TITLE: Emergency Evacuation System for All

STUDENTS: Bernhard Peyker Britt Blom Marstrander Janine Aßmann Jens Lücke Laura Mateu Lopez Liza Rotteveel

SUPERVISORS: Pau Martí Colom Ariadna Llorens García

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<table>
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<tr>
<th>FAMILY NAME</th>
<th>FIRST NAME</th>
<th>HOME UNIVERSITY</th>
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<tbody>
<tr>
<td>Aßmann</td>
<td>Janine</td>
<td>Kiel University of Applied Sciences, Germany</td>
<td>International Sales and Purchasing in Engineering</td>
</tr>
<tr>
<td>Marstrander</td>
<td>Britt Blom</td>
<td>Oslo University College, Norway</td>
<td>Civil and Structural Engineering</td>
</tr>
<tr>
<td>Lücke</td>
<td>Jens</td>
<td>Kiel University of Applied Sciences, Germany</td>
<td>International Sales and Purchasing in Engineering</td>
</tr>
<tr>
<td>Mateu Lopez</td>
<td>Laura</td>
<td>Universitat Politècnica de Catalunya, Spain</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Peyker</td>
<td>Bernhard</td>
<td>Technical University Bergakademie Freiberg, Germany</td>
<td>Technology Management</td>
</tr>
<tr>
<td>Rotteveel</td>
<td>Liza</td>
<td>The Hague University of Applied Sciences, Netherlands</td>
<td>International Marketing</td>
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Abstract

A good emergency evacuation plan for buildings is a key factor for saving lives in the case of an emergency. Therefore, the purpose of the project “Emergency Evacuation System for All” is ensuring the appliance of evacuation methodology, being as efficient and effective as possible, in order to maintain a maximum amount of safety for able and disabled people.

Major outcome of the project is a complete emergency evacuation system, taking all people into account for buildings with a special focus on public buildings such as university buildings. The project contains a general evacuation plan for all people, an applied evacuation plan for the main building at the Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú, a new technical evacuation solution for buildings, a report on existing technical solutions, a training plan for emergency helpers and a business plan for La Càtedra d’Accessibilitat, a non profit organization with the main goal to improve society standards concerning persons with disabilities.

Keywords: efficient evacuation, evacuation plan, evacuation system, people with disabilities, evacuation solutions, mechanical solution, training plan, business plan
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1 Introduction

This is the final report of the “Emergency Evacuation System for All” project undertaken during the European Project Semester 2009 at the Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú. The project was given by “La Càtedra d’Accessibilitat”.

The main goal of the project was to enable efficient emergency evacuation for all people as well as to raise the awareness of the situation.

Basis for the project was a study on existing evacuation plans for public buildings around the world. The main part of this research was to elaborate common parts and weaknesses of all these plans. This was done, in order to get a solid knowledge and background about this topic and to get the knowledge to improve other plans as well as create a whole evacuation system. Furthermore this study included a research on disabilities and the way these disabilities affect people.

Moreover the study included research on the needs of disabled people. The basis for this research was the “International Classification of Functioning Disability and Health” of the World Health Organization (WHO). A result of this study was the decision to specialise the “Emergency Evacuation System for All” on people with the most common and most affecting disabilities. The disabilities the EPS-team was concentrating on are: blindness and visual impairments, deafness and hearing loss, mobility impairment- and cognitive impairment. Furthermore all common and less common emergency situations or evacuation reasons were taken into account, to ensure to have a complete emergency evacuation system for all.

This report gives the outline and an overview of the whole project. The single parts of the report body are structured in The Goal – Content – Results / Recommendations. At the end of each part of the report body there is a link to the related document in the Appendix.

All documents and parts of this project work in synergy, in order to create a whole emergency evacuation system. It is important to keep this in mind, while reading this document to understand the problem and the topic of the “Emergency Evacuation System for All”.
2 General Emergency Evacuation Plan

2.1 The goal
The goal of the General Emergency Evacuation Plan is to enable efficient emergency evacuation. The evacuation plan is meant to be an aid on how to behave before and during an emergency evacuation. The plan should be read by all the people who use the building on a regular basis. Together with the Training Plan and the technical evacuation solutions, the General Plan will work as an emergency evacuation system.

2.2 Content
The General Emergency Evacuation Plan can be applied in public buildings. It consists of three parts; emergency preparedness, evacuation procedures and evacuation of people with disabilities.

- The emergency preparedness explains all the responsibilities which people using the building have, including the evacuation responsible person, evacuation coordinators and evacuation assistants. Furthermore, it describes how evacuation drills and evacuation maps should be carried out.
- The evacuation procedures describe guidelines on how to notify if an emergency occurs. This part also gives general evacuation procedures for all emergency evacuations, and specific guidelines on behavior during different emergency evacuations, for example fire, earthquake and gas leak.
- The last part, evacuation of people with disabilities, describes special consideration for people who suffer from blindness and visual impairment, deafness and hearing loss, mobility impairment and cognitive impairment.

2.3 Results / Recommendations
The General Emergency Evacuation Plan should be used for public buildings, to create a specific emergency evacuation plan. The General Plan includes all major parts of a plan. But unlike a specific plan the General Plan only includes the mandatory parts that are equal in the most public buildings. For the specific plan more particular information are required.

The General Emergency Evacuation Plan itself can be found in the Appendix A.
3 Emergency Evacuation Plan for EPSEVG VG 1-2-3

3.1 The goal
The Specific Emergency Evacuation Plan of the EPSEVG VG 1-2-3 building in Vilanova i la Geltrú has three main goals:
- to make the building safer for everyone
- to give an example of the application of the General Emergency Evacuation Plan
- outline possible improvements

3.2 Content
The Specific Emergency Evacuation Plan for the EPSEVG VG 1-2-3 building is an example on of how to use the general emergency evacuation plan. It was created according to the General Emergency Evacuation Plan.

The document starts stating relevant information about the building, to get an overview of the responsible persons, location of the gathering area, and the technical solutions implemented in the building. Moreover, emergency preparedness, evacuation procedures and evacuation of people with disabilities are described. This was created according to the General Emergency Evacuation Plan. Special attention was given to areas which occur specifically in the EPSEVG VG 1-2-3 building. These are for example hazardous areas like the laboratories and the kitchen.

3.3 Results / Recommendations
As a result of the implementation of the General Emergency Evacuation Plan to the EPSEVG VG 1-2-3 building, the EPS-team included recommendations about how to improve the security of the building.

These recommendations are shown in the document in the following way:

The document consists mainly of two parts: The first part describes the current state of the building and the second part contains improvement suggestions, in order to make the building safer for everyone. These suggestions are listed next to the current state.

Furthermore the EPS team created evacuation maps for the whole building. These maps also exist in two different versions. One is an evacuation map showing the current situation, the other one is the improved case. The maps were drawn according to ISO 23601:2009.

The emergency evacuation plan for EPSEVG VG 1-2-3 can be found in the Appendix B.
4 Training Plan

4.1 The goal
Almost every public building has a general evacuation plan, which contains the arrangements for an emergency. It is necessary to trust on the fact that special evacuation helpers are available. In an emergency, helpers are needed to help attendees in the best, most correct and fastest way out of the building. As a result, an intensive course with practiced theory is of particular importance. Emergency helpers should also know how to react i.e. in the case of fire or how to apply first aid. A suitable preparation is needed to avoid the worst and not to panic. The goal of this Training Plan is to prepare emergency helpers and all people who are work in a building for an emergency. The plan has to be developed with simultaneous consideration of standards and regulations, which are given by the legislator.

4.2 Content
The Training Plan gives guidelines on how employees and students have to be trained in order to become emergency helpers. The Training Plan consists of four different parts; evacuation drills, training courses on prevention, first aid courses and the organisation of the training.

- The first part gives information about the importance of the practising of evacuation drills. Furthermore it is described who should take care of these drills, what to look for while preparing the drills, and which are the facts to take care of. Moreover it contains information about the conferences, which have to take place after each drill, in order to figure out the strengths and weaknesses of that drill, so that improvements can be made.

- The training courses on prevention are described in the second part. The content of the training gives information about the foundation of the course, fire fighting and fire prevention and safe evacuation (building evacuation). The foundation of the course is also about, according to which criteria an emergency helper should act. In the part of fire fighting and fire prevention it is described what the course deals with. Following this, there is more information about the safe evacuation course given.

- The part on the first aid courses gives first a brief description, what first aid is about. Followed by the psychological part, that includes information about how to help an injured person by encouraging, consoling and taking care. It is also necessary to listen and talk to an injured person. The topics which will be dealt with in this course are listed. A short description is given. Furthermore, guidelines for the behaviour towards disabled people are defined.

- The organisational part gives information on how to organize the Training Plan, how to build the different groups for the courses, how often and where the courses will be offered and who should be part of an organisation that manages the appliance of the Training Plan.

4.3 Results / Recommendations
The result of the undertaken work is the Training Plan. The usage of the Training Plan is the best way to prepare the evacuation helper in the best way for an emergency. Due to detailed background knowledge, the helper will receive practical and theoretical courses. These courses prepare the emergency helper to act in an emergency immediately and professionally. Therefore, the number of accidents and damages should decrease. Now that the Training Plan is written, it should be implemented in public buildings along with a specific emergency evacuation plan.

The Training Plan can be found in the Appendix C.
5 Report on Existing Technical Evacuation Solutions

5.1 The goal

During a lot of building emergencies, people die or get injured. The main reasons for these disasters are that people do not have enough time to leave the building, are not able to leave the building, or realize the emergency too late. There are several technical evacuation solutions available, for people with and without disabilities to avoid these problems. The goal of the Report on Existing Technical Evacuation Solutions was to give an overview of existing technical evacuation solutions.

5.2 Content

Within the Emergency Evacuation System for All, the report on technical solutions gives an overview about existing evacuation solutions on the market. All technical solutions are listed with a description of the functionality, advantages and disadvantages and where available with prices. These results helped the EPS-team to create a new solution.

As a part of the whole emergency evacuation system for all, and in order to help making buildings safer, the EPS-team added a part with application guidelines for evacuation systems.

To keep structure in the overview, the EPS-team divided the devices into active and passive evacuation solutions. Active evacuation solutions are systems that transport people out of a building. These are for example evacuation chairs, platform lifts, elevators and evacuation slides. Passive evacuation solutions warn and guide people out of a building. Examples for these solutions are emergency lighting, directional sound evacuation, devices that glow in the dark and LPS-Local Positioning System for People.

5.3 Results / Recommendations

All public buildings should be equipped with a variety of different technical evacuation solutions. The amount and kind of solutions depends on the building and the persons who regularly use the building.

However, due to the fact that there are technical evacuation solutions for everyone, the goal must be that all public buildings are accessible for everyone (within the society) and in this way save for everyone. Even if this means that new solutions must be created. An example for such a new solution is the prototype of the Emergency Exit Elevator developed by the EPS-team.

The Report on Existing Technical Evacuation Solutions can be found in the Appendix D.
6 Emergency Exit Elevator

6.1 The goal

The Emergency Exit Elevator (EEE) is a device, ensuring emergency exit for wheelchair drivers and people with mobility impairment, being independent from the power-supply of the building in which it is implemented.

The solution the EPS-Team developed is especially designed for the EPSEVG main building in Vilanova i la Geltrú; however, the elevator can be applied to every building with a structure providing the possibility to implement mechanical devices on the outside.

Constructional guidelines were set to maintain the development of a device which is as appropriate as possible according to the needs of disabled people, building environment and main goals:

- The consumption of electricity delivered by the buildings power supply shall be avoided
- The elevator shall maintain evacuation service during every kind of emergency which was identified in the general evacuation plan, especially fire
- Disabled People, particularly wheelchair drivers and people with mobility impairment shall be able to operate the device without any help

6.2 Content

Bearing the chosen main criteria in mind the EPS-team created a constructional outline.

A cabin, which can be entered by a disabled person, is vertically grinding on four steel rods. The first and the second floor need to be covered for emergency exit so the rods end at a height that ensures of cabin movement to floor two.

The cabin itself is connected to a counterweight by a steel cable which is running over a pulley at the top. The counterweight is slightly heavier than the cabin itself, so the natural state of the cabin/counterweight system is: Cabin in the second floor, counterweight at the ground floor.

This leads to the problem that in the case of a demand from the first floor, the cabin has to be pulled down to the first floor. In order to avoid a pulling-down process, the first floor was defined as standard cabin position. Therefore a mechanism needed to be designed that stops the cabin in the first floor as it is grinding upwards from the ground floor. If there is a demand from the second floor the cabin is released and be pulled up to its natural state in the second floor.

As soon as the cabin is entered by the demanding person the added weight causes the cabin side of the counterweight system to become heavier than the counterweight. As a result the natural state of the cabin will become the ground floor. In order to ensure safe release of the elevator-user the cabin is not released before the user has entered the cabin completely. User confirmation for release is therefore required. When a leaver is pulled, the cabin grinds down.

Once the cabin, containing a user, is released, the speed must be regulated in order to maintain the secure release of the cabin, therefore the system will be braked. A hydraulic cylinder maintains a constant cabin speed while, shock absorbers sustain a smooth end of the braking process in order to prevent cabin user injuries.

6.3 Results / Recommendation

The result of the undertaken work is the theoretical construction of the EEE including planning of placement and design. Calculations for the loading capacity were made, material was chosen and, if necessary, mechanisms were developed.

A meaningful task for future EPS teams would be the implementation of a working prototype in the EPSEVG VG 1-2-3 building.

Further information on the Emergency Exit Elevator can be found in the Appendix E, F.
7 Business plan

7.1 The goal

La Càtedra d’Accesibilitat wants every space in the society to be accessible for every person independently, irrespective of their capabilities. La Càtedra would like to find out whether it is possible to sell emergency evacuation plans with a focus on persons with disabilities without making any loss. In order archive this, a business plan was written.

The goal of this business plan is to find out whether it is possible for a non-profit organization to sell and implement emergency evacuation plans with the focus on persons with disabilities. Since La Càtedra d’Accesibilitat is a non-profit organization, making profit is not the main goal. The main goal is to improve the society standards. However, it is of importance that the organization will not make any losses.

7.2 Content

The Business Plan consists of 5 different parts: the internal analysis, the external analysis, a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis, a confrontation matrix and a cost calculation.

The internal analysis contains data about La Càtedra. Information on the company structure, the mission, vision and values of the company and its target group is given. The external analysis on the other hand consists of information about the market, such as the main trends which can influence La Càtedra. Moreover, the external analysis includes a market research which was done among a number of potential buyers within Catalonia. After this analysis, the Strengths, Weaknesses, Opportunities and Threats of La Càtedra became clear and with these aspects the SWOT analysis was set up.

7.3 Results / Recommendations

Results

A very important outcome of the Business Plan is the SWOT analysis. The following chart shows the SWOT analysis of La Càtedra. The Strengths and Weaknesses were set up according to the information in the internal analysis. The external analysis on the other hand was the basis for the formulation of the Opportunities and Threats.

The SWOT chart makes clear that there are opportunities for La Càtedra to sell its emergency evacuation plans with a focus on persons with disabilities. This because there will be a bigger need for emergency evacuation plans with the focus on persons with disabilities and because the European Union is working on the building accessibility for these persons. La Càtedra is very specialized, they have a extended knowledge about the needs of persons with disabilities. That is why it is feasible for them to sell these emergency evacuation plans.

Market research

To find out if companies are interested in buying these plans, a market research was undertaken. This research was held among the potential target group of the emergency evacuations plans of La Càtedra d’ Accesibilitat. These potential buyers are owners of public buildings focused in Catalonia. In total 10 persons filled in the survey which was send by email, causing a response percentage of 15%.

The results of the market research showed that 30% of all persons that responded think that the emergency evacuation plan for their building is not sufficient enough to get persons with disabilities safe outside of the building in case of an emergency. It means that there is a need for emergency evacuation plans with a focus on persons with disabilities.

Moreover, the average amount of money the persons who responded would be willing to pay for an emergency evacuation plan with the focus on persons with disabilities is €750. The cost calculation underneath shows, that it is feasible for La Càtedra to sell its emergency evacuation plan against this price.

Cost calculation
An important part of the Business Plan is the cost calculation. The cost calculation shows how much it costs to make a specific emergency evacuation plan for a building out of the general emergency evacuation plan.

The costs for making the Specific Emergency Evacuation Plan for the EPSEVG building in Vilanova i la Geltrú out of the General Plan were €1001,90. The building size is 8882 m2. This means that the cost per 1 m2 are €0,1128 (€1001,90/ 8882= €0,1128).

The market research showed that the average amount of money what persons are willing to pay for an emergency evacuation plan with a focus on persons with disabilities for their building is €750. The average building size for these buyers has to be about (750/€0,1128) 6649 m2 or less. A lot of buildings are based in the category of 6649 m2 or less. What means that based on the average amount of money that buildings are willing to pay for an emergency evacuation plan with a focus on persons with disabilities there are a lot of buildings that could reconsider buying it from La Càtedra.

**Recommendations**

On base of the total business plan, the following recommendations are given:

Since there will be a bigger need for emergency evacuation plans with the focus on persons with disabilities, La Càtedra should do a lot of promotion within Catalonia for their emergency evacuation plans.

La Càtedra is very technical focused; sometimes a medical and social view is needed. Since the need for emergency evacuation plans with the focus on persons with disabilities will increase, La Càtedra could consider hiring persons from different specialties. These specialties could be social workers and physiotherapists. This will help keeping up with the competition, because the competitors already have persons form different studies involved in their projects.

For improving their emergency evacuation plan with a focus on persons with disabilities, La Càtedra needs persons from different studies to be involved.

The European Action Plan is very important for the improvement of the society standards. Since La Càtedra has got the same goal as the European Union, they should try to get in contact with the EU. The EU could consider working together with La Càtedra and they could be willing to support the company financially.

The Business Plan can be found in the Appendix G.
8 Conclusion

This report on the Emergency Evacuation System for All project shows that none of the single parts of the whole system can work without the others. It is necessary to have a complete evacuation system in all public buildings, in order to guarantee the security of all people which are using to the building.

This project can be used as a guideline respectively as an outline for adaptation processes to other public buildings.

A big challenge for the EPS-team is that none of the team members had specific knowledge about the topic before the project started. Much of the time in the first phase of the project was devoted to research, providing the team members with a solid background for carrying out the project. A problem the team faced was that most documents needed from the university were written in Catalan, meaning that a particular amount of time was used on translation. Furthermore, another challenging but also interesting part of the project is that most of the team members have different cultural backgrounds, with different habits when it comes to for example working routines. New points of view and working were offered.

All team members have improved their social skills during the whole term. The contribution of everyone made the EPS project a success for all involved parties.
9 Working Methodology

During the whole term the group was organized in the following ways:

- Weekly group meetings with the supervisors:
  In these meetings, all current and future tasks were discussed. Furthermore constructive criticism took place. In order to improve the work, all results of each team member were presented and discussed during these meetings. Moreover the timeframe and organizational tasks of the group were discussed and decided. In addition the group got feedback from the supervisors on work done and work in progress.

- Internal group meetings:
  When necessary, the EPS-team made internal group meetings without the supervisors, to discuss open questions, to help each other, to organize the following tasks and work, and to avoid communication mistakes.

- Wiki page:
  The EPS-team created a wiki page in order to have a communication and data sharing platform. All documents the EPS-team created can be found on this page (always the newest version), so that everyone has access to all documents and information at all time. Furthermore, this page was used for sharing links to web pages with useful information about the project. All meeting minutes were added to the wiki page.
  The wiki page can be found under:
  http://karaba.epsevg.upc.es/~eps/index.php/Main_Page

The project started with research on the different topics, to get an overview and solid background knowledge about the given task. The study included, among others, research on evacuation plans, classification of disabilities, how to deal with people with disabilities, and organizations that work on related topics, in order to get information.

All work the group members finished was revised by the other EPS-team members (whenever possible), in order to give constructive criticism, avoid misunderstandings and to have a contingency within all documents.
10 Acknowledgement

The project group “Emergency Evacuation System for All” would like to thank all the persons at the Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú involved in the European Project Semester and who gave us the chance to participate in this unique program, for their organization, information and help during the whole term. Furthermore we would like to thank our supervisors Mrs. Ariadna Llorens García and Mr. Pau Martí Colom for their assistance and constructive criticism during the whole term. Moreover we would like to thank La Càtedra d’Accessibilitat, in particular Mrs. Yolanda Guasch Murillo, who gave us the chance to work in this project.
11 Appendix

A. General Emergency Evacuation Plan
B. Emergency Evacuation Plan for EPSEVG VG 1-2-3
C. Training Plan
D. Report on Existing Technical Evacuation Solutions
E. Evaluation of Technical Solution
F. Emergency Exit Elevator
G. Business Plan