1. The principle of equivalence (of successes and failures).
2. The principle of approximate adjustment (assumption that people adjust so that the action match the condition).
3. The principle of emergence (acknowledgment that not all results can be explained in specific way)
4. The principle of resonance (neither possible or reasonable to base explanation on the cause-effect principle).

The principle of equivalence it is an assumption that both successes and failures of event can be a product from the same outcomes. Finding one or more parts of components in the situation that have failed or malfunctioned. In the typical accident modelling approach known as decomposition, the system is taking apart analyzing the event sequences bit for bit at every level to find a reason for accident or hazard. There

[50] FRAM - the functional resonance analysis method page 7, a handbook for the practical use of the methods 1 edition, June 2014
[51] FRAM - the functional resonance analysis method page 16, a handbook for the practical use of the methods 1 edition, June 2014

are differences between a well performing system and malfunctioning system. Based on the hypothesis of the resilience engineering and FRAM the things that go wrong and the things that go right happened in the same way. The explanation is followed in the second principle.

The principle of approximate adjustment in many socio-technical systems can be partially understood. Expectation regarding the condition of work or for carrying out an action are never reach the point of agreement with what was expected or recommended. Which means that often the work is carried out based on variability in the performance, creating the constantly adjustment to fit the existing condition. The segment of interfering are usually time, tools, information, conflicts and interruptions. Planning and managing a specific task/event creating by individuals or groups in the organization referring to the concept of limited resources such as time and labor in most cases turns to be enough, because the situation rarely changes the direction from what usually is the case. Adjustments are the reasons why things go right, however sometimes can be the reasons why they go wrong as seen in figure 4.

Figure 4 The principles of approximate adjustment [xx][52]

The principle of emergent outcomes based on objective variability it is segment of everyday adjustment where is it not possible to determent cause of something going wrong or specific to de described as a failure. It is outcomes grounded on the previous non-linear effect which has two principles, (firstly there is no proportionality between ``cause`` and `` effect`` and secondly, the effect cannot be explained by causal ``linear`` thinking) approaching the fact that variability in a system will create the outcomes as emerging. However, if it is not possible to predict or to find a certain core of cause observing the consequences, then one cannot be certain claiming that the results were caused by certain condition or situation. To demonstrate please see figure 4.1

[52] FRAM - the functional resonance analysis method page 17, a handbook for the practical use of the methods 1 edition, June 2014

	The outcome as resulting	The outcome as emerging
The house	The erosion creates by earthquake /storm: every time a storm hits the house, it is possible that something will burst under the influence of earthquake/storm (continuous exposure)	Whenever the storm hits the house there are chances of constructional collapsing. We can neither explain their appearance nor predict it.
Winter weather	When the temperature reaches below 0, water will freeze as a result	When water crystals fall through atmospheres when temperature are below 0 we do not know what form the snowflake will take. (formation of the snowflake)
Nature	Life of the young dingoes	The pattern of a flock of dingoes in the distance (may look like wolfs or fox in formation)

Figure 4.1 Examples of resultant and emergent outcomes [xx][53]

The principle of resonance it is a frequency of approaching and justifying the connection between different events which might occur. The principle of the system which consume the variability may exist with or without interfering the process of multiple functions or events. However, if system become affected by variability it might affect the other functions in the system and create resonance in the system. Which means that opportunity to reflect on what happened using the linear cause analysis will not benefit or explain the outcome of emergence. This type of analysis is called functional resonance and it is important source and indicate the frame to the FRAM.

The most important aspect when building a FRAM model is the subsistence of the information and protocol of an activity. Explaining the variability by determination of function, selecting the activities and couplings which is necessary for analyzing the system. A function as well as aspects of a FRAM is explained as [xx]:

- *,,A function typically describes what people – individually or collectively – have to do to perform a specific task and thus active a specific goal, for example, triage a patient or carry out medication reconciliation.*
- *A function can also refer to something that an organization does: for example, it is the function of an emergency department to treat incoming patients.*
- *A function can refer to what a technical system does either by itself (an automated function, such as a dialysis machine) or together with one or more people (an interactive or socio-technical function, like an electronic health record).”*

The basis of the FRAM is description of the functionality and the process of the activates in the event, creating the relations by aspects of functions to reach the protentional goal. This type of process is called couplings and it is presented by a hexagon in the model as seen in Figure 4.1.2 All the functions of a FRAM model are characterized by the six aspects creating the values in every function.

[53] FRAM -the functional resonance analysis method page 18, a handbook for the practical use of the methods 1 edition, June 2014

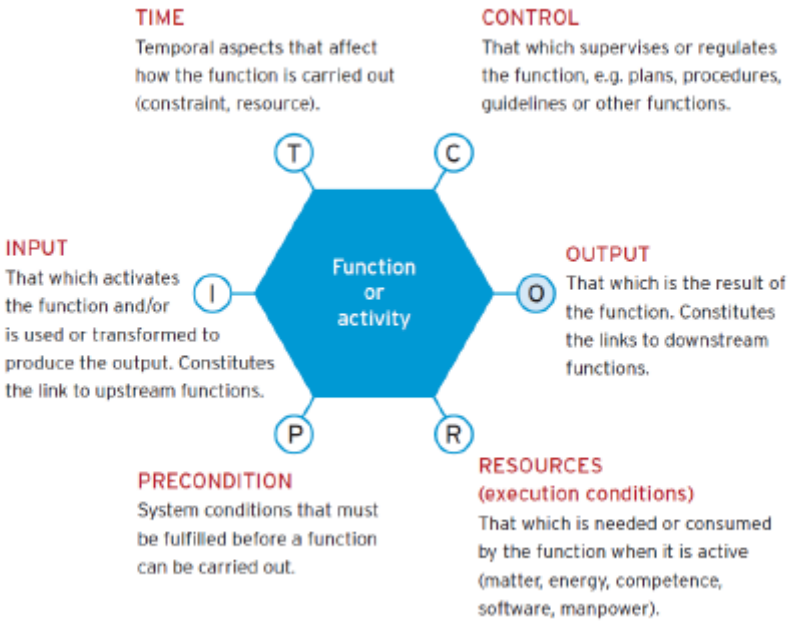


Figure 4.1.2 The six aspects of a function or activity [xx[54]]

4.2 Coupling -relationship between functions

Relatives between these six aspects of a function or activity, is categorized by relations and description based on risk analysis. It is a basis formulation which relates to description by different means of route or network diagrams, that creating a vision of functionals activity or a process. Each relationship is not directly described by graphical rendering, but more like indirect as product of relation- defined by aspects of functions. This technic is defined as coupling.

4.3 Foreground and background functions

Each function in the FRAM can be describe as a function of a foreground or as a background. Foreground function is a protocol of a practical model- role of the function, where variability of a function may have a consequence for the outcome of the event. On the other hand, background function is almost similarly function, which can be assumed to be constant without any type of variation during the process of incident, or process of analysis during the study of event. Background function is usually representing something that ii used during the process of foreground functions. For example, right level of staffing or their competence or skills during the instructional control. However, process of instruction may diverge, based on the learning development during resource, analyzing event and using the historical data.

[54] FRAM – the functional resonance analysis method page 29, a handbook for the practical use of the methods 1 edition, June 2014

4.4 FRAM model building

Illustration model as seen in figure 4.4 is created using the FRAM Model Visualiser program which is available for downloading at http://www.functionalresonance.com/ homepage. Handbook is also available for downloading (pdf-format) at www.centerforkvalitet.dk /Fram handbook

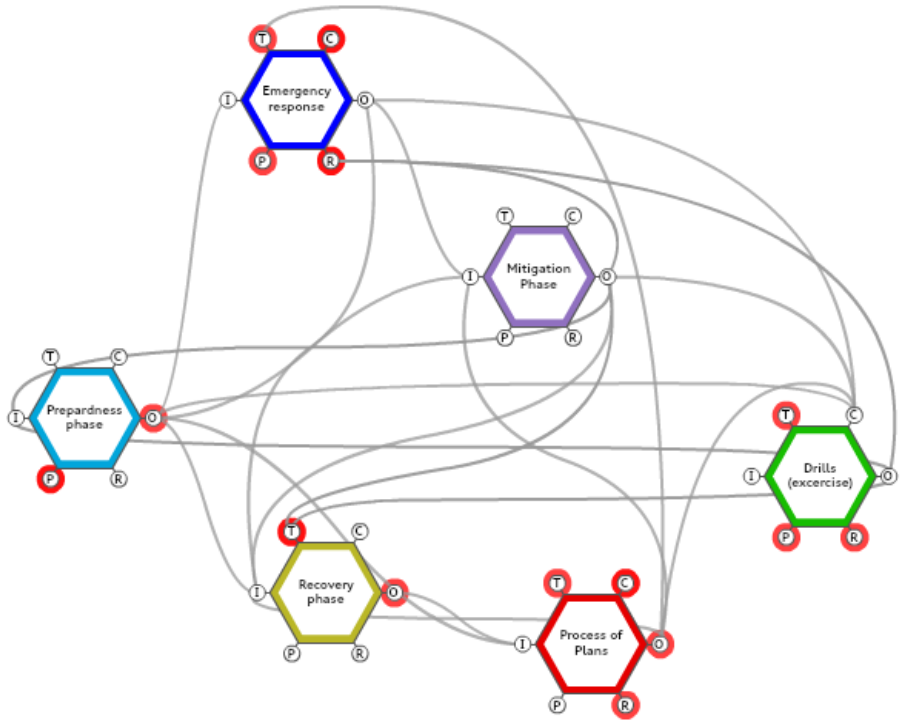


Figure 4.4 FRAM model of emergency management cycle

Summarizing aspects based on approached with the emergency management cycle involving the phases of mitigation, preparedness, respond and recovery. Each function is typically reference to theoretical and methodological issues that is substitute for argumentative power of different activities in the model. The objectivity of the figure 4.4 is to describe the process of developing a strategy using a framework for evaluation between functionality and practices response. As said before while explaining, purpose of existent of emergency management cycle: *Applying to the strategy of the emergency management begins with analyzing source of impact, using a comprehensive set of measures.* FRAM could be important improvement tool to present an informative concept of constructive planning, supporting a decision - making and risk analysis process.

Figure 4.4.1 describe function of Emergency response has a tow inputs of natural and manmade disaster. The impact of transparency of (time) response, indicate line of resources to determine efficiency of emergency response in risk situation. Response phase is also controlled by aspects of legislation as well as process of plans. Principal condition in relationship for the response phase, are warning system/crisis unit and awareness of event. The output of this function are recovery phase and risk communication creating the comprehensive process of respond to the event and approaches to the awareness on threat of risk signs. Regulator responsibilities is to make efforts to use best risk communication practices abilities when

they design transparency of strategy. Attributed to the response phase in this model is also system of software, alarm system and equipment.

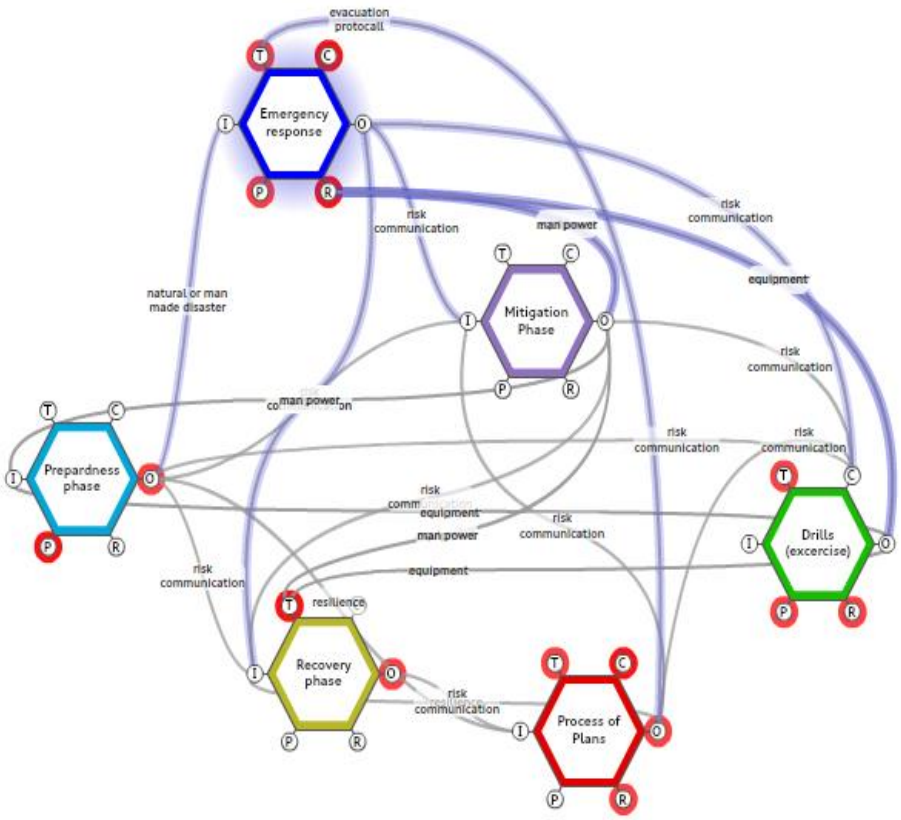


Figure 4.4.1 FRAM model Emergency response – function couplings

If we look at the figure 4.4.2 FRAM model Drill (exercise), this type of function has an appearance of frequency term which indicate the effort and quality of drills based on aspects of time (how often Vita school, will have an evacuation exercise). Another aspect is based on process of plans (emergency), as an impact of evaluations that's control output of exercise. Evaluation is needed because in the long term, not only will save time and money, but should also improve the success rates of the risk communication. To support this function the precondition to gain value of exercise is through resource such as man power (education of stuff), software (alarm system) and equipment. Furthermore, it is very important to have educated members of the stuff, so they can lead evaluate and implement input to improve exercise. Software (alarm system) is valued resource to improve procedure of outcome of the activity. Combining the aspects of outcome of the activity, by focusing on accessibility and emphasis on relevant procedure underlying a decision (process of information about how decision-making structure should be made), which relates to functions of precondition for the Response, Recovery and input for the Preparedness.

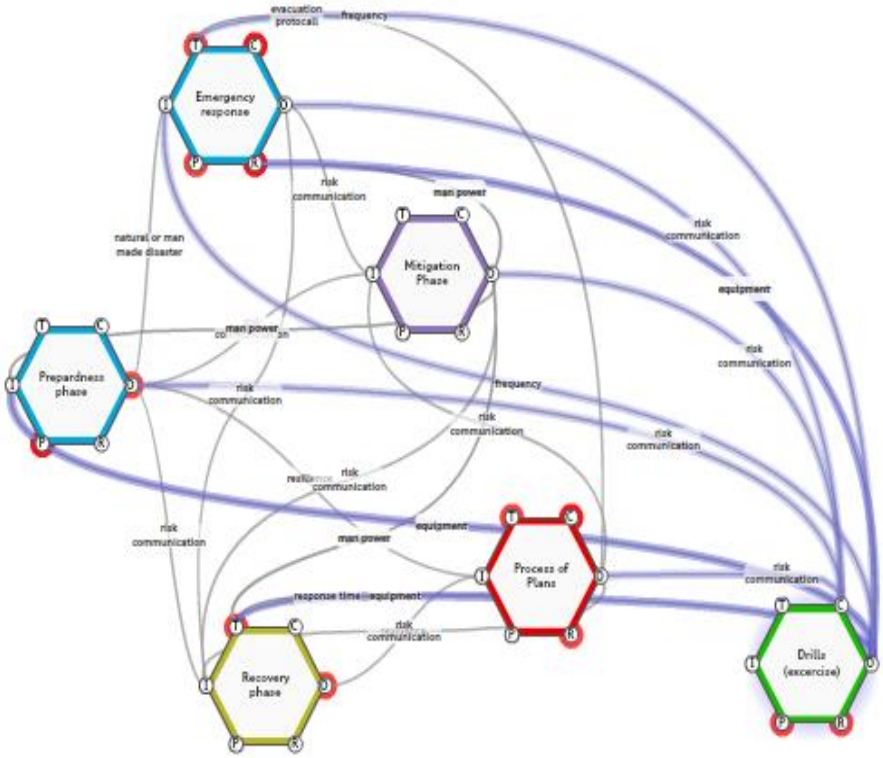


Figure 4.4.2 FRAM model Drill (exercise) – function couplings

Recovery phase as seen in figure 4.4.3 FRAM model – Recovery phase function of couplings begins first with input from the response phase and output from the mitigation phase. Time function are represented as a reaction based on the drills and response.

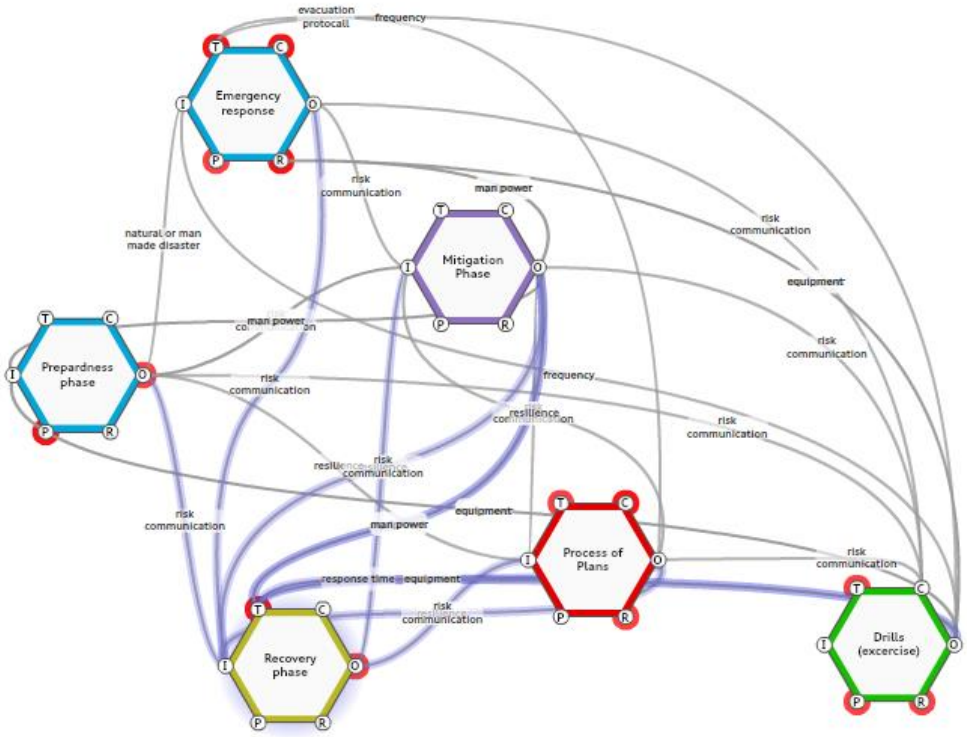


Figure 4.4.3 FRAM model **Recovery phase function of couplings**

The mitigation phase in this function as seen in figure 4.4.4 comes from the input of recovery phase and outputs from inputs of process of plans and preparedness phase. Risk communication in this segment is seeking to provide structural and informative aspects deciding context more substantial and knowledgeable to deliberate planning in case of fire.

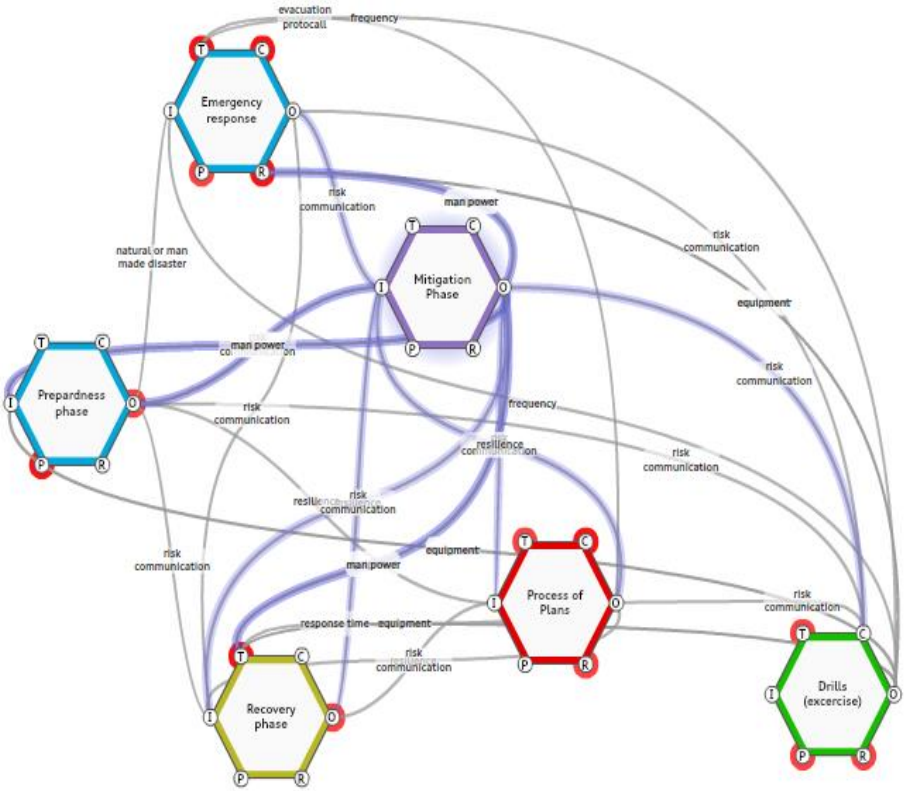


Figure 4.4.4 FRAM model **- Mitigation phase function of couplings**

The Preparedness phase in figure 4.4.5 has an input which refers to drills and exercise activity including conventional approaches to activate a preparedness phase in a cycle. The secondly the output of mitigation should have emphasis on increasing this phase. Also, this phase has four outcomes starting from response throughout risk communication and process of plans. Equipment as well as manpower is created impact of successful framework of most activities in an emergency management system and it is fundamental issue of outcome from the preparedness phase.

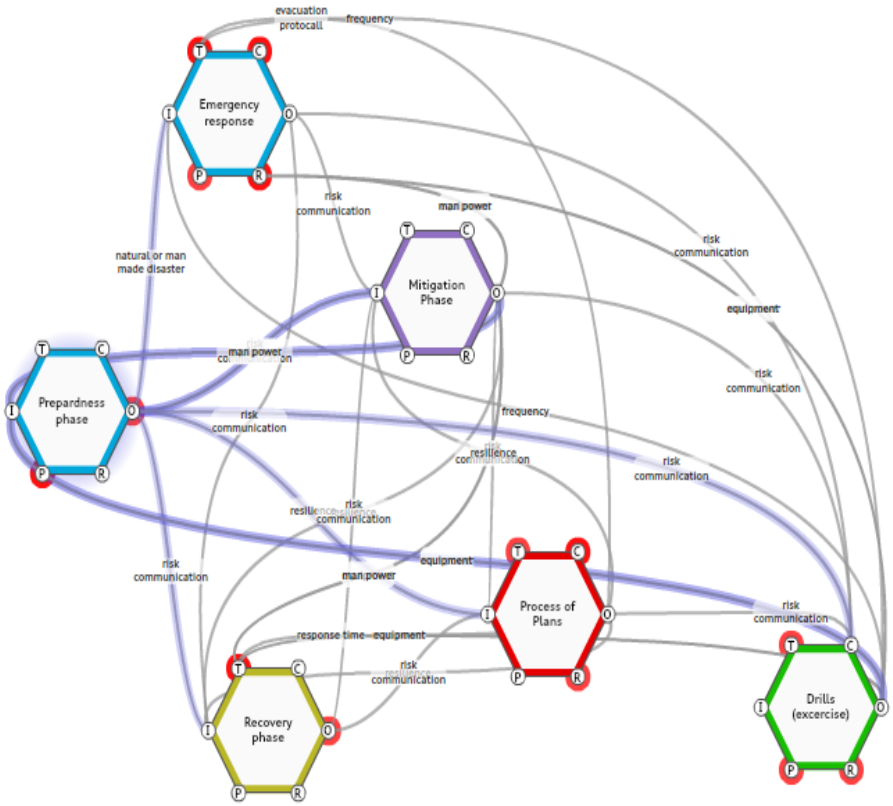


Figure 4.4.5 FRAM model – **Preparedness phase function of couplings**

4.5 Application of a FRAM analysis

The characterization of a FRAM analysis is the starting point of understanding how function and system of emergency management is integrated and interconnected with many aspects of functionality. The analysis is focusing on activities and variability of emergency system creating visible transparency from phase to phase. In each activity fragment of variability can be moved within the system, categorizing and clarifying each phase. In this segment emergency response have a large variable factor which create quantities of significance factor between and in the response as well as recovery phase. Significant effort in recovery phase can be highly affected by the response time. In conducting analysis on the relationship between activities had showed that the faster activity can return to normal (phase of pre-disaster), the higher increasing of flexibility the system entails.

To improve and reduce recovery time, focused effort should be based on functionality of mitigation and preparedness phase. Furthermore, the best way to improve and control the different variability and minimize the potential of possible emergent outcomes, is for the management to focus on train and exercise. More development orientated during the drills, testing the system and management will improve condition of positive variability and increase flexibility based on prevention and response as seen in figure 4.5.1.

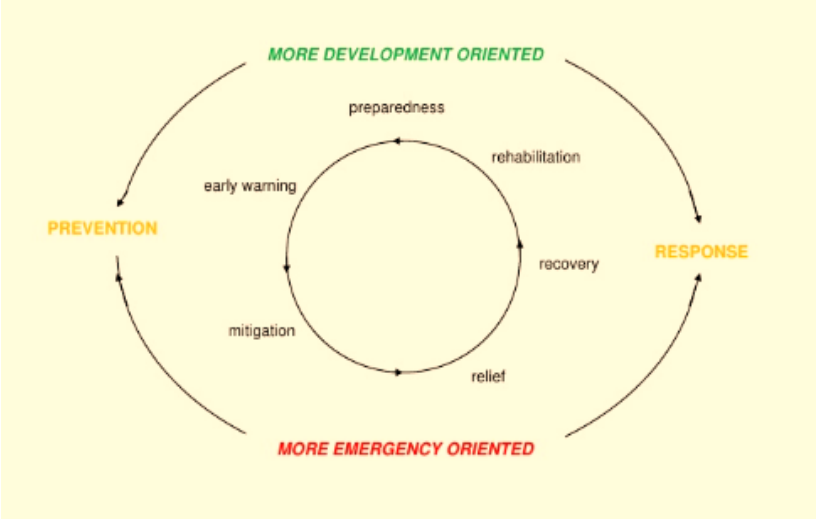


Figure 4.5.1 Development oriented increase focus and variability (from the google page https://www.slideshare.net/GRFDavos/disaster-and-development-training-at-grf)

Having the competent system of train and exercise is of primary importance, but communication is also very helpful in promoting larger decision acceptance. It provides appropriate opportunities for participants to speak and to be heard. Risk communication is an activity with a large variability and it can be affected by variables input. The training should be recorded and studied where focus should be related on implementation and learning aspects. Application of FRAM analysis do not create or fulfills completely development, nonetheless it leaves a space to more detailed functions and aspects. To have more overview over function which appears in the emergency cycle it could be relevant to divide the FRAM model into various stages and levels.

5

Pathfinder

Establishing the context of simulation

Pathfinder is an emergency egress simulator, that incorporates an advanced user interface and animated 3D results. A scale model can be built using for example AUTOCAD (DXF and DWG format) and imported to Pathfinder or you can import a blueprint sketch of the building in question (GIF, JPG PNG format) and draw directly over the image. Pathfinder uses two different simulation models: Steering and SFPE. In *Steering,* agents act independently to reach their goal, while avoiding other occupants and obstacles. In *SFPE,* agents use behaviors that follow certain guidelines, with density dependent walking speeds and flow limits to doors. Each agent uses different parameters to select a viable path to an exit, such as: queue time, distance, etc. Moreover, the agents will respond dynamically to changing queues, door openings/closures, smoke and debris. The user can modify parameters to change the behavioral patterns of the agents. Pathfinder includes agent models, that represent a range of cultures, ages and emergency responses. This makes it possible to display a population group of interest, no matter which part of the world the programmer might find himself/herself in. This software will help us to decide if the school can be safely evacuated and to help detect potential problems. The evacuation will be a fire drill, because the likelihood of a fire happening is higher than for example a bomb threat.

5.1 Limitations of the software - Pathfinder

Pathfinder does not currently integrate results from a fire model and it does not provide support for complex behaviors such as family grouping. Dynamic geometry is only partially supported (e.g. elevators, virtual escalators, and door opening/closing are supported, but trains and other moving surfaces are not). Elevators are supported in evacuation-only circumstances. They do not model a general-purpose elevator system.

The minimum requirements to run Pathfinder include:

- 32 or 64-bit Windows 7 or higher
- A processor the performance of an Intel i5
- 4 GB of RAM
- Graphics support for OpenGL 1.2

For a balanced performance they recommend:

- 64-bit Windows 7 or higher
- Intel i7-3770 (3.4 GHz, 4 Cores) processor
- 8 GB of RAM

- Graphics support for OpenGL 3.2 with an installed graphics card for large Revit models. [55]
- Evacuation time during the accident cause by fire

In the time of evacuation, the escape corridors must not contain concentrations of smoke, thermal radiation, or condition of temperatures changes. The period of evacuation time is usually made up based on three functions:

1. Waring time, t_{wa}
2. Response and decision time, t_{rd}
3. Walking and flow time, t_w

Every segment of evacuation protocol presents as evacuation time (t_{evac}), should be less than the time it takes for critical condition to occur, t_{crit}. The initial formula for evacuation is: $t_{wa} + t_{rd} + t_w < t_{crit}$.

To explain how evacuation process are perceived, it is necessary to obtain perception and decision supporting the hypothesis that relate to analyzing the critical condition and their acceptance. Figure 5.1 relate to depiction of the evacuation time and its components. To reviews attempting to determine a warning time contains the time form the ignition of the fire until people in the building are made of aware of the fire. The second phase is the time (response and decision) when people have been warned and the time until they decide to evacuate towards nearest exit. The third phase is called walking and flow time and it is basically time of collective measurements to see how long it takes people in the building to get outside into the open air or secure place. The total walking and flow time t_w is given by:

$T_w = t_{walk} + t_f$

t_{walk} = walking time (minutes)

t_f = flow time through doors/bottlenecks (minutes) where walking time t_{wakl} is expressed by l = walking distance (meters) and v = walking speed (meters /minutes). $T_{walk} = \frac{l}{v}$ Every critical element such as potential bottlenecks and possible subsequent congestion in the escape route must be considered.

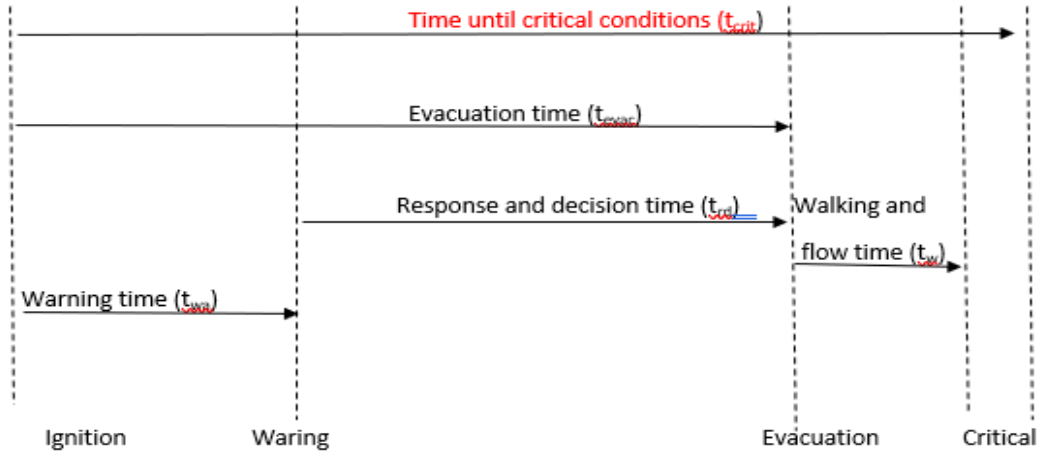


Figure 5.1.1 Schematic depiction of the evacuation time and its components[56].

[55] Pathfinder user manual page 4 and 5 2017, 403 Poyntz Avenue, Suite B Manhattan, KS 66502 USA www.thunderheadeng.com

[56] Fire -Safety Engineering page 460 by Larsen Schiøtt Sørensen 1 edition, 2014

By calculating walking speed for the people whom are familiar with the building and escape route, the walking speed is around 1.5 times the rate applicable to people who are unfamiliar with the building. Survey has shown that more than 70 % people in the building during the time of evacuation, tend to choose the door they came in by. (book fire safety engineering page 461).

The process of walking speed as seen in figure 5.1.2 can be used in buildings area where the evacuee can walk unobstructed by other people (buildings regulation where people density is less than 1.0 person/m^2), and where people have normal mobility. The time aspects that people use to get through a bottleneck, such as door or stair can be calculated using the W (width of the door or stair measure in meters), there is a correspondence effectiveness present as W_e (meters) and given by: W_e = W-BL where BL is boundary layer whose width is often set at 0.5 meter either side of the stairway or door and to 0.09 meter on each side of handrail.

Movement	Walking speed, v, along the plane
In a horizontal plane	1.3 m/s = 75 m/minute
Up the stairs	0.6 m/s = 36 m/minute
Down the stairs	0.75 m/s = 45 m/minute

Figure 5.1.2 Walking speed in building area for people density less than 1.0 people /m[57]

The essentially flow of people, F_a (people/min) passing the door or stairs is given by: $F_a=F_s \cdot W_e$ Time used for a number of people which indicates with (N), passing a entrance is given by: $t_f = \frac{N}{Fa}$

T_f = evacuation time through doorway measure in min

N = number of people to pass the doorway

F_a = actual flow through the doorway (people/min)

As mentioned earlier, there are 1193 students attending the school and 120 employees including teachers and pedagogues. The simulation will have focus on the building-section H. The boundaries for the simulation in the software will consist of evacuation of the 11 classrooms located on the first floor, where there is a total of 271 students and 11 teachers. The distribution of students is shown below. The average is 14 years old.

[57] From the book Fire -Safety Engineering page 463 by Larsen Schiøtt Sørensen 1 edition 2014.

Classroom	7.u section	H18 23 students
Classroom	7.v section	H17 21 students
Classroom	7.x section	H14 24 students
Classroom	7.y section	H13 25 students
Classroom	8.a section	H17 25 students
Classroom	8.b section	H15 27 students
Classroom	8.c section	H08 26 students
Classroom	8.u section	H11 26 students
Classroom	8.v section	H10 23 students
Classroom	8.x section	H09 25 students
Classroom	8.y section	H16 26 students

From the questionnaire related to the students, we can conclude some behavioural patterns on how they would react in case of an emergency.

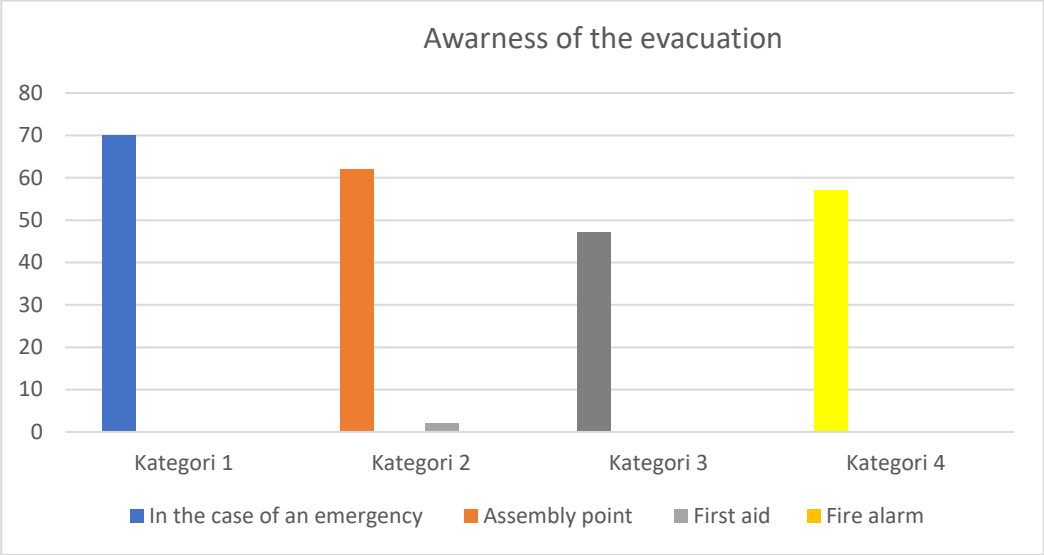


Figure 5.1.3 Diagram of awareness of the situation protocol

More than 70% of the students would evacuate, leaving the classroom in case of an emergency. Only 62% knew the location of the assembly point, but 47% indicated, that they have completed a certified first aid course and 57% indicated that they didn't knew how the fire alarm sounded. Headmaster and work environment manager, John Andersen, stated, that in the 15 years he has been at the school, there have only been one evacuation drill. John Andersen did not know the exact year of this drill, because he was not present at the time of the drill. However, he said that it was before the school was renovated, approximate in-between 2002 and 2014.

"With the amendment of the preparedness act from the July 2003, it was imposed that the municipal-councils once a year could decide if the buildings were covered by the "Operating Regulations" (fire and evacuation exercises)"[58]. It implies that the individual municipal council may order all schools in the municipality to hold fire and evacuation exercises. This explain why the VITA school haven had a fire drill in years. Head master John Andersen also said that they didn't have a goal for what the safe evacuation time should be, and they did not have any information about the last evacuation drill.

[58] https://brs.dk/viden/publikationer/documents/evakuering_af_skoler.pdf page 3

It would be an advantage to record the data of every single evacuation drill they might do or have, so in the future when they have a new evacuation drill they can see if they did better or worse than last time. In addition, we will estimate an available safe egress time (ASET) for the VITA school, so we can compare it with the required safe time (RSET) or escape time. RSET is the calculated time necessary between the fire ignition and the time at which all the pupils and teachers can reach an area of safety. The ASET is defined as the calculated time available between ignition of a fire and the time at which tenability criteria are exceeded in the mean of egress. This time must be longer then t_{REST} by an acceptable margin of safety. Past experiences with evacuation of a public academic building I would estimate the ASET (available safe egress time) should have a value of 4 minutes.

5.2 Simulation

To make an accurate representation of the school in Pathfinder, we have procured blueprints of the school, which we got from Esbjerg Municipality. The measuring tool in Acrobat Reader was used to measure up the drawings. We have selected the blueprints, but It would be possible to draw the entire building in AutoCAD and then import the AutoCAD file into Pathfinder.

5.2.1 How the simulation is build up?

There are serval ways of building a simulation in Pathfinder. In this project, we´ve imported a background image of the blueprints (PNG file) and modelled the first and second floor on top of that. The picture below shows how the picture gets imported to Pathfinder. Initially, you choose an anchor point, which is a reference point that determines where to place the image in the model. Then you choose a reference point A and a reference point B, and give the distance between the two points, which in this case is 44,8m. Then you have a background image you can build up the model.

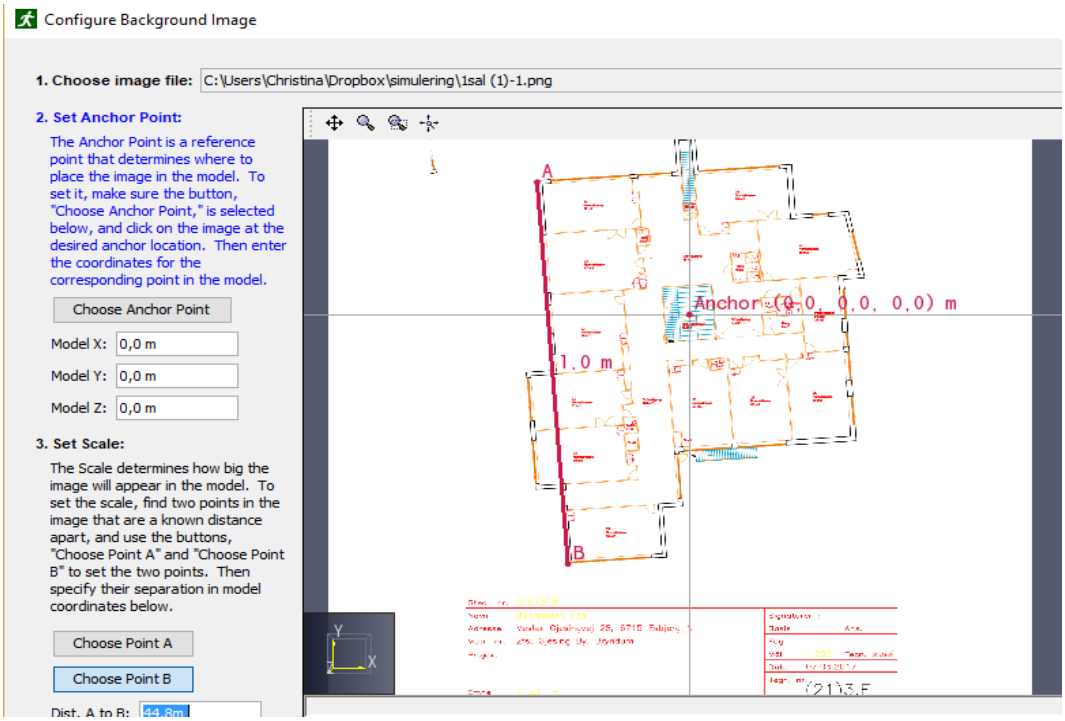


Figure 5.2.1.1 Background image the simulation is built after

When the background is added, you can start drawing in the model. There are two different tools you can use: one gives you the option to add a polygonal room and the other one gives you the option to add a rectangular room. Below you can see how it looks, when a room has been drawn In. To state the accuracy of the placed room, you can see that the area of the room that got added have a square meter of 71,9, where the same room from the blue prints of the school have a square meter of 72.

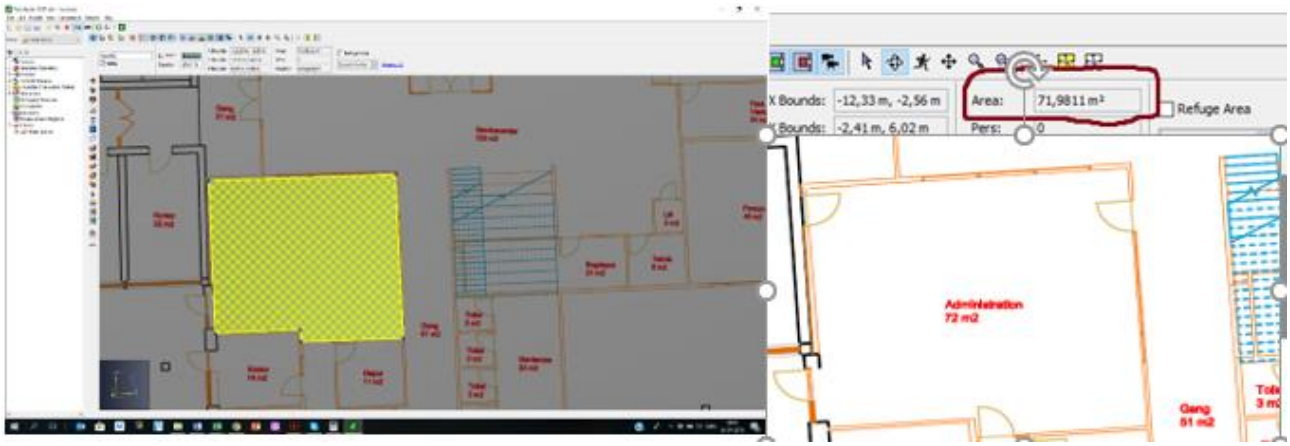


Figure 5.2.1.2 Validate the accuracy of the placed room in Pathfinder

When adding the first floor to the simulation, you must define the z plane. This is the height between the two floors, which in this case is assumed to be 3 meters. The last thing to do on the simulation was to implement stairs and doors with the right measurements. After running the simulation the first couple of times, the occupants did not want to take the stairs. This was solved by adjusting the stairs serval times, based on a trial-error method.

There is only one main exit in this simulation. This was done on purpose, because we wanted to see how long the evacuation would take, if the pupils had to evacuate from the first floor and through the main exit. Studies also show that people tend to evacuate from the exit they came through.

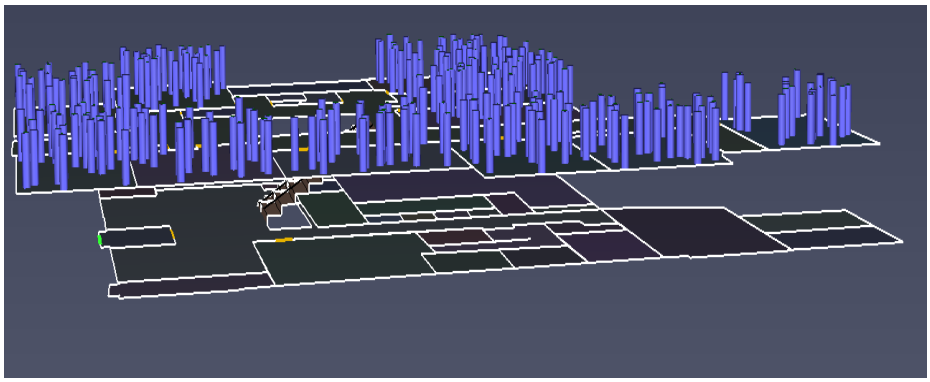


Figure 5.2.1.3 Finished simulation with occupants

5.2.2 Behaviour and profile patterns

Behaviours in Pathfinder represent a sequence of actions the occupant will take throughout the simulation. When the occupants have completed all the tasks that has been given to them, they are removed from the simulation. By default, there is a behavioural pattern in the model called “go to any exit.” This behaviour

simply makes the occupants move from their starting position, and to any exit present in the model, by the fastest route.

You can assign a wait action to the occupants. This tells the occupant to wait in their current location for a set amount of time. Once the time had expired, the occupants will begin their next action. In this simulation, the boys and girls got a 10-sec. wait action and the staff/ teacher got a 20-sec. wait action. This represents the decision time for the evacuation. The reason for the higher wait time for the teachers, was that they had to make sure that students had left the room, before they would leave the room. In the simulation, we did not consider the warning time. It would will influence the evacuation time if we factor it in.

Pathfinder uses an occupant profile system to manage distributions of parameters across groups of occupants. This system will help to control the occupant speed, size and visual distributions.

There are a lot of distinct characteristics you can assign to the occupants e.g.

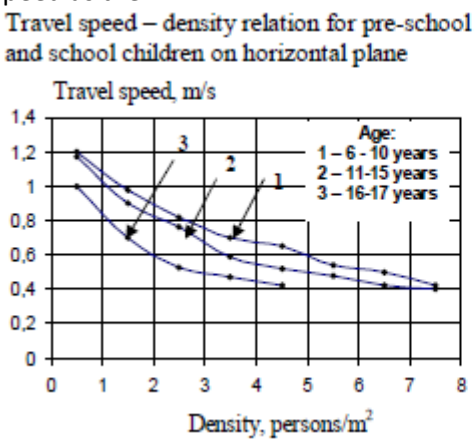
- **Priority level:** This is the priority of the occupant; the higher values indicate higher priority. This can allow the occupants of lower priority to move out of the way of those of higher priority.
- **Speed:** Specifies the maximum speed an occupant may travel in an open room.
- **Shape:** The shape of the occupant. In the simulation there was used a cylinder shape, where you must specify a height and a shoulder width. Shoulder Width is the diameter of the cylinder representing the occupant. It is used for collision testing and path planning during the simulation. This value will also affect how many occupants can be added to a room without overlapping. Height specifies the height of the cylinder used for inter-occupant collisions. This is useful for limiting collisions that might occur between occupants on different floors when the floors have been modelled close together.
- **Use Stairs:** whether the occupant can use stairs when moving one from one location to another. This may be useful to model occupants with physical impairments.
- **Reduction factor**: Is a steering mode parameter that specifics how well an occupant may squeeze past others in tight corridors. This factor should be specified as greater than 0 and less than or equal to 1. This factor is directly multiplied by the shoulder width during calculations, so a Reduction Factor of 0.5 would lead to the occupant being able to squeeze to one-half his shoulder width.
- **Collision Response Time:** when multiplied by an occupant's current speed, this parameter controls the distance at which an occupant will start recording a cost for colliding with other occupants when steering.
- **Wall Boundary Layer:** specifies the distance that occupants try to maintain with walls and other static obstructions.
- **Comfort Distance:** specifies the desired distance one occupant will try to maintain with others in a queue. This may be entered explicitly as a distance, an occupant area, or an occupant density.[59]

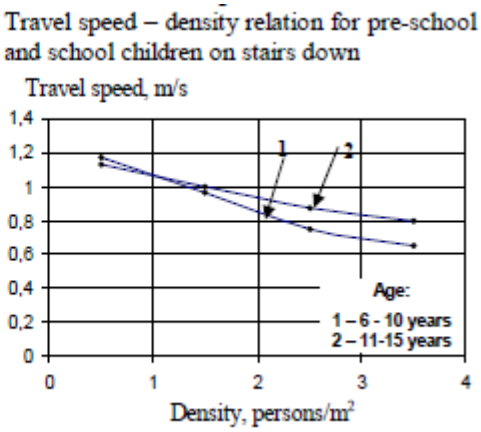
[59] Pathfinder user manual page 54 to 58 2017, 403 Poyntz Avenue, Suite B Manhattan, KS 66502 USA www.thunderheadeng.com

For the simulation the behaviour and profile patterns look like this for the three occupant types.

Behaviour	Initial Delay	Action	Speed	Reduction Factor	Collision response Time	Wall Boundary Layer	Comfort Distance	Hight	Shoulder width
Staff/ Teacher	20 sec.	Go to waypoint	1,0 m/s	0,7	1,5 sec.	0,15m	0,08m	1,8m	45cm
Girls	10 sec.	Go to waypoint	1,0 m/s	0,7	1,5 sec.	0,15m	0,08m	1,6m	40cm
Boys	10 sec.	Go to waypoint	1,0 m/s	0,7	1,5 sec.	0,15m	0,08m	1,62m	40cm

The speed of the occupants is base from a research article PRE-SCHOOL AND SCHOOL CHILDREN BUILDING EVACUATION[60]
The research data of human flow travel consisting of children and teenagers under normal conditions.
The teacher has the same speed as the pupils, because we assume that they will have to keep the same speed as them.





5.2.3 Steering mode

Pathfinder uses two different simulation modes: Steering and SFPE. In *Steering,* agents act independently to reach their goal, while avoiding other occupants and obstacles. The results of the simulation in steering mode was that It took the occupants 164 seconds to evacuate the building. After performing the simulation, it was clear that the bottlenecks and response time have a significant role in the performance of the total evacuation time. There was queueing at the stairs and at the exit. If we assume the warning time is = 1 min our total required safe egress time would be 3,44 minutes this is well below the available safe egress time, which is 4 minutes. Required Safe Egress Time= 3,4 Minutes < Available safe egress time = 4,0 minutes as seen in figure 5.2.3.1

[60] Made by V. V. Kholshevnikov, *D. A. Samoshin, # & A.P. Parfenenko#*State Moscow University of Civil Engineering, # Academy of State Fire Service of Russia, Moscow,
Russia

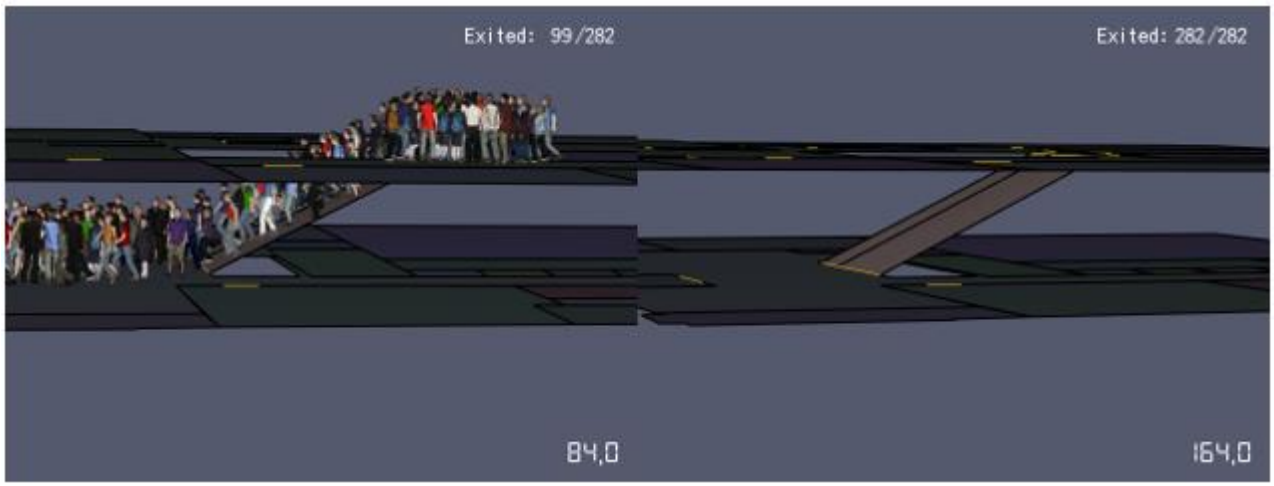


Figure 5.2.3.1 Simulation in Steering mode

5.2.4 SFPE mode

In *SFPE,* agents use behaviours that follow certain guidelines, with density dependent walking speeds and flow limits to doors. The SFPE mode uses the set of assumptions presented in the *Engineering Guide to Human Behaviour in Fire* (SFPE, 2003) and can give answers extremely like these hand calculations, depending on selected assumptions. In SFPE simulations, the mechanism that controls simulation movement is the door queue. The SFPE mode uses a simple set of assumptions and usually completes much faster than a comparable steering mode simulation in terms of CPU time.

The results of the simulation in SFPE mode was that It took the occupants 148,8 seconds to evacuate the building. If we assume the warning time is = 1 min our total required safe egress time would be 3,29 minutes this is well below the available safe egress time, which is 4 minutes

Required Safe Egress Time= 3,29 Minutes < Available safe egress time = 4,0 minutes.

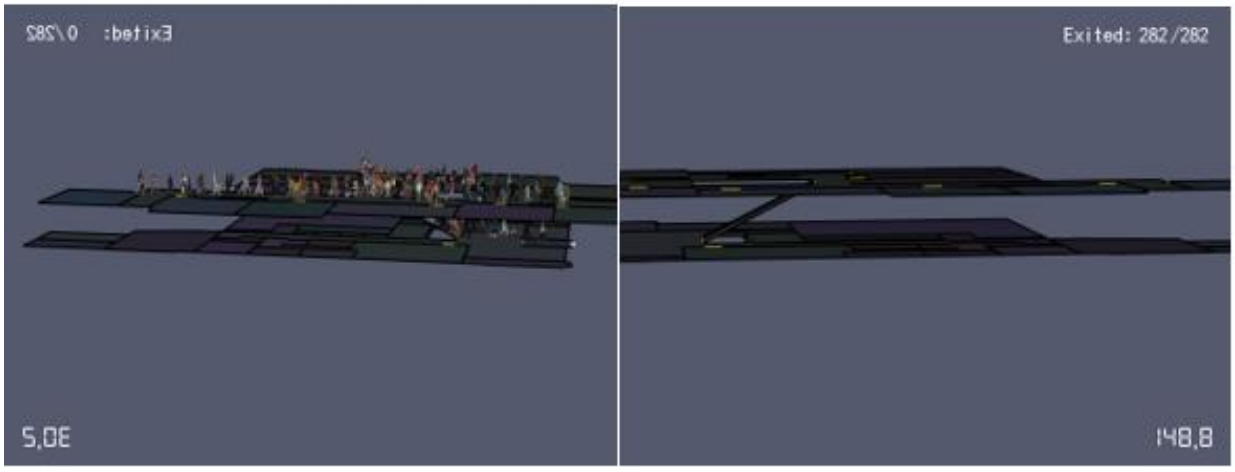


Figure 5.2.4.1 Simulation in SFPE mode

5.3 Evacuation time-hand calculation

To have a thorough examination of a fire emergency for the VITA school, this part of the report will focus on the calculations of the evacuation time for 271 students and 12 teachers from the first floor.

The safe evacuation time is generally calculated by simulating the speed of the students in the building (section H), whereby some assumptions are made for the reaction of the occupants in case of a fire. The evacuation time is calculated out from the worst-case scenario.

The equation of the Evacuation time made up of:

- Warning time, t_{wa}
- Response and decision time, t_{rd}
- Walking and flow time, t_w

$$t_{evac} = t_{wa} + t_{rd} + t_w < t_{crit}$$

In the above evacuation equation t_{wa} stands for the walking time and t_{rd} represents the response time. The third part of the equation t_w is the total walking and flow time. t_w is the combination of walking time and flow time, that is provide by the following equation.

$$t_w = t_{walk} + t_f = \frac{L}{V} + N/F_a$$

$$t_f = flow\ time\ through\ doors$$

$$t_{walk} = \frac{L}{V}; L = walking\ distance, V = walking\ speed$$

It is important to consider that the walking speed will not be the same in the corridors and on the stairs, therefore there are different equations for walking speed in the corridors and on the stairs. But it is also important to remember that the speed will be affected by the density of the people. The relationship between walking speed in corridors, V and people density, D is specified by the following equation.

$$V_{corr} = k_t(1 - 0{,}266 \cdot D)$$

$$D = people\ density$$

$$V = speed$$

K_t= 84.0 for level corridors or doorways and density of the people is assumed= 2[61]

$$V_{corr} = 84 \cdot (1 - 0{,}266 \cdot 2) = 39{,}31 m/min$$

To calculate the speed for the rising stairs, the following equation is used

$$V_{stairs} = k_t \cdot (1 - 0{,}266 \cdot D)$$

K_t=51.8(G/R)$^{0.5}$ for stairs[62]

Where G is the length of the stair tread going and R is the riser height of each step. Vertical/ horizontal ratio of each step is

[61] From the book Fire Engineering Design Guide, A H Buchanan; April 2001, university of Canterbury on page 87
[62] From the book Fire Engineering Design Guide, A H Buchanan; April 2001, university of Canterbury on page 87

$$V_{stairs} = k_t \cdot (1 - 0{,}266 \cdot D)$$

When the pupils get closer to the exit door, the density of the people will increase, this will also affect the speed. To calculate the speed, you must use this equation.

$$V_{exit} = k_t(1 - 0{,}266 \cdot D)$$

During the exit, the density of the pupils will increase therefore we now assume it will be 3 persons per sq. meter.

$$V_{exit} = 84(1 - 0{,}266 \cdot 3) = 16{,}97 m/min$$

t_w consists of two components, one relates to length and speed as we just have explained. The second component consists of the flow of the occupants through door, this will be explained in the following.

The value of specific flow Fs (people/min/meter) given by:

$$D = density\ of\ people\ at\ the\ exit\ point = 3$$

$$F_s = V_{exit} \cdot D$$

$$F_s = 16{,}97 \cdot 3 = 50{,}91\ persons/min$$

For the exit door with a W(m), there is a corresponding effective with designed W_e (m) and given by

$$W_e = W - B_L$$

where B_L (m) is the boundary layer width, usually taken to be 0.15 m on each side of a stairway, 0.05 m each side of a door or 0.09 m each side of a center rail.

B_l=0,02 for the main exit door at VITA school

$$W_e = 2{,}2 - 0{,}02 = 2{,}18$$

The actual flow of the people F_a (people/min) through the stairway or door is given by:

$$F_a = F_s \cdot W_e$$

$$F_a = 50{,}91 \cdot 2{,}18 = 45{,}58\ persons/min$$

The time t_{ts} in minutes for a number of people N to pass through the stairway or door is given by:

$$t_{ts} = \frac{N}{F_a}$$

$N = number\ of\ people = 271 + 11 = 282$

$$t_{ts} = \frac{282}{45{,}58} = 6{,}19$$

The distance between the furthest away classroom to the exit door is measured from the blueprint is approximately 36,6m. It is assumed that pupils and staff for this evacuation are using the man exit. There is 6,7meter long rising stairs on the escape route, the total walking time is:

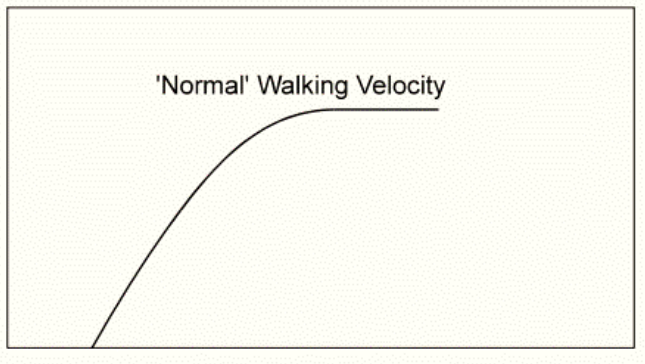


Figure 5.3.1 The relationship between walking velocity and inter-person distance

"The walking velocity for a person is dependent on the forward linear distance (proximity) to people ahead. One person in front of another will reduce the velocity for the person in question, as shown in the Figure 5.3.1. Inter-person distance is defined (in this case) as the distance between the centers of the bodies of two people. The velocity in stairs is reduced compared to the velocity for horizontal surfaces. The velocity descending a stair will be 0.5 times the horizontal velocity. Ascending a stair will take place with a velocity of 0.35 times the horizontal velocity. The normal unimpeded walking velocity for each person will be randomly chosen in the interval between 0.8 - 1.7 m/s."[63]

Therefore, we can figure out the speed for the stairs will be 50% of the $39{,}31 m/min$

$$t_w = t_{walk} + t_f = \frac{L}{V} + \frac{N}{F_a}$$

$$t_w = \frac{36{,}6}{39{,}31} + \frac{6{,}7}{39{,}31 \cdot 0{,}5} + \frac{282}{45{,}58} = 0{,}93 + 0{,}34 + 6{,}19 = \ 7{,}5 min$$

If we assume the warning time and the response time is = 1 min our total required safe egress time would be 8,5 minutes this is well above the available safe egress time, which is 4 minutes.

Required Safe Egress Time= 8,5 Minutes < Available safe egress time = 4,0 minutes.

5.3.1 Sub-conclusion for the hand calculation

In the simulation Pathfinder, we get an evacuation time of 164 seconds (2minuts and 44 seconders). This is well under the available safe egress time of the 4 minutes. The time-frame for the hand calculation is three times higher than the evacuation time in the simulation program. The hand calculation is not 100% accurate, it has not considered that there are two staircases next to each other. The small one is a normal staircase which has been use daily and the other once is for some different purposes.

According to the emergency protocol in the case of the fire, both staircases should be available for the evacuation procedure. However, we only consider one staircase in the hand calculation to see differences, acknowledge and characterized time -frame by using regular stairs. This could explain the high evacuation time we got. In additional regarding Pathfinder simulation software, the occupants are using both stairs to evacuate faster. Below you can see the two staircases one from the Pathfinder simulation and one from the CAD - drawings.

[63] Book: Egress simulex user guide, IES virtual Environment, page 34

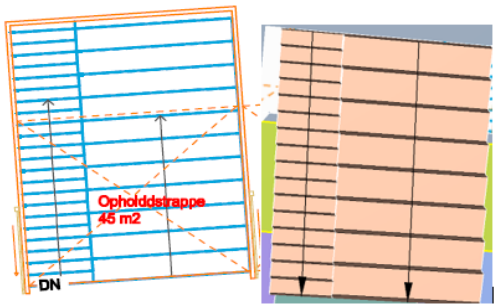


Figure 5. 3.1.1 AutoCAD – drawing and Drawing from Pathfinder

5.4 Conclusion

Pathfinder is a useful simulation tool, when you have established the right context, the appropriate assumptions, and use realistic quantitative data. This part of the report briefly concludes, that it is possible for 282 occupants to safely egress from the first floor, in case of a fire emergency, within 4 minutes of critical time, if the behaviour stays normal. The simulation detected bottlenecks at the stairs and at the main exit door. The reason for this, was that all the occupants had to evacuate at the same time through the stairs. There is also the possibility for the occupants to evacuate from the emergency exit at the first floor. This could reduce the bottleneck at the stairs and speed up the evacuation process.

Pathfinder is a user-friendly simulation software, when you have get familiar with the program. I would recommend that the VITA school hire an extern consultant to make the program for them, because there is some background knowledge you should have when making a simulation like this. But when all the parameters are set for the evacuation, it is easy for the school to use.

5.5 Identification of buildings

Vita school Bohr Esbjerg section H, is 8th track and include students from 7th to 9th grade. Our approach that maintains attention focuses on segments of building structure /components, including building regulation and people located in building section H. Section H, consist of floor plan and 1 floor as seen in figure 5.5.1.

Figure 5.5.1 Building section H floor plan and 1 floor plan.

Basis for creating fire scenario is to describe and calculate the interaction between building, people and materials (flammable) which can leads to an infinite number of possible fire. Relation to combustible materials and ignition sources to recognize and indicates where it is possible that fire may occur. From the perspective point of view any fire is relatively easy to fight, if it manageable and limited. The fire which have the largest spread and most impact are those that are allowed to develop unnoticed over an extended period of time. For research purpose it will be carefully considerate whether, in a building (section H), is possibility and probability that a fire can start and develop unseen. Creating a fire scenario using a quantitative analysis, such as a fire scenario with the highest probability and with the highest risk of probability and consequences, verifies and provide relevant information to make decision. Building regulation BR2017, consist of six categories. The categories of adversity are classified according to the use of the building section and how many people the building section is to be used for. Each category depends on whether the people are familiar with and whether the persons themselves can secure/evacuate themselves in the event of fire as seen in figure 5.5.2.

	All persons are familiar with the building section's retreat and escape routes	The building section is designed for day stay / night stay	The persons can be safe for their own help	Number of persons per room, which represents a fire-fighting unit
Application Category 1	Yes	Day care	Yes	
Application Category 2	Not necessarily	Day care	Yes	≤ 50
Application Category 3	No	Day care	Yes	>50
Application Category 4	Yes	Night stay	Yes	≤ 50
Application Category 5	No	Night stay	Yes	≤ 50
Application Category 6		Both	No	≤ 50

Figure 5.5.2 shows the difference between the six-application category.[64]

Application category 2 The building section is designed for day care with a few people per room, where all the people who usually stay in the building section do not necessarily know the escape routes but are able to bring them self to safety. It is a prerequisite that each room is intended for less than 50 people. Building sections are covered by contingency legislation and must therefore be operated in accordance with the relevant operational regulations. The distance of a building to neighboring road, road or stalemate has an impact on the fire-engineering properties of the building's external walls and exterior surfaces so there is no risk of fire spread nearby. Building height may imply stricter requirements for building exterior surfaces. The requirements for the external surface's fire-resistant properties, as well as the construction of firewall or not, depending on the distance to the neighbor's shaft are indicated in figure 5.5.3

[64]Fire protection of constriction, 2 editions, May 2005. Published by Danish Fire and Security Institute

Distance to neighboring road or stamped	Firewall	Exterior surface
5.0 m or more	No	At least clothing class K1 10 D-s2, d2 (class 2 clothing)
From 2.5 m to 5.0 m	No	At least clothing class K1 10 B-s1, d0 (class 1 clothing)
Less than 2.5 m	Yes, the wall or the walls facing the shell	At least clothing class K1 10 B-s1, d0 (class 1 clothing)

Figure 5.5.3 External surface requirements[65]

The specified fire-engineering classifications for building parts do not include consideration for wind loads or horizontal mass loads. Walls and floors are assumed to be separate building parts as seen in figure 5.5.5 The dimensions given are the minimum permitted target terms as the basic goal prescribed by permitted deviation according to Danish norms and standards. The specified dimensions for wood are the dimensions of needle wood according to DS 1002. Figure 5.5.4 is overview of fire engineering classes that meet European standards.

European class	Danish class		Building section H
Materials			
Materials class A2-s1, d0	Non-combustible material	aluminum steel copper zinc plaster brick light concrete fiber cement mineral wool	✓
Materials class B-s1, d0	Class A materials	fire-plated wood particleboard wood fiber boards and plywood slabs	✓
Materials class D-s2, d2	Class B materials	wood with a density of 400 kg / m^3, chipboard with density of 600kg / m^3, fiberboard with density of 600kg / m^3 and plywood slabs with density of 600kg / m^3	
Clothing's			
Clothing class K_1 10 B-s1, d0	Class 1 clothing	9 mm plasterboard boards 9 mm fire-resistant plywood 21 mm boards that are also fire-proofed and approved by the City and Housing Ministry	
Clothing class K_1 10 B-s2, d2	Class 2 clothing	The same as class 1 with density of 600kg /m^3	
Clothing class K_1 30 A2-s1, d0	30 min fire protection system		
Clothing class K_1 60 A2-s1, d0	60 min. fire protection system		
Floorings			
Floorings class $A2_{fl}$-s1	Non-combustible material		
Floorings class D_{fl} -s1	Class G floorings	concrete, terrazzo, 6 mm thick linoleum, 4 mm thick thickness pvc and 21 mm floorboards with non-combustible substrates	✓
Roofing			
Roofing class B_{ROOF} (t2)	Class T roofing		✓
Carrying non-additional building parts			
Building parts class R 30 A2-s1, d0	BS – building parts 30		
Building parts class R 60 A2-s1, d0	BS – building parts 60		✓
Building parts class R 120 A2-s1, d0	BS – building parts 120		✓
Carrying additional building parts			
Building parts class REI 30 A2-s1, d0	BS – building parts 30		

[65]Fire protection of constriction, page 95, 2 editions, May 2005. Published by Danish Fire and Security Institute

Building parts class REI 60 A2-s1, d0	BS – building parts 60		
Building parts class REI 120 A2-s1, d0	BS – building parts 120		✓
Not – carrying additional building parts			
Building parts class EI 30 A2-s1, d0	BS – building parts 30		
Building parts class EI 60 A2-s1, d0	BS – building parts 60		✓
Building parts class EI 120 A2-s1, d0	BS – building parts 120		
Doors			
Door class $EI_2$60-C A2-S1, d0	BS-door 60		✓
Door class EI230-C	BD -door 30		
Door class EI230	BD -door 30-M		✓
Door class EI260-C	BD -door 60		✓
Door class E 30-C	F -door 30		
Door class E 60-C	F-door 60		
Door class CSa	Self -closing smoke -proof door		✓

Figure 5.5.4 An overview of fire engineering classes according to European standards at Vita school Bohr Esbjerg

Firewall have to be carried out when buildings are placed closer than 2.5 m from neighboring shelf. A firewall consists of the wall itself and is equipped with a fire or fire extinguisher to prevent fire from spreading over fire walls. a firewall must be carried out at least as building component class REI 120 A2-s1, d0. Firewall identification indicates stability under fire. i.e. REI 120 must maintain its stability for at least 120 minutes, regardless of which side of the firewall is affected. Firewall must be carried out without any opening. A firebox must be stored at least 0.3 m above roofing, and the distance is measured perpendicular to the roof surface. As an alternative to a firebox, a firefighting replacement can be performed. Replacement of firebox must be carried out at least as building component class REI 60 (BD building section 60). In case of firebox replacement, firewalls must always be placed in close connection with the underside of the roof covering as seen in figure 5.5.5.

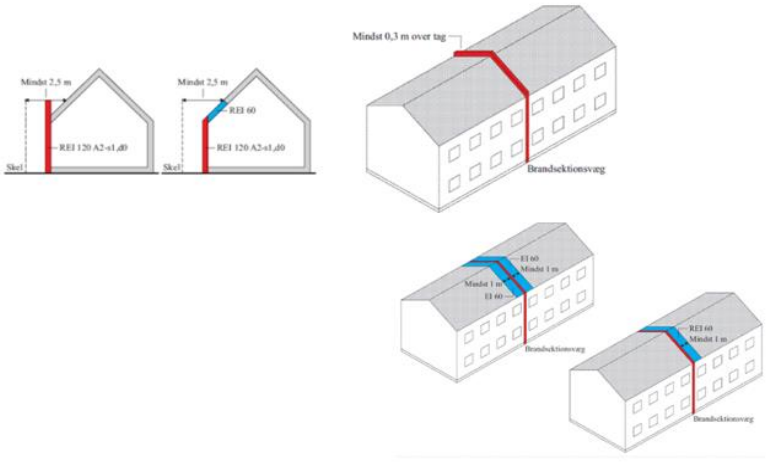


Figure 5.5.5 Examples of firewall located in neighboring shells and provided with either firebox or fire replacement[66].

[66] https://www.taasinge.dk/teknik/brand/

5.6 Location of escape routes and exists

For any space in application category 2, rules apply that from any point in the room no more than 25m must be used for the nearest escape route or exit. If a fire cell is not more than 150m^2 and is calculated for a maximum of 50 persons, it is sufficient for an exit or a door for escape that leads to two independent outputs in opposite directions. See Figure 5.6.1 A room which poses a particular fire hazard for example physics or chemistry premises as well as school kitchens should have two doors for escape, so people will not be blocked into the room in case of fire. The doors should be located at or near the end of the fire cell. A fire cells larger than 150 m^2 and intended for a maximum of 50 persons shall be carried out with two doors for escape routes or with two exits located at or near the opposite ends of the fire cell.

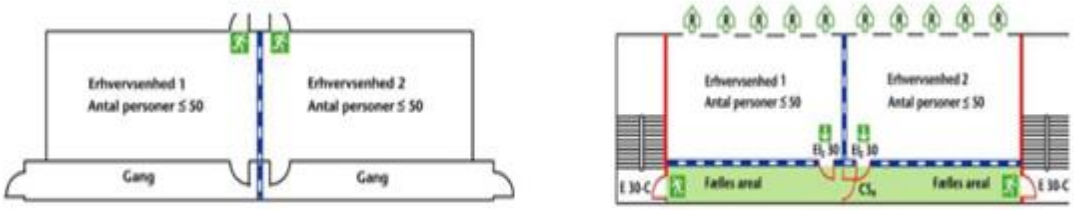


Figure 5.6.1 Escape routes principles for smaller spaces and escape routes for fire cells lager than 150m^2 [67]

Two-floor fire cells must have access to an escape route or to an exit for each floor. For fire cells with rescue apertures not exceeding 2.0 m above ground, access to an escape route is sufficient which only one direction to an exit leads in one direction to an exit when a maximum of 25 m to the exit corridor. An escape route in Section H, constitutes its own fire section. According to legislation, an escape route must have a minimum free width corresponding to the number of persons to use escape routes. It is considered 0.01m free width per person. If used by less than 100 persons, the escape route must have a free width of at least 0,82m (9m door) and if used by more than 150 persons, the escape route must have a free width of at least 1.5 m. Also, the walking distance in a fire cell to the nearest exit or to the door to escape route does not exceed 25 m from any point in the fire cell. The escape route lengths in section H although it does not exceed 50m have been installed smoke-proof doors, so the escape route corridors were divided into pipe sections. The door is done as door class CS_a (self-closing pipe-tight door) and is equipped with automatic fire door closure system (ABDL plant). Section H meets criteria for design of escape routes.

[67] http://docplayer.dk/9143511-Brandkompendium-for-installatoeruddannelsen.html

5.7 Emergency exits

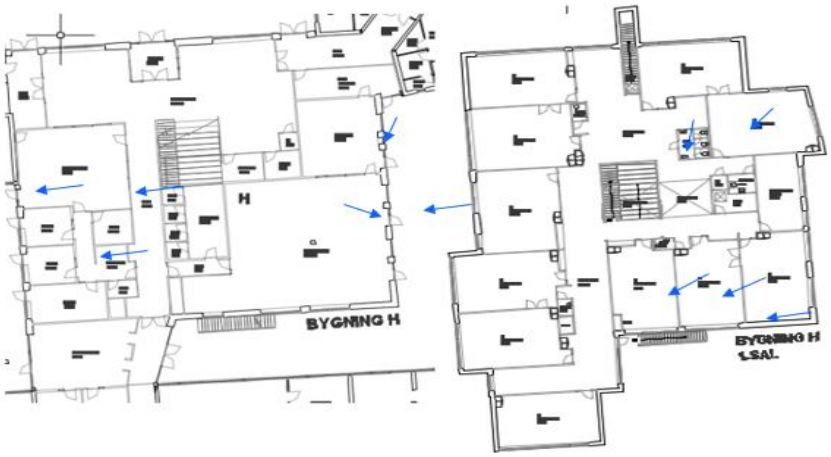


Figure 5.7.1 A room with two separate escape routes

According to fire protection of construction regulations, rooms for personal stay must be carried out with rescue apertures corresponding to a rescue opening per person. commenced 10 persons. Exemplary in our case involves a classroom calculated to more than 21 people, classroom must have three rescue openings. However, if there are two separate escape routes from a room, rescue openings can be omitted. Independent escape routes may be door to the open air and door for escape, giving access to terrain in the open as seen in Figure 5.7.1. In a space where rescue apertures are located less than 2.0m above the ground and where the risk of personal injuries associated with personal rescue is minimal, rescue apertures should not have a width or height less than 0.5m.

5.8 Passive and active fire protection

Creating the fire safety in buildings lay in distinction between passive and active fire protection. Passive fire protection consists of dividing the building into smaller fire-units. A fire section wall or fire doors which must be documented throughout drawings. Sometimes it is much easier to show on a drawing than to describe in words how a buildings component is constructed. However, it is very important that in large parts of buildings passive fire protection indicate that structures and surface are followed the requirements of the building regulations. That means classification of materials that are part of passive fire protection must be produced as well as tested and approved according to ETA-approvals (European Technical Approval). Each product must be tested for reaction and resistance to fire, mechanical resistance and durability, resistance to impact etc. products must bear a CE mark to identify their approval. Passive fire protection is a permanent buildings fire unit which will not be activated in a fire situation. However, their specific functionality reflects on the system and contributes to ensuring uncritical condition for people, limitation of fire and working condition in case of fire for emergency fire department.

If there are two buildings constructed on a single site with free space between the buildings, which correspond at least to the sum of their mutual distance requirements to neighboring houses, which is less than 5m, are considered as one building sections with regarding to division into fire sections and fire cells see figure 5.8.1

Figure 5.8.1 Two building section which are considerate as one

Regarding the fire-section walls in buildings H and A are constructed as at least walls class REI 60 A2-s1, d0 corresponding to BS-60 walls. All doors are made as least door grade EI2 30-C corresponding to BD-30 doors in every fire-cells and wall-exterior have clothing class $K_1$10D-s2, d2 as well as ceiling surfaces. Stairs were carried out with fire-grade class EI although according to fire protection regulations if floor on the upper floor does not exceed height more than 5.1 m above ground material class D-s2, d2 and R30 A2-s1, do may be used. Active fire protection: Includes fire technology installations that are activated by fire characteristics. Active fire protection usually sends a fire signal to another fire protection, to people in buildings and or to emergency rescue. The following items are considered as an active fire protection: automatic fire alarm system (ABA system), automatic sprinkler system as seen in figure 5.8.2 (ACS plant), smoke detection system, warning system fire ventilation and smoke venting, automatic fire extinguisher system (ABDL system), escape and panic lighting, hand fire extinguisher etc.

Maximum Ceiling Temperature	Temperature Rating	Temperature Classification	Color Code (with Fusible Link)	Liquid Alcohol in Glass Bulb Color
100 °F / 38 °C	135-170 °F / 57-77 °C	Ordinary	Uncolored or Black	Orange (135 °F / 57 °C) or Red (155 °F / 68 °C)
150 °F / 66 °C	175-225 °F / 79-107 °C	Intermediate	White	Yellow (175 °F / 79 °C) or Green (200 °F / 93 °C)
225 °F / 107 °C	250-300 °F / 121-149 °C	High	Blue	Blue
300 °F / 149 °C	325-375 °F / 163-191 °C	Extra High	Red	Purple
375 °F / 191 °C	400-475 °F / 204-246 °C	Very Extra High	Green	Black
475 °F / 246 °C	500-575 °F / 260-302 °C	Ultra High	Orange	Black
625 °F / 329 °C	650 °F / 343 °C	Ultra High	Orange	Black

Figure 5.8.2 Glass Bulb identification chart

Sprinkler system are design to cool the fire in its early phase and if the fire is nor extinguished, then the automatic water sprinkler should control it until the emergency start their effort. According to Danish Fire and Security Engineering Institute (DBI) ABA-system must be design in accordance with Guideline 232 Section 1, DBI Guideline 251/4001 Automatic sprinkler system (DBI 2009b), and (DBI 2008) automatic fire alarm systems. In this case there has been installed escape routes, panic lights as well as hose winds, where there is a maximum of 25m to the nearest hose winding, considering space distribution of furniture etc[68].

5.9 Sub-conclusion

Ability to make decision and to act require a strategy report which will describe the basis for fire-safety engineering calculation. The interaction between buildings, people and materials (flammable) leads to an infinite number of possible fire accidents. In practice it is almost impossible to analyses all potential fire-scenario, and it is important that before the quantitative analysis, to limit the problem to the main scenarios - limitation of the building sections. Corse of action must be through qualitative analysis of fire factors in selecting the fire scenarios to be investigated and carefully study of the plans, building description and interior design. The presence of flammable materials and ignition sources will indicate where it is likely that a fire may occur. Also, the areas where there will often be high fire load or high people loads, there is good reason to analyze the factors in these areas in detail. Any fire is relatively easy to fight, as long as it is manageable and limited. It has been proven that the fires which have the largest spread and most impact are those that can develop unnoticed over an extended period.[69] It should also be considered whether there may be fires in places that would delay evacuation, or in place which could lead to rapid fire speeding. A fire scenario is a fire cycle which are characterized by: a specific initial fire (fire-site, ignition source, fire object), impact of energy release -time curve which indicate the energy rate, smoke and fire spread including the position of doors (open or closed).

The selection of the fire scenario should be based on highest probability (whatever the impact size), and fire scenario with the uppermost risk which is product of probability and consequence. Furthermore, qualities of the decision-making for estimating the stability for the evacuation process is through analysis/report of the structural factors, people distribution in the building and identification critical location from which can be difficult to reach safety within a reasonable timeframe. The fire strategy report must include a building sections, explaining how evacuation plans re implemented, describing which safety calculation tools are used in the demonstration of personal safety.

There are two main factors to consider when preparing an evacuation strategy. The first one is simulation or phased evacuation (total evacuation of the entire building at once) and second is evacuation within the building or to the outside. The idea is to establish so-called evacuation areas or evacuation zones inside the building. Initially evacuation can happen to these areas, from where it must be possible to later evacuate out into the open. To assess the possibility of evacuation strategy, is necessary to relevance of the following factors: the building size and complexity, number of floors, distance to and size of exits, room size, people density and key people (evacuation management), establishing specific evacuation instruction and train people to manage to evacuate in time.

[68] **Brandsikring af byggeri page. 128, 2 editions, publish Maj 2005 by Danish Safety technology institute.**

[69] **Fire-safety engineering by Lars Schiøtt Sørensen page.133. 1. Edition, 2014**

6

Discussion

If we look at problem statement and our approach to questions which are related to risk communication, emergency protocol and risk associated relating to evacuation strategy *at the Vita school Bohr I Esbjerg, we can conclude that* risk communication depends on understanding how others regard threat, value, contingency and causal relationship. `Understanding` is the key words, not `convincing`. An object of risk potential can become a risk object as value priorities shift, risk-decision process re-value and new facts come on the table. In addition, affirmative way risk communication and strategies are symmetrical. There is no difference in nature between calming that something is a risk or not. It is simply a matter of establishing or preventing someone from establishing a relationship of risk between a risk object and an object of risk. The second segment is definition of risk base from attributions of value. The acknowledgment and ide of value is at the core of a relational theory of risk. That's why we would like to conclude with a statement for starting the process of risk communication with a value rather than potential of hazards, as is the common approach. Value is built on principals of subjective social agreement where we must understand how value is create and what people do, and how they want to do the things they do in their daily practice.

That means that the first step of risk communication must be addressing the terms of people`s practice of value. Also, the value of risk communication is to understand what people consider of a hazard as a risk or not. If we look objectivity, considering that we have a public school, risk communication as a segment of contributing to decision-making strategy, create some of the practical issues typically faced by risk managers that seek to communicate clearly with the stakeholders, in a decision process about the uncertainty which associated with the outcomes of proposed action (drills regarding evacuation). Our intention where to distinguish how risk communication is of main interest of interpretation the importance of decision-making strategy. When dealing with communication uncertainty, in the interest of helping people to make better informed decision, is always a challenge.

The issue facing the risk communication protocol is results in significant consequence of human perception and sometimes create difficulties to continue. Risk communication uncertainty can be an emotional and an ethical challenge for risk management. In conducting research on the relationship between risk communication and evacuation protocol is a matter or creating a model of strategy in terms of improving benefit of risk decisions, increasing trust of different stakeholders. This type of a transparency strategy can be successful, only if decision-makers are clear about what they expect of the target audience (stakeholders) and whether it will support expected outcomes. Basically, if risk communication sources are not trusted, risk messages or strategy are unlikely to be believed.

When it comes to the evacuation strategy, there are conditions and limitations. There are three parameters that are crucial in the process. Technologies that concern fire protection of construction, fire extinguishers, fire doors, alarms, sensors, etc. Present technologies at the Vita school Bohr, needs an upgrading in a form of investment to emphasis the building design and concept. The importance of upgrading for example the cell phones which are connected to alarm system will be beneficial and change the teacher's passive

behavior and the concept of having the cell-phones close to themselves. Plans in terms of education reform and education that can have a constructive impression in the structural process. And people with their behavior, motivation, pressure and communication skills. Ability to make decisions and to take an action lies in empowerment where people's personal preparedness in the terms of safety development based on educational drills will create opportunity to decide about a risk and then, take appropriate action to mitigate or eliminate the potential risk.

Another issue is `trust` in terms of information exchange among interested parties/stakeholders at the school. Mistake was the way of announcing the process of evacuation drills, without definition of interactive process of exchanging the information and option among stakeholders to participate, as well as constructive clarification of why an evacuation action is needed. Sending and receiving the message is a matter of informative structure, process of analyzing the risk assessment and influence/acceptance of decision-making process providing opportunities for stakeholders to speak and to be heard. This create and shape decision acceptance to improve the evacuation process. When it comes to terror it is a subject of consistent where, or if the terrorist know or can only hope that his victims are less than what he can achieve, he will use terror. In other words, terror will be a problem for many future generations. For the sake of discretion, terror will be a single glitch. There will usually be a well-developed organization behind. Organization is often structured as autonomous cells with some degree of coordination. The management's task is to decide goals, means and method. Precisely because organization is divided into cells makes it extremely difficult to detect and combat terrorist organizations. Therefore, terrorism is an unequal struggle. The terrorist organization chooses time place and method, in short it has the initiative. Alone by creating and developing the fear of terror, it seems as terrorist organizations are one step ahead of the struggle. Controversial initiatives have so far also focused on defense against terrorism. We try to secure ourselves, but in principle we choose to await terrorist actions. Only when the terrorists have been acting, huge resources are used to trace and imprison them.

7

Recommendation

Our recommendation had focus on some of the practical issues typically faced by risk communication as well as evaluation of evacuation strategy. Suggestion of risk communication process, based on research and case-study experience, have provide an objective and fundamental guideline for communicating protocol. Always be clear about the task and choose the precision and format of uncertainty which will allow the `need to know` information to be evaluated and interpretative as simple as possible. Survey has shown that when there are many sources of uncertainty it can be a huge challenge to think through the diverse ways that uncertainty could be evaluated and used in a decision context. Simplifying the content of the information can in many ways result and reflect on decision strategies on the part of `end-users` which are stakeholders. For risk communication uncertainty, typically faced by risk managers that seek to communicate with stakeholders, can be beneficial to focus on evaluation various aspects of the representation. People may have a difficulty accepting uncertainty, especially involving them or those they care for. It became an issue which may affect they emotional and ethnical judgment. Corresponding the precision of informative representation to the expected uncertainty creates a common agreement about uncertainty in multi stakeholder groups. The first recommendation is good evidence reporting which must consider the characteristic features of the stakeholder's information processing.

The most important thing is knowledge about the concept of risk analysis, risk communication, framework of risk assessment and expected values and probabilities. Awareness of people's interpretation of accepting information, impact of misconception and negativities (there is a risk potential) rather than positive accept the information will provide a better understanding how to create context of informative protocol and structure. AGREE framework is a tool table, which assessment criteria based on development of stakeholders ethical and communicative aspects as seen below in table. The second recommendation is CORA (communication of risk assessment), which is a tool for reporting and gather the evidence from non-expert audiences based on assessment. The CORA framework presented below consists of seven criteria which reflect on characteristics starting from the process of assessment to the prominent features of the outcomes of the assessment. The key issue here is to allow the recipient (stakeholders) to make a judgment about the trustworthiness of these assessments. It is important to note that CORA framework intent to provide an overview of the theoretical mechanisms that may produce risk communication efforts to the assessment.

Quality assessment domain for. example – evacuation	*Definition - protocol /drills*
Scope of purpose	*Overall aim of the guideline, the specific questions regarding procedure of evacuation*
Stakeholders involvement	*Extent to which the guideline represents the views of its intended users.*
Rigor of development	*Methods used to gather information/feedback and synthesize facts*
Clarity and presentation	*Correct way of sending the message. Language and format of guideline.*
Applicability	*Organizational, behavioral and phycological reaction*
Editorial independence	***Independence of the recommendation and acknowledgement of possible conflict of interest of its developers***

AGREE framework table[70]

I. ***Referee to general information regarding assessment:***	***1. Responsibility*** ***2. Research /objectives and scope as well as limitation*** ***3. Founding information available about funding of assessment.***
II. *Criteria for composition:*	*1. Selecting a group of people (experts)*
III. *Criteria for independence:*	*1. Procedure that are applied to gather an informative aspect* *2. Technological application* *3. Developing a plan*
IV. *Criteria for public consultation:*	*1. Is there information about a procedure applied to receive comments and inputs from various stakeholders?*
V. *Criteria for structure and process of assessment:*	*1. Method of strategy of searching* *2. Does the report indicate which procedures were used to enhance the quality of the assessment?* *3. Explanation of the process and procedure* *4. Evaluation of facts and evidence*
VI. *Criteria for conclusion:*	*1. Information availability about the procedure and acceptance.* *2. The strength and weaknesses of the available evidence.* *3. Information about uncertainties of the assessment.*
VII. *Criteria for communication:*	*1. Discussing the pros and cons.* *2. Conclusion discussed in context of other assessment. – comparing*

CORA - communication of risk assessment-framework table[71]

The third recommendation is also a framework of systematically task and problem-solving table. It is an effective decision - term with clearances of who is doing what or when and it consist of cognitive theoretical segment such as:

- Inflectional aspects
- Decisional process
- Qualitative approaches
- Acceptance

[70] **Effective Risk Communication page. 46 edited by Joseph Arivai and Louie Rivers III first published 2014.**

[71] **Effective Risk Communication page. 59 edited by Joseph Arivai and Louie Rivers III first published 2014**

Decision house -systematic task and problem-solving table

What do we KNOW: is basically action plan of what should be done, who should do what and who must be informed? It includes a process of choosing the methods and procedures.

What DO: is an informative approach in term of what should the assessment could solve and what kind of impact will this have on stakeholders? What do we know about the assessment and possible dividing phase of the task up into. Exchanging the information in the group to create the vision and an overview procuring the goal of the task.

What CAN: is an opportunities and possible solution involving brainstorming leaving space for creative ideas and options. Resource manpower and competencies.

What we WILL: is a decision process and motivational factor that involves our emotional capacities. It is an issue of advantage and disadvantages of different options discussed and clarified. Consideration of different factors including time, security, safety engineering and resources. Impact of assessment relating on selecting one or more solutions and mitigate/neglect any negative consequences.

The fourth recommendation is increasing focus on fire safety engineering. According to the DEMA (Danish Emergency Management Agency), the best way to prevent fire problems in schools is through education about fire and fire -prevention to change human perception, increasing focus on safety. DEMA have developed in collaboration with teaching ministers, material to teach students in grades 0 and 1 about fire and again in 4 and 5 classes of how dangerous it is to play with fire. It has been mentioning to expand the educational materials to 6 and 7 classes based on statistic survey[72].

Introducing risk management process, to the school will probably benefit the safety protocol and embrace the challenges associated with seeking to understanding the consequences of risk associated with fire. The theoretical structure of risk management process is carried out based on an establishing risk policy, that relates to many areas and contributes to the risk, being treated and evaluated in a larger context. Table of risk management process contain a list of the most crucial decision criteria and consume to the level of technical assessment. Selection of risk management options involving the risk communication, as concept of interactive process of exchange an information and option among individuals.

[72] http://www.kl.dk/ImageVaultFiles/id_29012/cf_202/Forebyggelse_af_brand_p-_skoler.PDF
http://brs.schultzboghandel.dk/checkout/shopbasketcheckout.aspx?sc_lang=da&sb=1&items=1*IFV13

Identification of risks	**Identification of risk can include many kinds of risks. In most organizations or projects, it can be beneficial to involve people across departments/disciplines, etc.., in a brainstorming session to identify potential risk or events that could threaten the organization.**
Analysis of risks	The risk can be expressed as a combination of frequency and impact and risk level as frequency x impact (RL=F x I) It is often describing to systematically change the presumption and assumptions to identify those parameters that have a special importance to the analysis results. As such sensitivity analyzes are an essential part of a risk analysis. Frequency may, among other things be expressed as a number of times per year or over a period. Impacts can among other things be expressed as an expected monetary loss, the impact on the surrounding environment or the number of persons who may suffer harm. With very serious risks, where the impact is very great, this alone can be critical to the subsequent assessment and treatment of risk ratio.
Assessment of risks	Results of the analysis for frequency, impact and risk level assessed and compared with acceptance criteria. It is possible to: • Accept • Eliminate • Reduce the frequency and or impact or • Transferring the risk, or portion thereof, to others. In some contexts, the acceptance criteria are given in advance, e.g. by authorities or others who have a requirement function demand.
Treatment of risks	Is basically: • Assess the measures that are technically, financially and otherwise best to reduce the risk to an acceptable level. • Select measures • Implement measures
Follow-up, documentation and evaluation of the Risk Management Process itself	**Follow-up covers among other things, that the implemented measures and emergency readiness available is constantly maintained and match current conditions. Transferred risks must also be followed up. Documentation must ensure that the organization can account for measures and emergency reediness to address risks, as well as irregularities and accidental events are documented and included in the regular updating and review of the risk management process.**

Table of risk management process[73]

The process of risk management represents a fundamental change from a focus on risk communication effects and structure to recognition that communication strategy. It is a process that is linked to the analysis and to be a tow-way dialogue, between those who are responsible of implementation of the process and stakeholders to exchange information of processes and experience.

Implementation of safety 1 which is `ensuring that the things go right` and safety 2 `avoiding that things go wrong`, will increase the efficiency and strength people value and intuition of element of rational theory of risk. The nature of safety management depends on the definition of safety and can changed approach to motivation aspects regarding practice. To determent the process of implementation of both safety we must look at the definition and difference between them.

[73] **Fire-safety engineering by Lars Schiøtt Sørensen page.499 1. Edition, 2014**

Definition of safety[74]	**Safety I**	***Safety II***
	That as few things as possible go wrong	*That as many things as possible go right*
Safety management principle	Reactive respond when something happens	*Proactive try to anticipate developments and events.*
Explanations of accident	Accident are caused by failures and malfunctions.	*Things basically happened in the same way, regarding of the outcome.*
View of the human factor	**Liability**	***Resource***

Emerging a formative structure where decision-making process are based on deliberation and acceptance of outcomes will shape the options of decision process. There are some practical suggestions on how to begin decision making process of safety I and safety II involving risk communication as a part of developing policy:

- Look for what goes right, as well as what goes wrong.
- When something has gone wrong, look for everyday performance variability rather than for specific cause.
- Look at what happens regularly and focus on events based on how often they happen (frequency) rather than how serious they are (severity).
- Allow time to reflect to learn and communicate.
- Learning from past failures and disconnect in communication.
- Remain sensible to the possibility of failure and be mindful.

When it comes to evacuation strategy, our suggestion is predict based on expectancy of value of informational- strategy to predict and avoid passive human behavior. It is not possible to assume that all the children during evacuation would be in their classrooms. Therefore, it would be an innovative idea to send message via mobile device or by notification on a large screen. Alarm signals should be active for more than 10 seconds and teachers should use the speaker system to ensure that all children evacuate safely from the school. Using the risk communication as a part of intuitive decision-making process will increase a decision-choice, course of action, the probability of the events occurrence and benefit and cost associated with all the viable options in the process of evacuation strategy. However, more realistic viewpoint is that most individual because of task /event complexity and their limitation processing ability of evaluating the concept of information strategy are not able to consider rational decision-making approaches. That´s why it is necessary to establish the process of risk management to engage people in a process of thinking what matters in the context of risk evaluation.

These efforts in term of theoretical perceptivities based on human and social condition will open the way for innovative perceptivities on the conduct of risk communication. Our approach supplies answers to key questions, regarding a critical and in the way determinate feature of risk communication in practice based

[74] **The basis differences of safety I and safety II** http://www.resilienthealthcare.net/A_tale_of_two_safeties.pdf

on why, how and by whom something is considered as a risk or not. The second aspect is human perception and engage in learning process about risk related issues as well as concept of engagement or participation. Establishing the process of risk management, decision-making structure and risk communication concept as part of people empowerment to understand the complexity of a risk related issue, and then take relevant action on the elements which are clarified by that understanding. This segment of theoretical value can only be realized by providing people with a level of knowledge, participant in educational drills and awareness that will allow them to engage meaningfully and rightfully in discussion on risk.

Appendix

Formidling til folkeskolen

Kulturanalysen som middel I informationsplanlægningen

Malene Gronemann Giorgi

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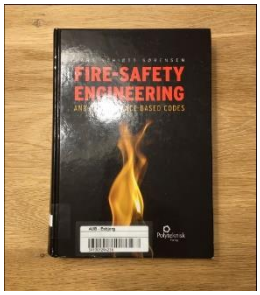

FIRE – SAFETY ENGINEERING AND PERFORMANCE – BASED CODES

Lars Schiøtt Sørensen 1. Edition, 2014

Polyteknisk Forlag, Copenhagen

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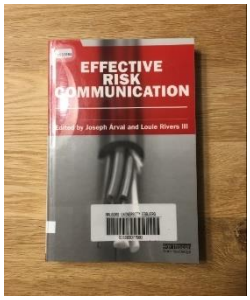

EFFECTIVE RISK COMMUNICATION

Edited by Joseph Arvai and Louie Rivers III

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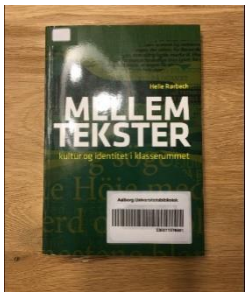
2 Park Square, Milton Park, Abingdon, Oxon OX14RN



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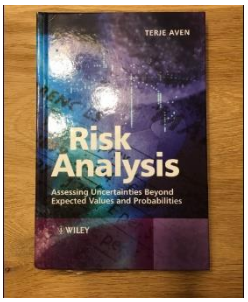
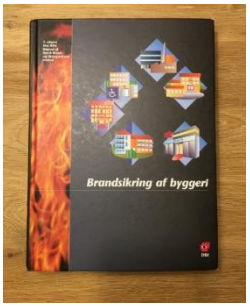


Risk Analysis Assessing Uncertainties Beyond Expected Values and Probabilities

Terje Aven (University of Stavanger, Norway)

Published 2008 reprinted with corrections August 2009

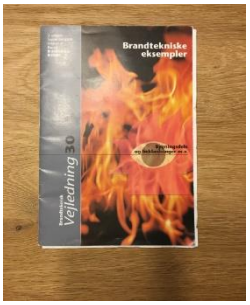


Brandsikring af byggeri

Second Edition May 2005

Dansk Brand og sikringsteknisk Institut

ISBN 87-88961-73-7



Brandtekniske eksempler

Second Edition September 2009

Published by Danish Fire Institute

www.brandteknisk-institut.dk

e-mail: drift@drift.dk

fram figure nr 1

Funktionsnavn	Emergency response
Beskrivelse	
Aspekt	**Beskrivelse af Aspekt**
Input	natural or man made disaster
	frequency
Output	risk communication
Forudsætning	danish emergency management agency -worning unit
Ressource	man power
	software
	equipment
	alarm system
Kontrol	legislation
	evacation protocoll -doc.
Tid	Response time
	evacuation protocall
	frequency
	recovery phase

Funktionsnavn	Recovery phase
Beskrivelse	
Aspekt	**Beskrivelse af Aspekt**
Input	risk communication
Output	risk communiction
	resillience
Forudsætning	
Ressource	
Kontrol	
Tid	man power
	equipment
	response time
	alarm system
	emergency response

fram figure nr 1

Funktionsnavn	Prepardness phase
Beskrivelse	
Aspekt	Beskrivelse af Aspekt
Input	man power
	equipment
Output	resilience
	risk communication
	danish emergency management agency
	natural or man made disaster
Forudsætning	alarm system
	evacation protocall
Ressource	
Kontrol	
Tid	

Funktionsnavn	Process of Plans
Beskrivelse	
Aspekt	Beskrivelse af Aspekt
Input	resilience
Output	risk communication
	response time
	evacuation protocall
Forudsætning	
Ressource	
Kontrol	legislation
Tid	

fram figure nr 1

Funktionsnavn	Mitigation Phase
Beskrivelse	
Aspekt	Beskrivelse af Aspekt
Input	risk communication
	resilience
Output	equipment
	man power
	risk communication
	resilience
Forudsætning	
Ressource	
Kontrol	
Tid	

Funktionsnavn	Drills (excercise)
Beskrivelse	
Aspekt	Beskrivelse af Aspekt
Input	
Output	man power
	equipment
	frequency
Forudsætning	danish emergency management agency -worning unit
Ressource	competencies
Kontrol	risk communication
Tid	frequency

fram figure nr 1

Sted nr.	03.046		
Navn	Bohrskolen Vita	Signaturer :	
Adresse	Vester Gjesingvej 28, 6715 Esbjerg N	Basis	Ans.
Matr. nr.	2fs, Gjesing By, Bryndum	Fag	
Projekt		Mål 1:250	Tegn. sussi
		Dato 07.03.2017	
		Tegn. nr.	(21)3.E
Emne	1 sal H		

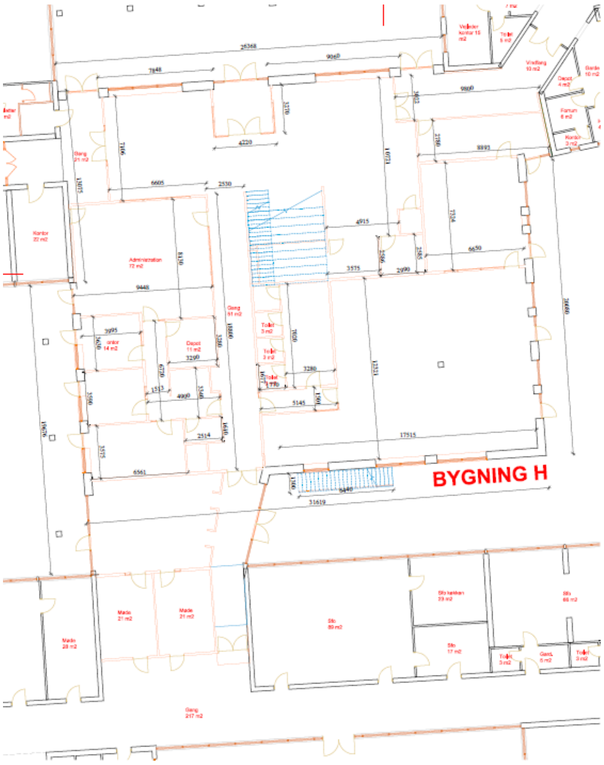
Ejendomme
Teknik og Miljø
Frodesgade 30, 6700 Esbjerg
Tlf. 76 16 16 16

Esbjerg Kommune

Sted nr.	03.046		
Navn	Bohrskolen Vita	Signaturer :	
Adresse	Vester Gjesingvej 28, 6715 Esbjerg N	Basis	Ans.
Matr. nr.	2fs, Gjesing By, Bryndum	Fag	
Projekt		Mål	1:250 Tegn. sussi
		Dato	07.03.2017
		Tegn. nr.	(21)3.E
Emne	stueplan I H		

Ejendomme
Teknik og Miljø
Frodesgade 30, 6700 Esbjerg
Tlf. 76 16 16 16

Esbjerg Kommune



Sted nr.	03.046	
Navn	Bohrskolen Vita	Signaturer :
Adresse	Vester Gjesingvej 28, 6715 Esbjerg N	Basis Ans.
Matr. nr.	2fs, Gjesing By, Bryndum	Fag
Projekt		Mål 1:150 Tegn. sussi
		Dato 07.03.2017
Emne	Stueplan 1.Sal H	Tegn. nr. (21)3.H

Ejendomme
Teknik og Miljø
Frodesgade 30, 6700 Esbjerg

Esbjerg Kommune

```
Simulation:         simulering part6
Version:            2017.2.0301
Mode:               Steering
Total Occupants:    282


Completion Times for All Occupants (s):
  Min:               34,2       "00275"
  Max:              163,8       "00192"
  Average:          102,3
  StdDev:            36,3

Completion Times by Behavior (s):
       Behavior Count     Min   Min_Name          Max   Max_Name          Avg   StdDev
           Boys   129    39,8    "00264"        163,8    "00192"        130,7     24,6
          Girls   144    34,2    "00275"        113,9    "00158"         74,6     21,2
          staff     9   104,7    "00024"        162,4    "00202"        137,6     16,3
*all behaviors*   282    34,2    "00275"        163,8    "00192"        102,3     36,3

Completion Times by Profile (s):
       Profile  Count     Min   Min_Name          Max   Max_Name          Avg   StdDev
          boys    129    39,8    "00264"        163,8    "00192"        130,7     24,6
         girls    144    34,2    "00275"        113,9    "00158"         74,6     21,2
         staff      9   104,7    "00024"        162,4    "00202"        137,6     16,3
*all profiles*    282    34,2    "00275"        163,8    "00192"        102,3     36,3

Travel Distances for All Occupants (m):
  Min:               21,3       "00275"
  Max:               61,1       "00162"
  Average:           41,4
  StdDev:             7,5
```

```
Simulation:         simulering part6
Version:            2017.2.0301
Mode:               SFPE (Basic)
Total Occupants:    282


Completion Times for All Occupants (s):
  Min:               32,5       "00264"
  Max:              148,7       "00165"
  Average:           92,2
  StdDev:            32,8

Completion Times by Behavior (s):
       Behavior Count    Min    Min_Name          Max   Max_Name          Avg   StdDev
           Boys   129   32,5     "00264"        148,7    "00165"        105,3     37,3
          Girls   144   35,0     "00275"        113,3    "00185"         78,2     20,5
          staff     9   88,0     "00024"        143,0    "00330"        127,0     15,8
*all behaviors*   282   32,5     "00264"        148,7    "00165"         92,2     32,8

Completion Times by Profile (s):
       Profile  Count    Min    Min_Name          Max   Max_Name          Avg   StdDev
          boys   129   32,5     "00264"        148,7    "00165"        105,3     37,3
         girls   144   35,0     "00275"        113,3    "00185"         78,2     20,5
         staff     9   88,0     "00024"        143,0    "00330"        127,0     15,8
*all profiles*   282   32,5     "00264"        148,7    "00165"         92,2     32,8

Travel Distances for All Occupants (m):
  Min:               20,0       "00264"
  Max:               44,5       "00132"
  Average:           32,0
  StdDev:             5,4
```