Nationaal Lucht- en Ruimtevaartlaboratorium

National Aerospace Laboratory NLR

Executive summary

European Helicopter Safety Team (EHEST): Technological Solutions Mitigating Helicopter Safety Issues

Problem area
In 2005 the International Helicopter Safety Team (IHST) was launched with the objective to reduce the helicopter accident rate by 80% worldwide by 2016. The European Helicopter Safety Team (EHEST) is committed to the IHST objective, with emphasis on improving the European safety.

Technology is not high on the list of highest ranking incident / accident causes and contributing factors, as it is merely the lack of technology that may have led to an accident. Technology however provides a variety of solutions that can (directly or indirectly) address the identified safety issues and that can contribute to prevent various types of accidents or to increase survivability. Therefore, EHEST's Specialist Team (ST) Technology has been created in March 2011.

Description of work
The main goal of the ST Technology is to list technologies and link them with accident causes and contributing factors as identified in EHEST analyses to assess the potential of technologies to mitigate safety issues. Hereto the team is tasked to:

- define a tool;
- list technologies;
- rate the technologies;
- disseminate the results;
- provide continuous updates.

In 2011 the top 20 safety issues were identified from EHEST analyses and the team developed a tool (technology matrix) to assess the potential of technologies. In

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2012 the work continued by identifying technologies, and the process of evaluating (rating) these technologies is defined and started.

Results and conclusions

As of early 2012 the technology matrix includes almost 80 technologies divided over 11 categories of which 26 have been rated. Due to this limited number the results obtained so far are preliminary but give an indication of the usability of the results.

Applicability

This concept is a powerful tool to prioritise technological solutions from a safety perspective and identify development needs. At a glance the scored results can be interpreted and the effort be focussed on developing the most promising technologies.

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European Helicopter Safety Team (EHEST): Technological Solutions Mitigating Helicopter Safety Issues

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Summary

The work presented in this paper is being carried out under the aegis of the European Helicopter Safety Team (EHEST).

EHEST took off in 2006 as the helicopter component of the European Strategic Safety Initiative (ESSI) and the European branch of the International Helicopter Safety Team (IHST). EHEST is committed to the IHST objective to reduce the worldwide civil helicopter accident rate by 80 percent in 10 years (i.e. by 2016), with emphasis on improving the European safety. EHEST brings together helicopter and component manufacturers, operators, regulators, helicopter and pilots associations, research institutes, accident investigation boards and some military operators from across Europe. The complete list is available on the EHEST website.

In total the initiative counts around 50 organisations and 130 participants, of which around 70 are actively involved in the analysis and implementation work. EHEST addresses the broad spectrum of helicopter operations across Europe, from Commercial Air Transport to General Aviation, and flight training activities.

One of EHEST sub-teams is the Specialist Team (ST) Technology, whose main goal is to assess the benefit of technologies and/or technology solutions on mitigating safety issues. Technologies can provide a variety of solutions that address directly or indirectly the safety issues and can contribute to prevent different types of accidents or to increase survivability. For this purpose a matrix (tool) has been developed in which results of the accident analysis performed by the analysis team of EHEST, being the accident factors (coded as ‘Standard Problem Statements’ – SPS’s), are linked to R&D and technological developments. The accident analysis results are based on the analysis of 311 helicopter accidents in the timeframe 2000-2005. The basic layout of the matrix has been presented in 2011 at the 37th ERF in Italy. It is believed that the result of this exercise will be of benefit for both the safety and the engineering communities.

The core part of the paper will concentrate on the matrix, the technologies listed in the matrix and the results achieved thus far. The basic criteria for the selection of technologies are:

- new (emerging) technologies
- existing technologies, not yet used on helicopters
- existing technologies used on large helicopters, but not yet on small helicopters

Each of the listed technologies is scored against each of the listed safety issues. Thus the scoring process is driven by the selected technologies, and recommendations will be developed based

on those technologies and their scores versus the safety issues. On the other hand the matrix can be used in the other way around, starting with a given safety issue and assessing the extent to which the listed technologies do (or don't) address the issue. This allows identifying safety issues for which technological solutions exist or are being developed and those for which technological developments are needed.

The concept of a technology-safety issues matrix is a powerful tool to prioritise technological solutions from a safety perspective and identify development needs. At a glance the scored results can be interpreted and the effort be focussed on developing the most promising technologies.

Contents

Abbreviations

AAIB	Air Accident Investigation Branch
ACE	Airframe Condition Evaluation
AHS	American Helicopter Society
AIB	Accident Investigation Board
CAA	Civil Aviation Authority
CFIT/W	Controlled Flight Into Terrain/Water
EASA	European Aviation Safety Agency
EGPWS	Enhanced Ground Proximity Warning System
EHA	European Helicopter Association
EHAC	European HEMS & Air Ambulance Committee
EHEST	European Helicopter Safety Team
EHOC	European Helicopter Operators Committee
EHSAT	European Helicopter Safety Analysis Team
EHSIT	European Helicopter Safety Implementation Team
ERF	European Rotorcraft Forum
ESSI	European Strategic Safety Initiative
GPS	Global Positioning System
HFACS	Human Factors
HFDM	Helicopter Flight Data Monitoring
HOMP	Helicopter Operations Monitoring Program
HUMS	Health and Usage Monitoring System
IHST	International Helicopter Safety Team
JHSAT	Joint Helicopter Safety Analysis Team
MX	Maintenance
R&D	Research & Development
RFID	Radio Frequency Identification
RPM	Revolutions Per Minute
SMS	Safety Management System
SPS	Standard Problem Statements
ST	Specialist Team
TAWS	Terrain Awareness and Warning System
UV-IR	Ultra-Violet - Infrared
VFDR	Voice and Flight Data Recorder

1 Introduction

The work presented in this paper is being carried out under the aegis of the European Helicopter Safety Team (EHEST) [1]. In 2005 the International Helicopter Safety Team (IHST) [2] was launched with the objective to reduce the helicopter accident rate by 80% worldwide by 2016. The EHEST contributes to this effort. Chapter 2 of this paper elaborates more on the EHEST goal, organisation and its sub-teams.

One of EHEST sub-teams is the Specialist Team (ST) Technology, whose main goal is to assess the benefit of technologies and/or technology solutions on mitigating safety issues. For this purpose a matrix (tool) has been developed in which results of the accident analysis performed by the analysis team of EHEST [3], being the accident factors (coded as 'Standard Problem Statements' – SPS's), are linked to R&D and technological developments. The basic layout of the matrix has been presented in 2011 at the 37th ERF in Italy [4]. The main tasks of this team are further described in chapter 3.

The accident analysis team of EHEST aims at identifying all factors, causal or contributory, that played a role in the accidents using a standardized taxonomy. The resulting top 20 factors are used by the ST Technology and are listed in chapter 4.

The currently listed technologies by the ST Technology are categorized and a brief qualitative description of the categories used, including some examples of technologies, is provided in chapter 5.

Chapter 6 provides an overview of the preliminary results obtained thus far by the Specialist Team on technology. It is believed that the result of this exercise will be of benefit to improve safety and for the engineering communities. This paper is finalized with some concluding remarks.

2 EHEST organisation

The European Helicopter Safety Team (EHEST) took off in 2006 as the helicopter component of the European Strategic Safety Initiative (ESSI) [5] and the European branch of the IHST. EHEST is committed to the IHST objective to reduce the worldwide helicopter accident rate by 80 percent by 2016, with emphasis on improving European safety.

EHEST brings together helicopter manufacturers, operators, authorities, helicopter and pilots associations, research institutes, accident investigation boards and a few military operators from across Europe. EHEST has members from organisations including Eurocopter, AgustaWestland, new EHA, EHOC, EHAC, CHC Helicopter, Shell Aircraft Ltd, British Petroleum, EASA, UK CAA, DGAC France, BEA France, ENAC Italy, CAA Norway, FOCA Switzerland, RAeS/GAPAN, Irish CAA and AAIB, AIB Hungary, UK AAIB, BFU Germany, QinetiQ, NLR, DLR, AIB and CAA Spain, APYTHEL, Swiss Helicopter Association, and European Cockpit Association (the complete list is available on the EHEST website). In total the initiative counts around 50 organisations and 130 participants. EHEST addresses the broad spectrum of helicopter operations across Europe, from Commercial Air Transport to General Aviation, and flight training activities.

The initiative is organised as follows:

- a strategic and decision making body: the EHEST;
- an analysis team: the European Helicopter Safety Analysis Team (EHSAT);
- an implementation team: the European Helicopter Safety Implementation Team (EHSIT). The EHSIT is sub-divided in five Specialist Teams (ST's): ST Training, ST Operations and Safety Management System (SMS), ST Regulation, ST Maintenance and ST Technology;
- a communication team: the EHEST Communication Working Group. This team has defined a strategy to address General Aviation and the small operators, addressing the global helicopter community through publications in professional journals [6] and linking to international forums such as the International Helicopter Safety Seminar (IHSS) and the EASA Rotorcraft Symposium [7]. In addition, more technical publications are presented in engineering forums such as the AHS [8] and ERF [9].

3 Specialist Team Technology

Technology is not high on the list of highest ranking incident / accident causes and contributing factors, as it is merely the lack of technology that may have led to an accident. Technology however provides a variety of solutions that can (directly or indirectly) address the identified safety issues and that can contribute to prevent various types of accidents or to increase survivability. Technology can be a powerful means to improve safety, as it brings solutions to known safety problems, including those of operational nature.

Therefore, the ST Technology has been created in March 2011. The main goal of the team is to list technologies and link them with accident causes and contributing factors as identified in the EHSAT analyses to assess the potential of technologies to mitigate safety issues. The main tasks of the team are the following:

- define a tool;
- list technologies;
- rate the technologies;
- disseminate the results;
- continuous updating.

3.1 Develop a Safety Issues Matrix tool

The ST Technology has developed a tool, consisting of an Excel-file containing two tab sheets. The first sheet contains a list of technologies (technology database) and the second sheet contains a technology–safety matrix providing rows with technologies and columns with the accident factors (named 'Standard Problem Statements'; SPS's), see chapter 4 for more information on the applied SPS taxonomy.

3.2 List technologies of interest

The basic criteria for the selection of technologies are:

- new (emerging) technologies;
- existing technologies, not yet used on helicopters;
- existing technologies used on large helicopters, but not yet on small helicopters.

3.3 Rate the technologies

To determine the most advantageous technology for each safety issue, it is necessary to provide scorings. The process for this evaluation involves two rating elements: Impact and Usability, each on a scale from 0 to 5. Impact is a measure of how well the particular technology can mitigate the specific SPS. Usability is the measure indicating whether the technology can be utilised for a specific SPS and against what (relative) cost.

The individual ratings for Impact and Usability are automatically summed and colour-coded to arrive at a total score (0-10). A total scoring of 0 to 3 is considered not or slightly promising, 4 to 6 is considered moderately promising and 7 to 10 is highly promising. This method is considered intuitive, enabling a quick interpretation of the results. It can be used to identify which category of technology addresses which generic safety problems, which technologies best addresses specific safety problems and which safety problems are not (yet/sufficiently) addressed by technology.

3.4 Disseminate the results

Dissemination of the results is vital for achieving the specialist team's objective to prioritise technological solutions from a safety perspective and identify development needs and to focus the effort of research institutes, industry and authorities on developing and/or promoting the most promising technologies. Currently the dissemination is through papers and presentations at various forums. Next to these dissemination channels, future anticipated dissemination channels are through the EHEST website and possibly articles in relevant journals and magazines.

3.5 Continuous updating

The accident analysis is continuing, which may result in variations in the established top 20 SPS's as used in the Matrix tool. Also existing technologies are evolving in time and new technologies may be developed. These aspects combined imply that the matrix will need to be updated on a regular basis.

4 Top 20 Standard Problem Statements

The EHSAT accident analysis aims at identifying all factors, causal or contributory, that played a role in the accidents. These factors are coded using the Standard Problem Statements (SPS's) taxonomy as adopted from the US Joint Helicopter Safety Analysis Team (JHSAT). These SPS's are specified using a three level system in which the level of detail is increased for each level. For instance, an SPS at level 1 is defined as 'Ground Duties'; the level below, level 2, contains an item like 'Mission Planning'; this is further detailed at level 3 into various sub-items like e.g. 'Inadequate consideration of aircraft operational limits'. Based on the analysis of more than 300 accidents the spread over the different SPS items is rather large while the total quantity per SPS level 3 items is rather low. Therefore it was decided to focus on the top 20 level 2 SPS's, being (in ranking order d.d. 2011):

1. Pilot judgment & actions - Human Factors Pilot's Decision
2. Pilot situation awareness - External Environment Awareness
3. Ground Duties - Mission Planning
4. Pilot judgment & actions - Flight Profile
5. Part/system failure – Aircraft
6. Unsafe Acts / Errors – Skill-based Errors
7. Safety Management - Inadequate Pilot Experience
8. Unsafe Acts / Errors – Judgement & Decision-Making Errors
9. Pilot judgment & actions - Procedure Implementation
10. Mission Risk – Terrain / Obstacles
11. Pilot judgment & actions - Landing Procedures
12. Safety Management – Management
13. Maintenance – Maintenance Procedures / Management
14. Regulatory - Oversight and Regulations
15. Preconditions; Condition of Individuals - Cognitive Factors
16. Pilot situation awareness – Visibility / Weather
17. Aircraft Design - Aircraft Design
18. Maintenance – Performance of Maintenance Duties
19. Preconditions; Condition of Individuals - Psycho-Behavioural Factors
20. Regulatory - Accident Prevention

In the remainder of this chapter a brief qualitative description of the top 10 of the above SPS's is provided, so as to give some insight into what is included in each one of them.

Pilot judgment & actions - Human Factors Pilot's Decision

Human factors and decision making are important assets in accident prevention. Available resources must be used as planned (resource management). Cues that should have led to termination of current course of action or manoeuvre must be taken seriously. Aircraft limitations, rules and procedures must be adhered to. Only authorized equipment should be used and warning systems must not be disabled. And last but not least: a pilot must know his own limitations and capabilities, and make use of them in his decision making process.

Pilot situation awareness - External Environment Awareness

A pilot must constantly be aware of the external environment, like the aircraft position and altitude, aircraft state and flight envelope, surrounding hazards and obstacles. He must be able to detect and/or avoid conflicting traffic. Aiding systems, like enhanced vision systems or thermal imaging, must be used in appropriate environmental conditions. Also sufficient knowledge of the aircraft's aerodynamic state must be in place. Only then can the pilot be able to recognize cues to terminate the current course of action or manoeuvre, and to act accordingly.

Ground Duties - Mission Planning

The planning of the mission is an important part of the flight preparation, but one in which latent, and thus potentially dangerous, risks can be initiated. Proper consideration must be given to aircraft operational limits, performance, fuel planning and weather and wind conditions, thereby making use of actual operational data and mission requirements. A lack of sufficient experience may lead to inadequate planning and inadequate consideration of obstacles.

Pilot judgment & actions - Flight Profile

The flight profile must always be chosen such that it is safe for various aspects. These include conditions like altitude, airspeed, take-off and approach, rotor RPM and power margins.

Part/system failure – Aircraft

Pilots can hardly do anything about failures, but react to the consequences. Airframe components can fail due to inadequate design, manufacturing defects, overstressing, lubrication starvation or acts from the outside like lightning strikes. This may include items like rotor blades, rotor hubs, drive train components, landing gear, etc. Also rotorcraft systems can fail, such as the hydraulic, electrical, fuel or flight control system, or the avionics or data recording equipment.

Unsafe Acts/Errors – Skill-based Errors

Many errors can be made, either based on insufficient experience or due to certain skills that have been adopted. This can lead to inadvertent operation, checklist errors or procedural errors. But also to over-control or under-control, or to a breakdown in the appropriate visual scan.

Finally, but not so much applicable to helicopters, an inadequate anti-G strain manoeuvre can lead to mishaps.

Safety Management - Inadequate Pilot Experience
An important part of safety management is the pilot's experience in relation to the operation. Inadequate pilot experience, be it in general, with the area and/or mission, or in the helicopter make/model is unacceptable. This also holds for a student pilot or a pilot with insufficient (general) knowledge.

Unsafe Acts/Errors – Judgement & Decision-Making Errors
During an operation a proper risk assessment is essential. This also includes the appropriate prioritization of tasks. Necessary actions must be taken on time, and not being rushed, delayed or ignored. And the pilot must pay sufficient attention to decision-making during operation.

Pilot judgment & actions - Procedure Implementation
A pilot's ability to correctly implement procedures is very important to prevent accidents or incidents from happening. A pilot can act improperly due to misdiagnosis or he may exhibit control / handling deficiencies. A response to loss of tail rotor effectiveness may be inadequate. Also energy and power management during the complete mission is crucial. The pilot may improperly recognize and respond to a potential dynamic rollover. Fuel monitoring must be carried out adequately. And finally there may be all kinds of procedure implementation mishaps.

Mission Risk - Terrain/Obstacles
Certain missions can be very risky and full of potential dangers due to the nature of the terrain or the presence of obstacles. This may include flying near hazards, obstacles and wires. But it may also include remote landing sites or flying over unsuitable emergency landing terrain. Flying at high density altitudes can also pose a problem, as do operations with limited power margins. And last but not least lack of operating site reconnaissance or unforeseen obstacles can spoil your day.

5 Technologies

As of early 2012 the technology matrix includes almost 80 technologies divided over 11 categories (the number of technologies listed thus far is shown in between brackets):

- Aircraft Design (7)
- Avionics (16)
- Crashworthiness (5)
- Data Monitoring (9)
- Dynamic System (8)
- Maintenance (5)
- Operational Support (1)
- Situational Awareness (17)
- Vibrations (3)
- Workload (2)
- Other (4)

In the remainder of this chapter a brief qualitative description of the above categories is provided, including some examples of relevant technologies.

Aircraft Design

This category includes items that need to be included in the aircraft design, implying that they cannot be easily retrofitted in case they have not been considered before. Some examples are:

- All-electric rotorcraft
- Integrated three-function valve, simplifying hydraulic system lay-out
- Ultrasonic ice protection system
- Engine backup system to aid autorotational flight

Avionics

More and more avionics are being developed to aid the pilot and operator in their day-to-day business. A few interesting examples, some of which are already being used in fixed-wing aircraft:

- Improved Flight Management Systems, Attitude-Heading Reference Systems and Air Data Systems
- Self-monitoring smart electro-mechanical actuators
- Traffic collision awareness equipment
- Ground collision avoidance system
- Automatic Dependent Surveillance Broadcast
- Flight envelope protection system

Crashworthiness

Crashworthiness in the design cannot prevent accident/incidents from happening, but it will protect the occupants (or other sensitive loads) against the impact. A few examples:

- Energy absorbing materials in construction and seats
- Self-healing, crashworthy fuel tanks
- Seat attenuator and slide system
- Airbags and harness restraint systems

Data Monitoring

Accident analysis is strongly dependent on the availability of adequate and accurate data. But those data can also be used to inform the pilot. Many developments are in place to facilitate those data, like:

- Light helicopter HOMP systems
- Full Authority Digital Engine Control with vibration and condition monitoring
- Flight data acquisition and monitoring system (can also be used for training and fleet management)
- Cockpit information recorder (audio, video and GPS)
- Miniature or deployable voice and flight data recorder
- Flight data evaluation and processing tool for accident and incident investigation

Dynamic System

The dynamic system is an important part of the helicopter, being the primary source for transmitting power and providing thrust and control. The system is prone to high vibration and loading levels. New technologies are actively trying to reduce those levels:

- Various new-technology types of blade lag dampers, such as fluid-elastic inertial or magneto-rheological fluid–elastomeric dampers
- Active vibration, noise or load reduction through piezo-electric actuators that correct unwanted blade behaviour by making small tab deflections
- Helicopter sling load stabilization using a flight director to guide the pilot, thereby reducing the load instability
- New rotor concepts with increased blade number to ease vibration and noise reduction

Maintenance

Maintenance is an important part of the day-to-day operations. Some interesting new technologies are being developed that can alleviate the maintenance burden or preclude accidents/incidents:

- Use of RFID (Radio Frequency Identification) tags on helicopter parts
- Helicopter usage spectrum development (monitoring individual helicopter usage)
- Health and Usage Monitoring System (HUMS)

- Rotor blade corrosion coating

Operational Support
Many aircraft defects can be timely detected or even prevented when a good life monitoring system is in place. Improvements in operational support processes can be beneficial. One example is the US Army ACE-3D (Airframe Condition Evaluation) program, linking a defect database to a 3D visualization tool.

Situational Awareness
Many accidents/incidents are related to (lack of) situational awareness, especially during aerial work or inadvertent flight into degraded visual environment. Technologies can be used to drastically improve safety:

- Digital ground navigation database for predictive ground collision avoidance; this may be coupled to an intelligent flight path guidance system
- Ways of combining information from various visual sources (sensors)
- Novel display techniques to minimize the risk of spatial disorientation
- Advanced symbology injection in night vision systems, thereby increasing its effectiveness
- Combining real-time imagery (video) with 3D vision
- Weather uplink and flight safety program, linking and unifying all sorts of weather observation and prediction techniques
- Various types of obstacle detection and terrain avoidance systems (using laser, radar, laser radar or millimetre-wave imaging)

Vibrations
Vibrations can lead to additional fatigue and therefore to accidents/incidents. Systems that reduce the vibration level will have a positive effect:

- Adaptive helicopter seat mount concept for aircrew vibration mitigation applications
- Hydraulic lag dampers that reduce vibration levels
- Composite helicopter blades, also to reduce vibration levels

Workload
Workload reduction is also an important step to increase safety:

- Advanced alerting system – capabilities for part time display of vehicle parameters (includes a sophisticated monitoring of aircraft parameters)
- 3D audio for enhanced cockpit communication to reduce workload

Other

Miscellaneous other technologies, such as:

- New fire detection system for engine and main gear box compartment using UV-IR optical flame detector
- Autorotation training display on a flight training device, showing optimized autorotation trajectory for the actual flight condition.

6 Preliminary results

Of the almost 80 technologies currently listed in the matrix 26 have been rated. Due to this limited number the following results are very preliminary and only included to give an indication of the usability of the results. Some results are shown for technology categories addressing generic safety problems and for technologies best addressing specific safety problems.

6.1 Technology categories addressing generic safety problems

For the categories that include multiple rated technologies it can be seen what (set of) SPS is typically addressed by that category. At this stage this can only be done for the categories on data monitoring, situational awareness and aircraft design.

Data monitoring

Data monitoring technologies rate high on the regulatory SPS, specifically on accident prevention and the part/system failure and maintenance SPS.

Situational awareness

The category situational awareness typically addresses the SPS related to pilot situational awareness but also on mission risk, in particular related to terrain and obstacles and partially on pilot judgement and actions in particular related to landing procedures.

Aircraft design

The category aircraft design typically addresses the SPS related to design, but on a more technology specific level could also be beneficial for mission risk, part system failure, skill based errors and judgement & decision making errors.

6.2 Technologies best addressing specific safety problems

When looking at the individual technologies 13 of all currently rated technologies stand out as highly promising for one or more level 2 SPS. In total 4 technologies have highly promising ratings for 3 or more SPS. These are the Deployable Voice and Flight Data Recorder in the data monitoring category, the enhanced Ground Proximity Warning System / Terrain Awareness and Warning System and Laser radar obstacle and terrain avoidance system in the situational awareness category and the Digital Map in the avionics category.

Deployable Voice and Flight Data Recorder

This technology is a deployable Voice and Flight Data Recorder (VFDR) for flight data and voice data acquisition and storage. In this case a Crash Survival Memory Unit gets (automatically) deployed in case of a crash or in case of sinking of the rotorcraft after impact into water. The equipment is floatable and is equipped with an Emergency Locator Transmitter and Underwater Locator Beacon.

Enhanced Ground Proximity Warning System / Terrain Awareness and Warning System
The Enhanced Ground Proximity Warning System (EGPWS) is already used on airplanes to prevent Controlled Flight Into Terrain/Water (CFIT/W) and provides a warning of fixed obstacle hazards such as power lines and towers. Collision avoidance systems such as Terrain Awareness and Warning System (TAWS) can undoubtedly be justified in environments where the risk of mid-air collision rises. According to [10], EGPWS/TAWS is assessed as ‘likely to prevent 75% of CFIT/W accidents and mid-air collisions’, allowing for some non-availability of equipment.

Laser radar obstacle and terrain avoidance system
The Laser radar obstacle and terrain avoidance system is an obstacle detection system which can sense objects as thin as wires, thus making it useful for wire strike prevention. The system uses an eye-safe laser which is mounted on the fuselage to provide the pilot with the information about the surrounding environment using both optical display and aural warning.

Digital Map
In line with the EGPWS / TAWS but more aimed at avionics is the digital map technology. This includes a precise navigation system which also provides elevation and obstacle information to the pilot. Both integrated and standalone digital map systems are available.

Concluding remarks

The EHSIT Specialist Team Technology has developed a dedicated tool (technology-safety issues matrix) linking the results of the EHSAT analysis (accident causes and their contributing factors) to technologies. This concept is a powerful tool to prioritise technological solutions from a safety perspective and identify development needs. At a glance the scored results can be interpreted and the effort be focussed on developing the most promising technologies.

At this stage almost 80 different technologies are listed and the rating process has started. The results obtained so far can be used to identify which category of technology addresses which generic safety problems and which technologies best addresses specific safety problems. 13 of the currently 26 rated technologies, stand out as highly promising for one or more accident cause(s) and their contributing factors (SPS). In total 4 technologies have highly promising ratings for 3 or more SPS, being the Deployable Voice and Flight Data Recorder, the enhanced Ground Proximity Warning System / Terrain Awareness and Warning System, laser radar obstacle and terrain avoidance system and Digital Map avionics.

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