

ENHANCEMENT OF SCHOOL TRANSPORTATION SAFETY BY USING INNOVATIVE INTEGRATED TECHNOLOGIES, THE “SAFEWAY2SCHOOL” PROJECT.

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ABSTRACT

The school transportation issue hides lots of dangers. Between 1994 and 2001, in Sweden 361 children were injured or killed during transportation to and from their school, whereas 455 were killed or injured in Austria only in 2007 and 97 were killed in 2005 in Italy. In a single school bus accident in Greece in 2003, 20 children lost their lives. Different as the above numbers may be, they all tell us one thing: Crashes involving school buses and crashes involving children travelling to and from school are far from negligible and require further efforts to be drastically reduced.

SAFEWAY2SCHOOL project scope is to design, develop, integrate and evaluate technologies for providing a holistic and safe transportation service for children, from their door to the school door and vice versa, encompassing tools, services and training for all key actors in the chain. The SAFEWAY2SCHOOL promotes a holistic approach, to assure a safe and secure transportation for the children; to and from school through integration of various technologies and systems.

The SAFEWAY2SCHOOL integrated system will be comprised of the following parts:

- Routing and re-routing application, including real time rerouting.
- Surrounding traffic information while en route and while children embark and disembark from the school bus.
- Intelligent Speed Adaptation system.
- Safety belt checker.
- Intelligent bus stop.
- Family notification system.
- VRU notification system.
- Training modules for all stakeholders.
- Inventory tool for classification of the bus stops

The current paper provides an overview of the SAFEWAY2SCHOOL integrated system as this has been extrapolated from the initial research in the user needs and the accident analysis and has been outlined through the projects Use Cases. Also, the methodological approach, that was followed in order to extract the Use Cases, is being introduced. Finally, the basic results derived from accident data analysis, as well as the final Use Cases are illustrated.

1. THE STORY BEHIND

Going to and from school is a daily transportation habit realised by millions of children within Europe [1]. The number of children going to and from school with different transportation means vary between countries; for example in Sweden the number of children (age 6-16) is estimated to 250.000, in Poland they are approximately 700.000 and in Austria they are about 450.000. Additionally to the population of children in EU countries, the organisation of school transportation varies also. The school transport is most of the times free and organised and provided by the public authorities. However, the criteria that need to be fulfilled in order to have the right for free transport differ between countries. Thus, the school transport is not only provided by bus, it can also be by taxi or other transportation means. In SAFEWAYS2CHOOL project only school transport by bus is included and studied, with the argument that this is one of the most used transport modes across EU countries.

Even though protecting the children - one of the most vulnerable transport system's users – is of great importance for all societies, bus transportation to and from school is a highly underinvested area in most EU-countries. School transport by bus is not just about going by the school bus, but it should be considered from a door to door perspective. This perspective is important to be taken under consideration, in order to identify the most critical situations for children on their daily travels. Unfortunately, crash statistics often lack data about school bus transport accidents from a door to door perspective, especially when the children are vulnerable road users, i.e. before the bus arrives or after it departs. This is one reason for the failure to throw light onto the situation and falsely makes the safety problems regarding bus transport to school look less serious. This is not only a limitation from a EU perspective but also for example in the US [2, 3]. Several measures to increase safety for children are recommended in the EU-report Road safety in school transport (2004). However, a literature review of evaluated support systems for school transport which evaluate children's safety when boarding, exiting and walking to/from or waiting at the bus stop, shows only five scientific papers evaluating such systems [3, 4, 5, 6, 7, 8, 9].

In the EU it is common to have a mixed system of school transport [14, 10]. The mixture is related to both criteria's for the right to school transport, regulations, financing, vehicles used for transportation. The different systems in the EU countries and the different methods of recording crash statistics makes the comparison between the countries complicated [11, 12]. There is no special EU-wide statistics on accidents during travel to and from school available [13].

There are differences between EU countries regarding regulations and definitions of school transport. Some children are transported by school bus that is provided as such but not with any special features or traffic rules applying to their presence on the road. Other children are transported by the regular public transport system. The criteria for school transport differ and there are also major differences regarding regulations for equipment on the bus, for example mandatory sign on the bus showing children.

In order to have a deeper understanding of the situation for the children going to and from school by bus there is a need for more detailed crash statistics in the EU. This should be done in order to include a perspective from door to door, but also to include all crashes, regardless mode of transportation (public or special purchased buses).

1.1. The school transportation situation , examples of EU countries

Europe is, most often, decentralised with regard to passenger transport. Amongst member States, school transport comes under the jurisdiction of the various local organising authorities (with wide variations in area covered). Public passenger transport has become a critical issue in local life, particularly with the increasingly negative effects of urban congestion. From this perspective, there are many transport organisers who seek to prioritise the use of public transport in general and even more to relate it with school transport, among others Great Britain, France and Belgium. Nevertheless the concept of school transportation is not a homogenous one across Europe. Its use depends mainly on policy relating to schools (setting up of educational establishments, increasing length of education, diversification of options and specialist fields of study) and the degree of rurality in the country concerned.

Within SAFEWAY2SCHOOL the school transportation situation in seven countries has been presented and a summary of this situation is illustrated below in this paper.

1.1.1 *Sweden*

In Sweden, about 250.000 children, age 6-16, travel by public school transport in Sweden, using both specially purchased buses and other public transportation means also. Only the special purchased buses need to be specially marked. The sign used for school transport is yellow with a red frame and a black symbol of children. This sign is also equipped with flashing lights. In Sweden, there are no regulations related to other road users regarding the buses marked by this sign. Local authorities in Sweden have to provide free transportation for a pupil if necessary, taking into account the distance, the traffic situation, disabilities of a child and other special circumstances. The distance that gives the right to free school transportation varies from 2 to 4 km depending on the age of the child. Also in Sweden, the drivers of school transport vehicles are not specially educated for handling children. It is the municipalities' responsibility to make sure that the children are educated and trained in order to guarantee a safe transport from a door to door.

1.1.2 *Poland*

In Poland, around 700.000 children between 6 and 16 years of age travel by school buses. A special government funded program is implemented for purchasing school buses. New buses purchased by the Ministry of National Education are equipped with safety belts and signing/markings, and are also adapted for transportation of children with disabilities. Another option for local authorities is to buy either used buses and transform them into school buses (signing/markings), or select the transportation service through a tender offer. In these options it is not always possible to adapt the buses to transport children with disabilities. Vehicles transporting an organized group of children or youth under the age of 18 should be marked in front and back with a plaque of yellow colour with a black symbol of children. School buses in Poland are orange coloured (only the ones purchased by the Ministry), marked in front and back with rectangular white plaques with black "school bus" text on it. Drivers of school buses have to go through special training, carried out by the Police. School bus drivers and persons supervising safe crossing for children can give orders or signals to other road users. Other drivers approaching a school bus are obliged to stop if the stop sign on the bus is turned on. A guide/assistant should be present on board of each school bus – there are no regulations as far as their training is concerned. However, they should have a certificate of first premedical aid training. Local authorities assign teachers or retired teachers to assist on school buses (special purchased buses). New buses and the older ones (leased from the transportation companies) meet all the requirements as far as exhaust emission limit is concerned for this type of vehicles.

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1.1.3 *Italy*

In Italy, the number of the children between the age of 6 and 16 years old that travel by school buses is not identified. The regional authorities provide guidelines for school transportation services and the municipalities deliver and regulate these services on their territories. Regulations are slightly different in different municipalities, especially between cities and small villages. Nevertheless, they share some key points. Municipalities must provide means of transportation to people with disabilities who are willing to attend publicly funded courses. Each Italian Region has its own discipline for public transport, although general service requirements are shared, e.g. safety, subcontracting rules and disabled users' needs. Regulation in general, focuses on means and personnel to be employed for delivering the service, but poor attention is dedicated to bus stop safety, besides general safety requirements. No specific reference is usually made to home-to-stop or school-to-stop routes, or on how to inform drivers about the presence of children at a specific stop. Routes and stops are usually defined and renewed at the beginning of each school-year, taking the list and location of kids' addresses into account. Most recent rules (e.g. in the Reggio Emilia area) state that routes and stops are also defined according to average traffic conditions and road safety. Road education for compulsory school students is recognized as a priority for improving overall road safety; since the early '90s road safety education has become a class subject in schools.

1.1.4 *Austria*

In Austria, approximately 450.000 pupils at the age of 6-16 travel to school by bus. As schools are under the administration of the municipalities, it is also the municipalities who are responsible for providing school transport to public schools. They have to choose the school bus companies and the road, to provide secure routes and transport and bus stop or lay-bys. There are four possibilities for school transport by bus: with cars or minibuses either commercial, or non-commercial; with buses as commercial non-scheduled services; or buses in line operation. For commercial school transport an additional school transport authorisation for the driver is required. Commercially operated school buses are obliged to be equipped with a yellow-red school transport sign, warning lights on the roof and alarm. While the warning lights are on, other vehicles are not allowed to overtake the bus at the bus stop, even if the bus-stop is in a lay-by. For school transport with mini buses (both commercial and non-commercial) the equipment of these lights is only optional. A new legislation concerning school transportation in mini buses require additional driving mirrors and control lights that show the driver if there is still a door open. Since the 1990's, every child has to have its own seat, for vehicles up to 9 seats. For buses a one-child-one-seat rule was enacted in 2008. Furthermore, since 1999 new buses must be equipped with seat belts. However, these rules do not affect school transport by line operators.

1.1.5 *Greece*

In Greece, the number of children from 6 to 16 years old that goes to school by bus, it is not identified. There is a great variety of school buses used, with the most important difference to be between the school buses used by public transport and private schools. Children in Greece, who go to public school, usually go there on foot. In the rare case when the children are not going to school on foot, mostly the public transport is used, or they are driven to school by their parents. In any case, the government is responsible for taking specific measures and actions about school transport either in public or private schools. Despite that, parents are obliged to send their children to their resident school, which is the closest school to their home, and this policy seems to be working well. In rural areas there is not always a school in each village and often the children have to travel to

the biggest village of the district. In this case, the children are transferred to and from school with public transport. This transport is being provided by the state under various conditions that differ from district to district. In contradiction to the public school, the private schools have their own (purchased or rent) fleet of school buses. The school buses that are purchased are the well-know yellow school buses of different types (mini buses of 10 seats to typical coaches of approximately 50 seats). Mainly the mini buses are used for the transportation of children with age up to 6 years old and the big coaches for the children from 13-18 years old. Apart from the schools that have their own purchased fleet, there are also schools that have one part or the whole part of their fleet rented. The rented school buses are not dedicated school buses, but typical coaches that perform any kind of massive transportation. Thus, these buses are not yellow and they do not have special features for children. When it comes to the dedicated school buses, the yellow colour is the significant element that differentiates the school buses from the other buses. Also the yellow school buses must have the title "school bus" written in the front and in the back of the bus. When it comes to the commercial coaches that just perform school transport, the issue gets more complicated. The front sign must clearly illustrate the name of the school and the special number of the bus, thus it is placed for the convenience of the children in order to identify the bus. In addition, in the back sign must include the following phrase: "Caution, School bus. Continual stops", as well as the speed limit: 60km/h. In order for a school to design the net of the school bus stops and the route of the school buses, the addresses of all the children involved in the transportation procedures must have been noted down, as well as their age.

All private schools in Greece follow more or less the same methodology in order to identify the location of the stops and the route of the bus. The identification of the school bus stops and routes is being done by the school transportation manager and his/her team. This team first of all marks the stops and the routes to the area map. The next step is to hand these plans to the bus drivers who checks if these routes are feasible and whether this plan is effective, or not. This trial phase may last from 2 weeks to several months and within its duration changes to the stop locations and the routes, may occur.

All children at elementary school are picked up outside their home. In high schools the stops are defined from the location of the student's homes. Despite that, the stops are more or less the same for each school year. At this end, the stops are pretty much determined before the school year starts, only small changes may occur before the beginning of the year, when a double check is taking place and the respective students are placed in each stop. Also the stops may be repositioned according to the age of the students. In more detail, the bus stop is placed in the nearest to the youngest child's house location. This action is implemented rather rarely though. The bus routes for elementary and high schools are normally using the same planning guidelines. Most of the schools try to find the "optimum" route for their buses by linking the bus stops with the nearest path. Some schools prefer the school bus, not to pass from highways or high density roads or too small roads. Other schools have a time limit for each school route and when they believe this time limit will be exceeded they stop the route and create a new one.

Children with special needs are hosted in schools that dedicated to their needs. These schools are located all over Greece and have only students with special needs. In addition, these schools use accessible transportation means.

1.1.6 *Germany*

In Germany 4.5 million children with ages form 6 to 16 years old go to school and about 40% of them use buses and other public transport systems. In Germany, school transport Enhancement of school transportation safety by using innovative integrated technologies0701_Chalkia_E

is organized either with public buses or with special school buses. Some students go by train, many take the bike, some walk and lot of children go with their parents by car. Official school buses are marked with a square shaped sign showing two children going hand in hand. The sign is orange with a black frame and the symbol of the children is black. Safety features in school buses are not mandatory. Only in the smaller buses, used for pupil transportation, the driver must ensure that the seat belts are fastened and a seat is taken by one child only. A few years ago a new road law was applied for school buses. When stopping at a bus stop, the bus driver has to turn on the warning indicators. A stopping bus may be overtaken in walking speed. Cars following the bus are not allowed to overtake the moving bus. The oncoming traffic is obliged to pass the bus also in walking speed on the other lane. However the law was difficult to gain acceptance, so intensive control by police is applied in order to enforce this new law.

Children with disabilities are typically transported in smaller buses as the ones mentioned above. A special education for bus drivers is not mandatory. Larger school bus companies offer trainings for drivers dealing with groups and difficult situations that may occur. The children receive training either by their parents, the police and the municipality or by the school. Training is especially applied in first grade. Many bus stops at schools are especially designed in a safe way to protect the children and are built off the road. Some schools send teachers to keep a track on the boarding process, however this is not mandatory.

1.1.7 *France*

In France around 1.700.000 children are using the school transportation means (estimation in 2007, figures used in 2009 because 2 years are necessary to collect the data, source CERTU), this figure includes pupils using dedicated school buses and regular public transport buses.

School transportation organisation is decentralized. The organising authority is the department, but a part of the organisation can be entrusted to cities, groups of city, association of parent's pupil. Vehicles transporting a group of children should be marked in back with a plaque of yellow colour with a black symbol of children. Recently, on-board flashing pictograms have been implemented in school bus. They enlighten only while doors are open and 15 seconds after the doors closed. This equipment is mandatory in France for all the vehicles manufactured since 20 October 2008. It can be put in the front or in the back of the vehicle. There are no specific speed limits for school bus. Nevertheless, it is recommended by the French government that local authorities are free to impose lower speed limits for this type of transport than the one from the Highway Code. Implementation of ethyl-tests to check level of alcohol for school bus drivers is on the way with some experimentation in various regions of France. These systems will prevent the bus engine to start if the test indicates a too high level of alcohol after the driver blows in it. The equipment of this system to all the school buses in France would be conducted in 2010.

From the above it is obvious that the organisation and situation regarding school transport varies already among those countries.

2. SCHOOL TRANSPORTATION ACCIDENT ANALYSIS

2.1. Methodology

The aim with the accident analysis is to find support for the selection of SAFEWAY2SCHOOL scenarios that have a maximum potential impact in traffic safety. The work has taken into account the mixed school transport systems used within Europe, i.e. by specially purchased school buses, public transport, school taxi and specially equipped STS vehicles.

The analysis has been done in 3 different steps which are described in detail below.

1st step

The initial step was to conduct a literature review. Four databases were searched: Scopus, TRAX, ITRD, TRIS. Only references from the year 2000 or later was included in the literature search. However, some older literature has been referred to when it seemed relevant.

2nd step

National accident statistics from Austria, France, Italy, Poland, Greece and Sweden were analysed. The aim was to focus the analysis on aspects related to pre-crash circumstances [15].

3rd step

The work in step 2 was summarised and the most frequent accident scenarios and dangerous situations from a door-to-door perspective for children travelling to/from school was identified.

2.2. Accident analysis in Europe

There are no European wide crash statics on travelling to and from school available [1], so there is a need to look into other available source. One is the European Union database EC-CARE*. During 1998-2003, it could be found that children in the age of 6-11 years old were represented killed or seriously injured, especially during afternoons, possibly when going home from school, see **Error! Reference source not found.**

Sweden

Between the years of 1994 and 2001 there were 256 police reported accidents related to school transport in Sweden and within these accidents 361 children were injured or killed. About 73 percent of the injured children were injured as vulnerable road users, among them 51 percent when running in front of or behind the bus (Anund et al., 2003). The situation for 2003-2006 is almost the same, with three children, aged 6-16 years old killed per year at school hours, in average [16]. Additionally, the most severe injuries were identified among pedestrians (69%). This is major difference in comparison to people, aged 25-64 years, killed and injured at the same time. Among those 77% was passengers of bus or passengers of vehicle.

Italy

* CARE is a Community database on road accidents resulting in death or injuries. The purpose of the CARE system is to provide a powerful tool which would make it possible to identify and quantify road safety problems throughout the European roads, evaluate the efficiency of road safety measures, determine the relevance of Community actions and facilitate the exchange of experience in this field.

According to data provided by the National Statistics Institute (ISTAT), road accidents are the first death cause for children in Italy. According to ASAP (Association of Friends of Road Police), 9,924 children were injured in road accidents in 2005. Among them, 17.3 percent was hit while crossing the street. In 2005, 97 children lost their life in road accidents. Of the fatally injured children, 20 were pedestrians (20.6%).

Austria

In Austria, 423 road accidents happened in 2007 during school travel in which one student (age 6-15 years) was killed and 455 injured. Both for school travel/transport fatalities, and injuries, this was the best result in the last decade. Traffic accidents with school buses are relatively rare. According to the Austrian Social Insurance for Occupational Risks, only 7 percent of all student accidents (not only traffic accidents) happen on school travel, 5 percent thereof are school bus accidents. Most of these school bus accidents (40%) take place inside the bus, one quarter while entering/leaving the bus and about 10 percent while crossing the street before/after the bus ride; the latter being however the most severe. Last year, 74 students got injured in connection with school buses.

Greece

According to official school bus accident statistics, 1,450 people have been killed in school bus related accidents since 1990. Among these fatal injuries, 67 percent were the occupants of other vehicles involved in the school bus accident, 25 percent were pedestrians or bicyclists, and nine percent were passengers in school bus-type vehicles (<http://www.erso.eu/>). Approximately, 27 school-aged children die in school bus accidents every year. Seven of these are passengers in a school bus and twenty are pedestrians. Of these twenty pedestrians, fourteen are killed by school buses and the other six are killed by other vehicles involved in a school bus accident. More than one half of all pedestrian fatalities involve a child aged five to seven years old. School bus accident statistics in Greece show that most school aged pedestrians are killed in school bus accidents between the hours of three and four in the afternoon. The hour between seven and eight o'clock in the morning is also a time where children are most often victims of school bus accidents. According to school bus accident statistics almost one half (45 percent) of all school bus accidents involve impacts to the front end of a school bus. Other common crash types include right side impacts, non-collisions, and left side impacts, rear impacts, and top impacts in descending order.

France

A detailed report on the topic of safety at school bus stop showed accidents at the scholar bus stops in comparison with total accidents of children transport accidents [17]. It could be seen that during 1999-2001 they represented 12% of the total. The gravity ratio (number of killed / 100 accidents in average for the 6 years) presented in the study was 15.9, that is much higher than road accidents in general that was 6.3 during 2000 and 4.99 in 2002.

The report also looked at circumstances during the crash and it was noted that the most common situation when a child was killed was when they were hit by an "overpassing" vehicle (8 out of 15 fatalities during 1997-2003).

2.3. Crash statistics

The in-depth crash statistics were studied from Swedish data. In Sweden though, as in other countries, there are no statistics available describing if a person killed or injured has been so strictly during the trip to or from school. Therefore, an in-depth analysis based on all crashes during day time (06.00-16.59 during Monday-Friday) with children injured or

killed and where also bus, taxi or pedestrians were registered [5] has been realised and the outcomes are presented in the figure below.

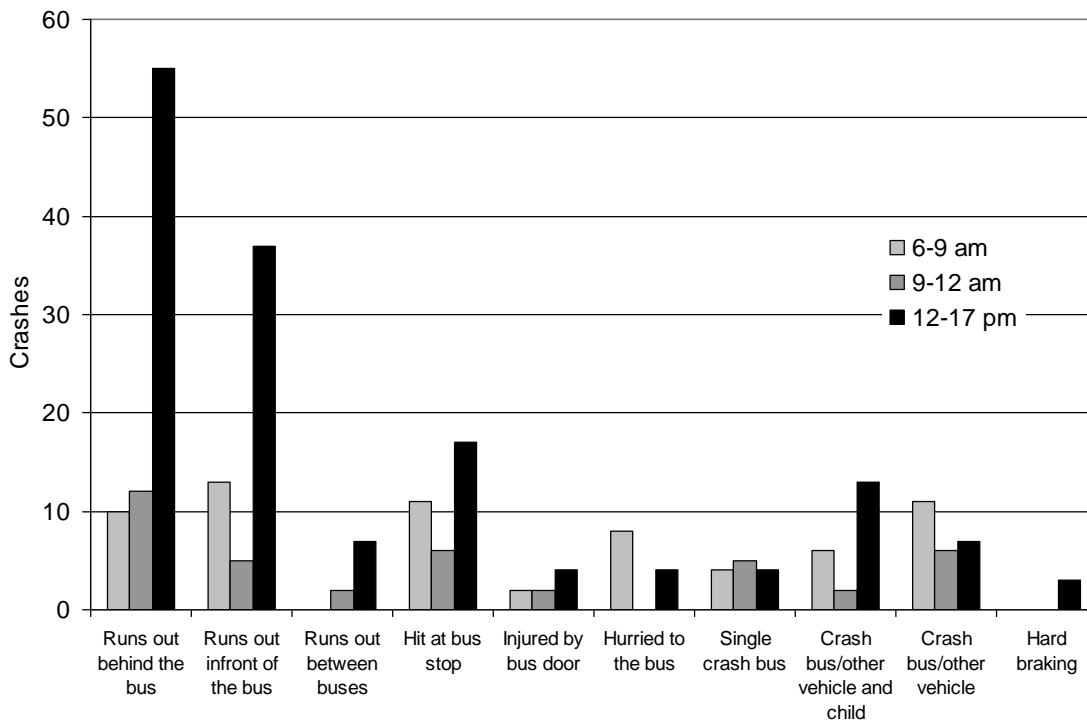


Figure 1 – In depth crash statistics analysis.

Based upon the figure above, it has been found that the most common situation of school transport accidents is when children were running out behind the bus when coming back from school.

2.4. Critical scenarios

Based upon the aforementioned, the most critical circumstances in the school transportation namely are:

1. The greatest danger for the children is when they act as pedestrians, meaning as vulnerable road users.
2. In most countries the most fatal and severe accidents with children happen when children return from school.
3. In most countries the most fatal and severe accidents with children happen during full day light.
4. Most of the recorded accidents happen while weather conditions are “normal”.
5. The most common situation for school transportation accidents with children are when they are running out behind the bus.
6. Most accidents happen when there are deviations from the normal routines.

The following scenarios have been considered to be the most critical according to school transportation accidents.

Scenario 1

A child is de-boarding in the afternoon, goes along the bus side and turns right and pass behind the bus to cross the road. An oncoming vehicle has no time for reaction and break. The child is hit by the oncoming car in high speed. Accident analysis and literature indicated the high risk related to bus stop for school children, especially when de-boarding in the afternoon [4, 5].

Scenario 2

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A scholar bus is manoeuvring (on the right or on the left) at a slow speed on a square or on a parking space. The driver attention is devoted to other pedestrians around the bus, to the surrounding traffic. The driver did not detect a pedestrian located on the side of the bus (blind spot). The pedestrian can get run over by the bus with high gravity of injury [18].

Scenario 3

Due to children crushes near the bus, a child can fall down between the bus and the sidewalk, or fall down from the sidewalk to the road at the arrival of the bus, or when it is leaving the stop. Equivalent scenario has been found for pedestrian and public transport [19].

Scenario 4

A child is on the way to the bus stop. It is dark outside and the road has a speed limit of 70 km /h. The child is hit by a passing vehicle (STRADA and ITS database).

3. SAFEWAY2SCHOOL USE CASES

The SAFEWAY2SCHOOL has a holistic approach, to assure a safe and secure transportation for the children; to and from school in order to cover all the possible accident areas of transportation. SAFEWAY2SCHOOL therefore focuses on safety criteria for the way to and from the bus stop, for the trip inside the bus, and how to make the surrounding traffic reduce speed and be more aware that children may be nearby. This approach has been defined as holistic approach and it is presented in .All the aforementioned components of the transportation to and from school are depicted in the SAFEWAY2SCHOOL Use Cases that are presented in the current chapter.

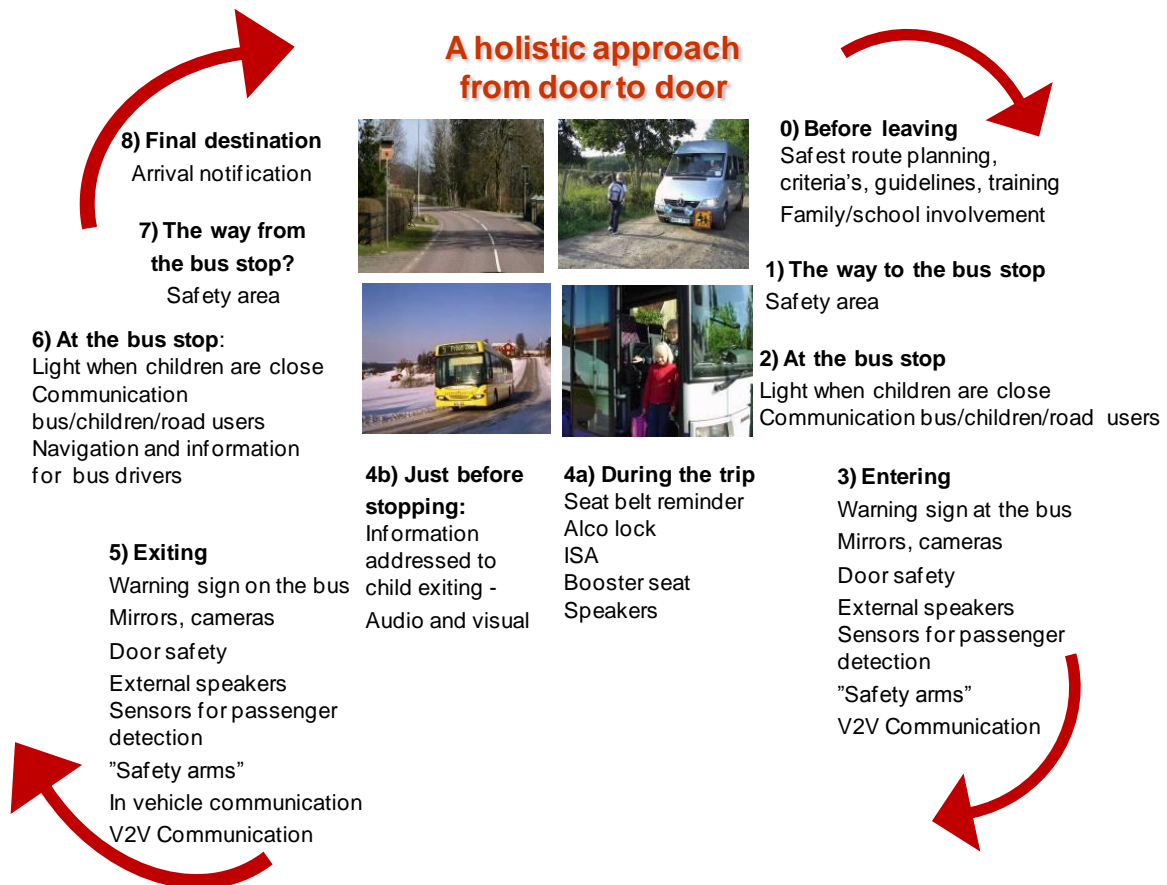


Figure 2 – SAFEWAY2SCHOOL holistic approach.

3.1. Methodology

The main issue with extracting Use Cases for SAFEWAY2SCHOOL was the development of an adequate methodology to support it. Based upon the theoretical approach for Use Cases, the User and stakeholder needs defined for this project, the Accident analysis and an exhaustive review of the literature on this subject , a methodology has being applied and was gradually improved until now that we have reached the final Use Cases collection.

In SAFEWAY2SCHOOL the methodology that leads to the extraction of the Use Cases is illustrated in the following figure.

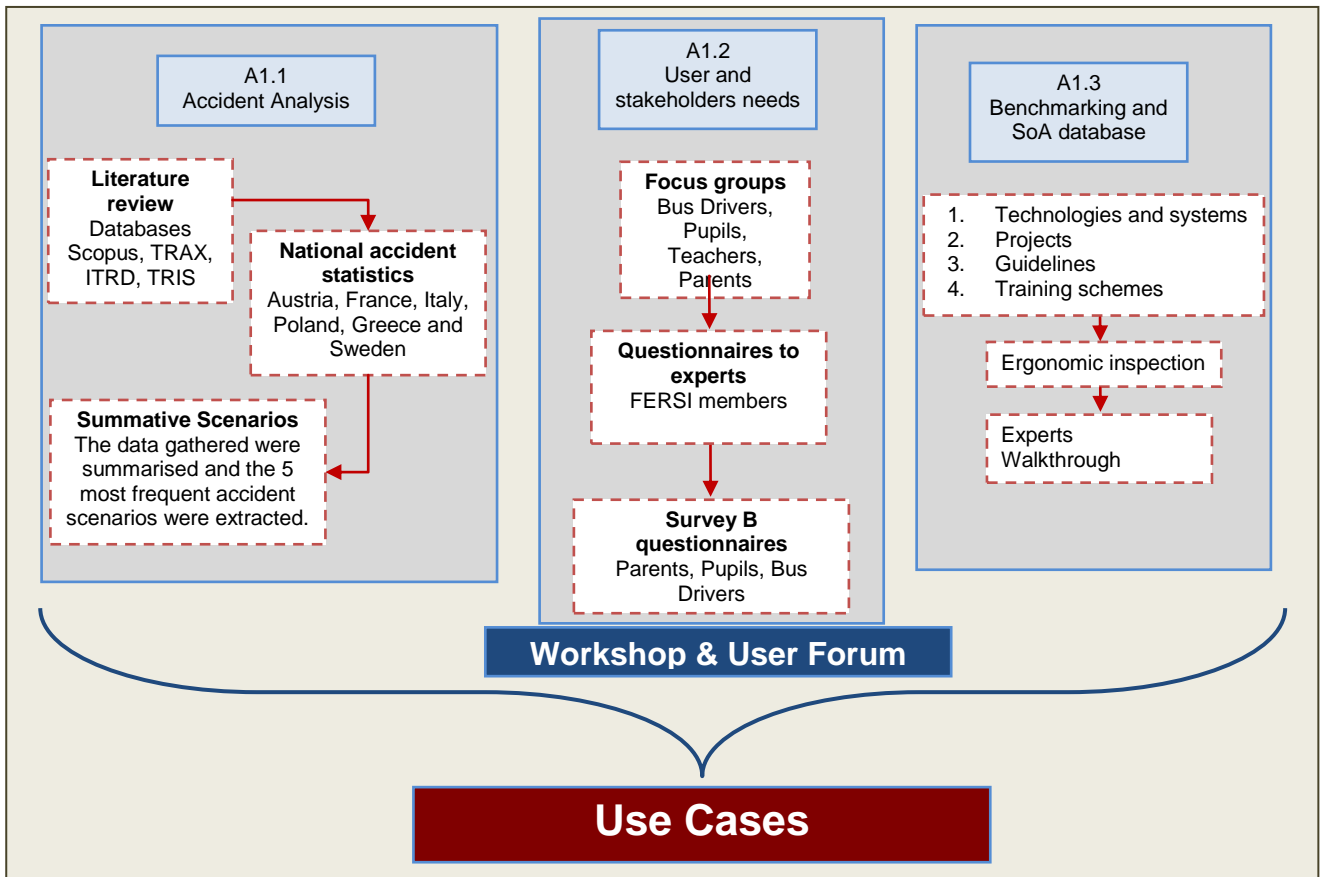


Figure 3 – Use Cases methodological framework.

3.2. SAFEWAY2SCHOOL Use Cases overview

- Category 1-Routing & Rerouting
 - UC 1.1 Safest route planning
 - Scenario 1: School bus routing
 - Scenario 2: Pedestrian routing
 - Scenario 3: BiciBus routing
 - UC 1.2 Route monitoring
 - Scenario 1: School bus route monitoring
 - Scenario 2: BiciBus route monitoring
 - UC 1.3 Real time rerouting for traffic
 - Scenario 1: Rerouting due to traffic conditions
 - Scenario 2: Rerouting due to stop rescheduling
- Category 2-Surrounding traffic information

- UC 2.1 Surrounding traffic information while en route
 - Scenario 1: Surrounding traffic information while school bus en route
 - Scenario 2: Surrounding traffic information while BiciBus en route
- UC 2.2 Surrounding traffic warning while for children ingress-egress
 - Scenario 1: School bus visible.
 - Scenario 2: School bus hidden, i.e. behind a curve
- Category 3-On board systems
 - UC 3.1 ISA
 - UC 3.2 Safety belt checker
- Category 4-Intelligent bus stop
 - UC 4.1 Child approach to bus stop notification
 - UC 4.2 Child at bus stop notification
- Category 5-Notification
 - UC 5.1 Family notification
 - Scenario 1: Ingress
 - Scenario 2: Ask about the child's situation
 - Scenario 3: Reach the school
 - UC 5.2 VRU notification
- Category 6-Training
 - UC 6.1 Bus driver training
 - UC6.2 Parent training
 - UC6.3 Children training
- Category 7 –Inventory tool
 - UC 7.1 Inventory tool classification of the bus stops

The aforementioned Use Cases are presented to the following aggregated figure.

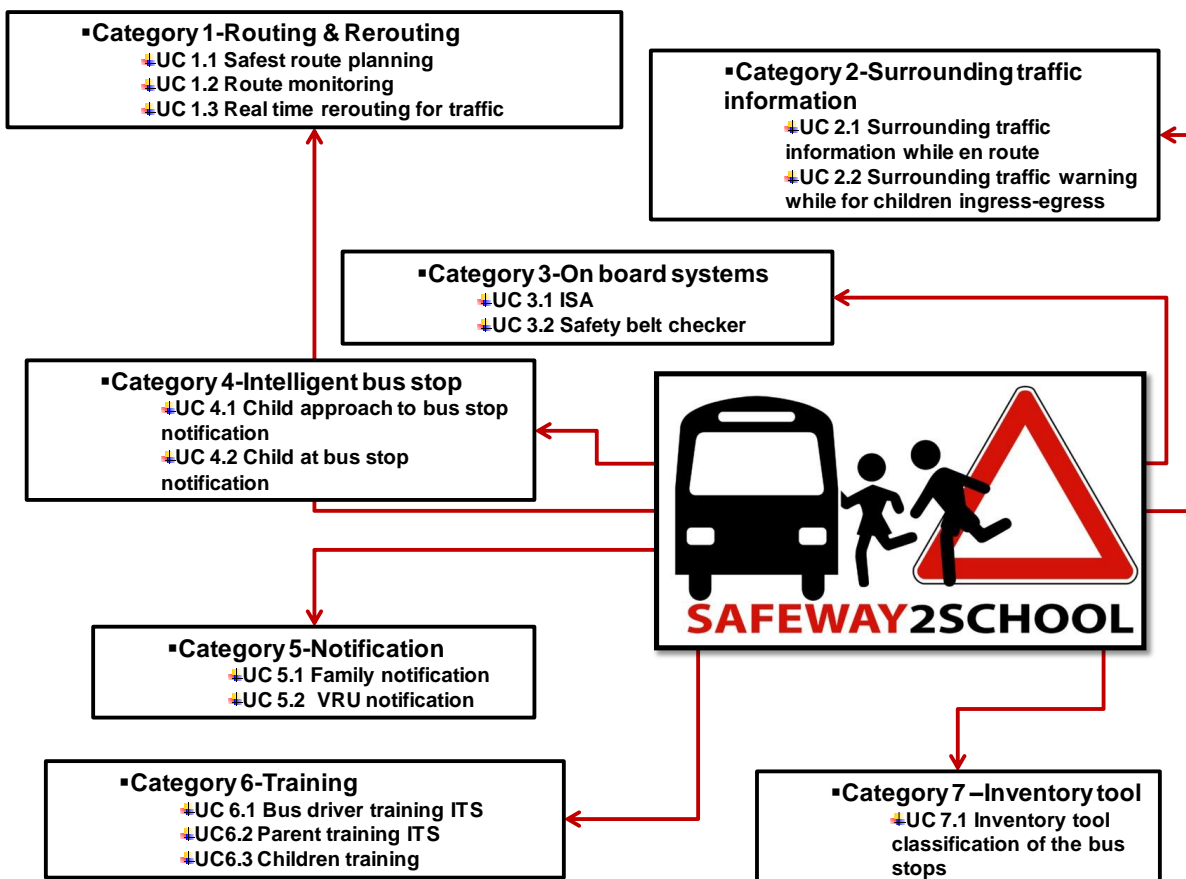


Figure 4 –Use Cases Overview.

3.3. Use Cases prioritisation.

The prioritisation of the Use Cases was an important procedure for the extraction of the final detailed Use Cases and it was realised from users of the project during the first SAFEWAY2SCHOOL Workshop and User Forum meeting. The aim of the Workshop and User Forum meeting was to gather involved stakeholders, experts and users, in order to inform them about the project concept and objectives, to disseminate the project preliminary findings and finally introduce and prioritise the projects Use Cases. In more detail, the objectives of the Workshop and User Forum meeting were the following:

- To disseminate the aim, objectives and targeted developments of SAFEWAY2SCHOOL to the experts and the users.
- To provide early information on project developments and retrieve stakeholders' feedback.
- To trigger stakeholders' interest in order to be actively involved in the project progress and developments throughout its duration.
- To discuss the preliminary Use Cases of the project and get the stakeholders' opinion and prioritise the Use Cases.



Figure 5 – SAFEWAY2SCHOOL Workshop & Use Forum meeting

At the SAFEWAY2SCHOOL Workshop & User Forum meeting various stakeholders presented and were informed about the project and the Use Cases and participated to their prioritisation. The meeting was divided in two main parts:

Part 1: Presentation of the project and the Use Cases.

Part 2: Prioritisation of the Use Cases.

The SAFEWAY2SCHOOL Use Cases were prioritised by using a structured methodology, following the steps below:

- Distribution of the Prioritisation Template.
- Filling in of the template individually from the participants, with the assistance of one person from the Consortium.
- Preliminary prioritisation of the Use Cases and the user requirements.
- Separation in groups and discussion between the external participants about their 3 top rated priority Use Cases.
- Extrapolation of relevant results and summative outcomes.

The Use Cases were prioritised from the experts and the stakeholders with a marks from 1 to 3, 1 for the top priority Use Case and 3 for the less important priority Use Case. After the completion of both sub-phase of phase 2 the results were gathered and the top priority Use Cases were extracted. The top priority Use Cases that derived from the Workshop are the ones that received the most “1” marks and they are the following 4:

- Use Case 2.2
 - **Surrounding traffic warning children ingress-egress**
- Use Case 3.2
 - **Safety belt checker**
- Use Case 4.1
 - **Child approach to bus stop notification**
- Use Case 6.3
 - **Children training**

The chart below illustrates the prioritisation ranking from the Workshop and User Forum meeting external participants.

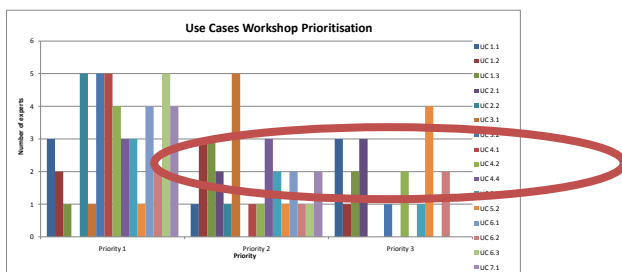


Figure 6 – SAFEWAY2SCHOOL top priority Use Cases.

4. CONCLUSIONS

This paper describes the school transportation in Europe with special emphasis on school buses. The school transportation in seven different countries is illustrated, depicting the differences in the organisational and legislative situation in different countries and sometimes within the same country.

This divert situation in school transportation is being confirmed by the accident analysis that has been realised in the same countries. From the accident analysis, the most critical scenarios according to accidents during school transportation have been emerged, depicting that the most critical situation for the children is running behind the school bus when travelling from school to home, in the evening.

From the above studies outcomes and also other data emerged from the SAFEWAY2SCHOOL project, the Use Cases derived. The Use Cases describe the user Enhancement of school transportation safety by using innovative integrated technologies0701_Chalkia_E

interaction with the system to be, from all the perspectives. The 15 Use Cases that emerged, cover fully the various domains of the school transportation chain that SAFEWAY2SCHOOL proposes through its holistic approach (see Figure 2). The Use Cases cover all the holistic approach areas in a balance way as it is illustrated in the following figure.

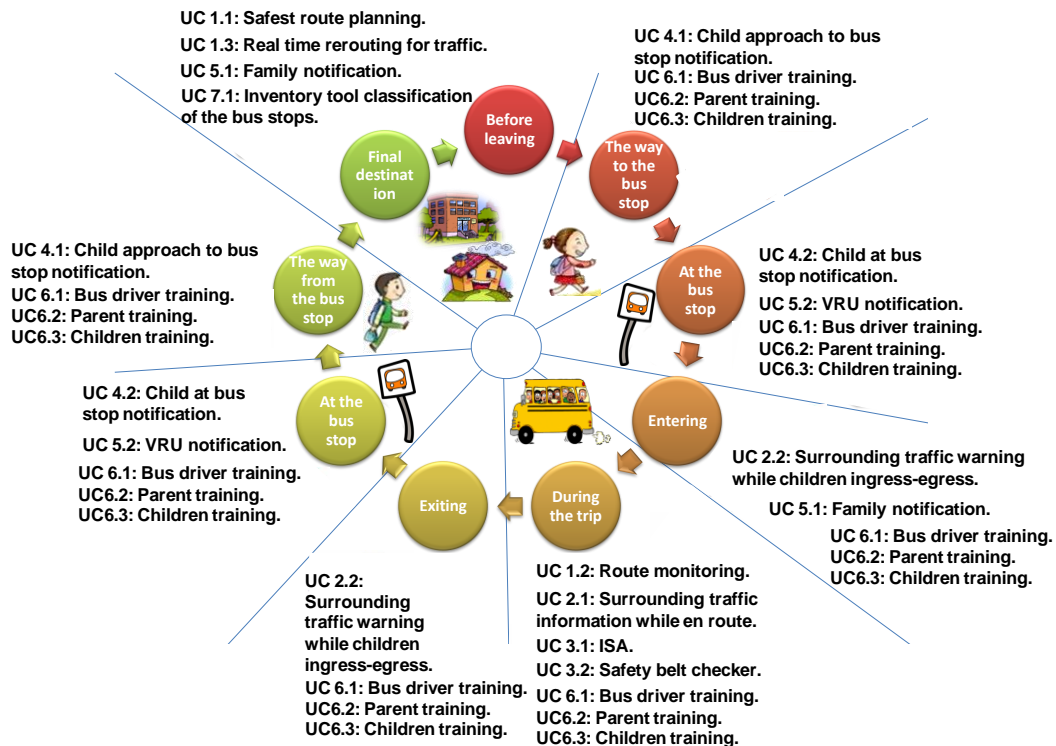


Figure 7 – SAFEWAY2SCHOOL Use Cases per holist approach stage.

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