SAFE COOPERATING CYBER-PHYSICAL SYSTEMS USING WIRELESS COMMUNICATION

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AUTHORS

Contributors

All partners have jointly contributed, coordination was made by Aitek SpA and Politecnico di Milano.

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2.6	2017.03.17	Contribution to Chapter 3 by Use Case 2 and 5 partners
3.0	2017.03.28	Final review

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ABBREVIATIONS

Abbreviation	Description
AE	Academic Exploitation
C2CCC	Car 2 Car - Communication Consortium
CBWF	Centralized Bed-Washing Facility
CEN	European Committee for Standardization
C-ITS	Cooperative Intelligent Transportation System
CLW	Control Loss Warning
ECU	Electronic control unit
ETSI	European Telecommunications Standards Institute
DIF	Digital Innovation Forum
IE	Industrial Exploitation
IEEE	Institute of Electrical and Electronics Engineers
IMO	International Maritime Organization
ISO	International Organization for Standardization
LE	Large Enterprise
OEM	Original Equipment Manufacturer
RSU	Road Side Unit
RWS	Road Weather System
SE	Standardization Exploitation
SME	Small Medium Enterprise
TCU	Telematics Control Units
TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicle
UC	Use Case
UMV	Uninhabited Marine Vehicle
USV	Unmanned Surface Vehicles
V2I	Vehicle-to-infrastructure
V2V	Vehicle-to-vehicle
VCS	Vehicle Control Station
WP	Work Package

1 EXECUTIVE SUMMARY

This document represents the Deliverable D6.2 "Dissemination, exploitation and certification report year 1" of the SafeCOP project and describes the first year activities of the Work Package (WP) 6 which is focused on the dissemination, exploitation and standardization of the project results.

This document consists of the following three chapters:

- Chapter 2 is referred to the dissemination. It contains the description of the project web site, the project flyer and the publications referred to the project topics. These represent the most important way to disseminate the project ideas and results. This chapter includes also the dissemination plan for the next years.
- Chapter 3 is focused on the commercial exploitation of the project outcomes. Even if this task is not yet started some preliminary activities have been already done. In particular the main contribution reported in this work is the proposition of a reference approach for the development of the business model for each use case outcomes. Moreover this chapter includes update of the project proposal, referred to market analysis for each applicative scenario considered and exploitation plan of each partner.
- Finally Chapter 4 regards the standardization and certification activities. Considering that it could be a little early in the project, and no relevant results of such activity are already available, this chapter is a brief overview of the next years' strategy.

2 DISSEMINATION

The SafeCOP Consortium believes that disseminating the project results to relevant parties and to the general public, and exchanging useful knowledge among the Consortium itself are crucial for attaining scientific and technological cutting-edge results and for fostering the long-term success of the project. Effective dissemination is indeed key to the success and the sustainability of the project. Accordingly, the project Consortium intends to put considerable effort in the dissemination of its research results.
In what follows, we will distinguish between the so-called "internal dissemination" and "external dissemination", and we will clarify the communication tools adopted in each case. More specifically, after an initial specification of the general dissemination objectives, we will identify the target audience, the activities and the goals for each kind of dissemination pursued.

2.1 DISSEMINATION OBJECTIVES

The purpose of the dissemination within the SafeCOP project can be broken down in the following objectives:

- To increase the awareness of the project results among various stakeholders and the general public
- To engage and interact with relevant stakeholders outside the project Consortium, both within and outside academia (i.e. industry, general public, standardization bodies, interested parties, etc.)
- To ensure the visibility and the influence of the project results

In what follows, we will detail the dissemination plan, along with the groups we target, and the tools we use to disseminate and to communicate the research results. At the end of the section, we will then specify the activities done and the results achieved within the first 12 months of the project.

2.2 DISSEMINATION PLAN

SafeCOP dissemination plan lays out in detail how the Consortium intends to capitalize on various opportunities to make the SafeCOP project known.

An initial list of target groups has been identified. To them, key messages and results will be communicated during the entire duration of the project as well as at the end of it. These groups are possible end-users of the advancements developed within the project, academic partners interested in the area of research and technical committees of relevant standardization bodies. In particular, we will target:

- Research and scientific community
- Industry
- Standardization bodies
- General public

We aim at disseminating the work specifically related to safety assurance, certification and standardization. The dissemination will be achieved through reports, papers, workshops and the direct participation of the partners in the respective organizations. As SafeCOP has far-reaching

application potentials, partners will make sure to include project results in their research work, in their communication activities, in their teaching plans and in their commercial activities.

2.2.1 Internal dissemination plan and communication tools

SafeCOP internal dissemination plan, through selected communication tools, aims at ensuring the smooth circulation of information, knowledge and documentation among the Consortium. This will ultimately improve the cooperation among the project's partners, thus positively impacting on the success of the project as a whole.

The tools we use for internal dissemination include:

- *An internal project website and repository of relevant documents*: this is intended to ensure that every partner can access the information needed quickly and safely. It is also aimed at keeping track of the project's progression and at easing collaboration within the Consortium. The website is used as database and as knowledge management tool, collecting information about SafeCOP-related scientific topics, reports, project's state-of-the-art and outputs
- *Internal workshops and meetings:* these enable partners to share relevant information and to strengthen working relationships

2.2.2 External dissemination plan and communication tools

External dissemination aims at ensuring the visibility of the SafeCOP project and at increasing the awareness of the project's results among relevant stakeholders as well as the general public. Our goal is to disseminate the results using a variety of tools. Each of these tools will be described in this section.

Project website

The website is the main public face of the project. It has a responsive design, i.e. it can be viewed on mobile and desktop browsers offering good user experience on both of them (see Figure 1), and it is easy to navigate thanks to a careful selection of information and relevant tabs. The website does contain special sections describing the project's goals, partners, news about the progression and the results of the project, events organized and upcoming ones, and public deliverables.

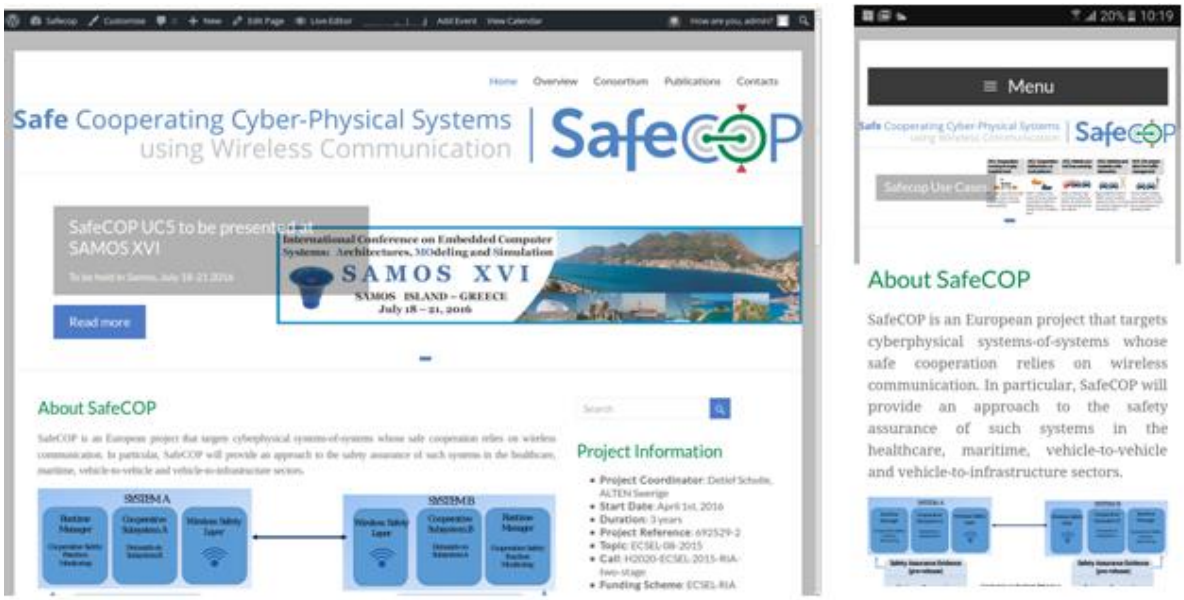

Figure 1: SafeCOP website – desktop (left) and mobile (right) versions

The website also contains a link to the SafeCOP twitter account. We intend to offer online versions of the tools resulting from the project to encourage their adoption by interested parties and to speed up the experimentation phase. The website (http://www.safecop.eu/) is hosted internally at Politecnico of Milano (Italy) and it is updated regularly to inform the reader about the project's progresses.

To measure traffic, we have been using the Jetpack plugin developed by Wordpress, which provides quick statistics within and about the website itself. The screenshots below show where the majority of referrals to the website came from (Figure 2), also with respect to the countries they are linked to (Figure 4), and some statistics related to the number of visitors (Figure 3). Most visitors landed on the website through the Google search engine, followed by those who typed the url directly into the browser. This seems to indicate that, so far, the majority of the visitors are interested parties. In the future we aim at engaging a wider audience with key messages clearly explained, news about the project and interesting activities.

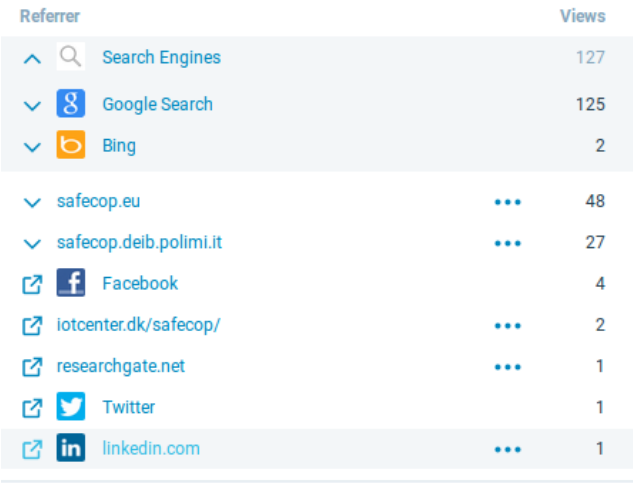

Figure 2: SafeCOP website referrals

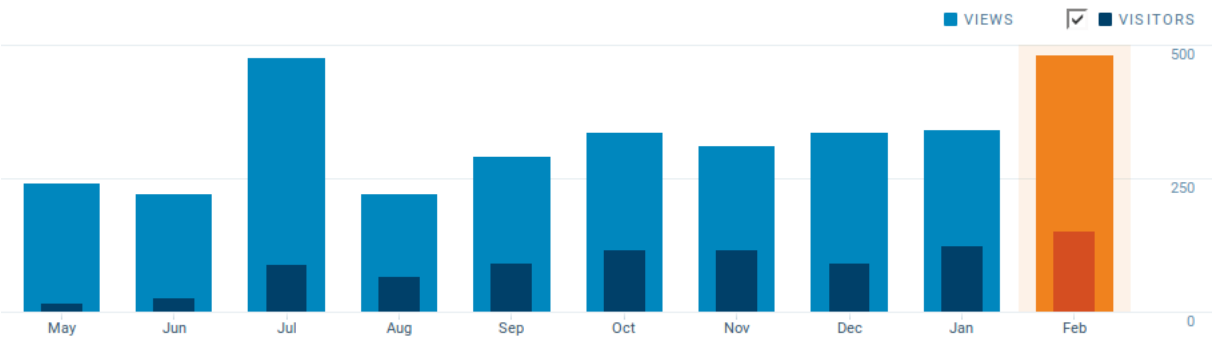

Figure 3: Statistics related to SafeCOP website's visitors

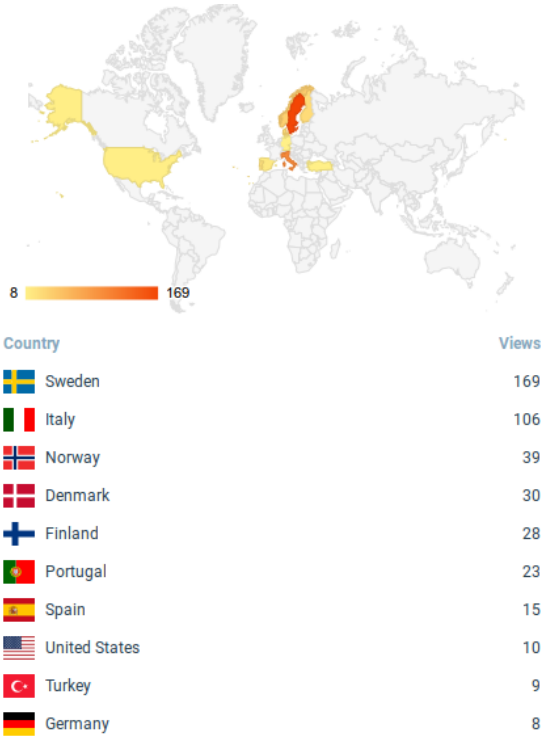

Figure 4: SafeCOP website visitors' countries

Social networks

SafeCOP has both a twitter and a LinkedIn account. The twitter account (see Figure 5) is used as a mean for quick communication and interaction with other relevant projects and EU organizations. It is updated regularly and it is intended to foster new collaborations that will, potentially, lead to future projects. The SafeCOP LinkedIn group (see Figure 6) is also used mainly as a channel for networking among project's partners and stakeholders. They both contain updates about the project's progress, upcoming events as well as news about workshops and conferences, and they are used to drive traffic to the main website too.

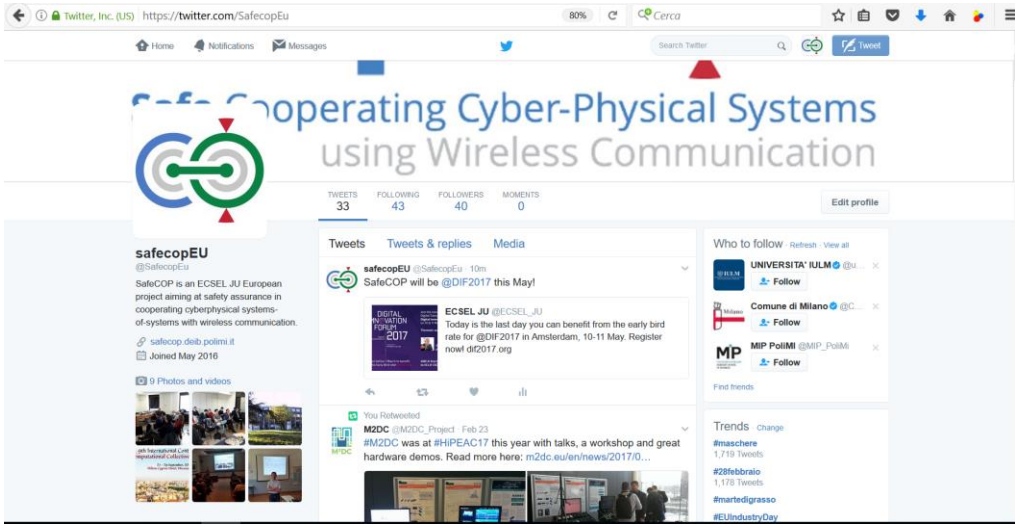

Figure 5: SafeCOP twitter account homepage

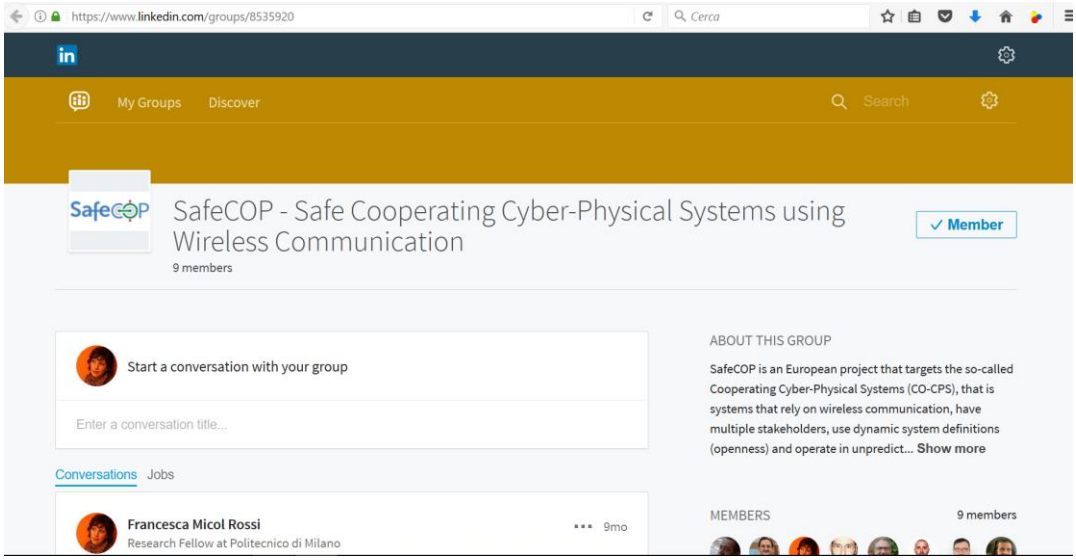

Figure 6: SafeCOP LinkedIn group

Twitter analytics and dashboard are used to track impressions and to view progress. At the moment, the SafeCOP twitter account has 40 followers. Figure 7 below shows the peaks whenever a blog post is published or a link is shared via social media.

In the future we plan to engage a wider audience with both Twitter and LinkedIn to further disseminate information about the project and its progress.

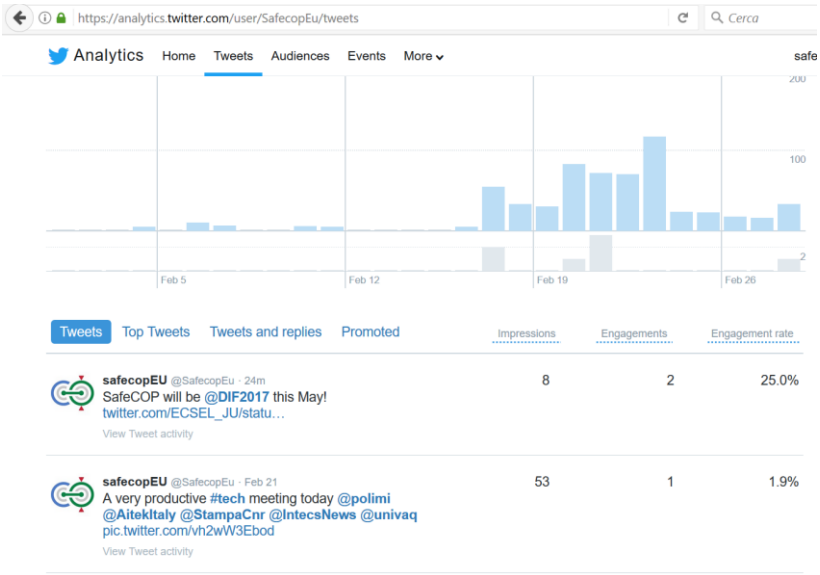

Figure 7: SafeCOP twitter account - spikes

Project flyer

The project flyer is intended to explain in plain language the main features of the project. To ensure a wide dissemination of this type of non-technical information, the flyer is downloadable from the project website for free and it will also be distributed at events.

The flyer is shown in Figure 8.

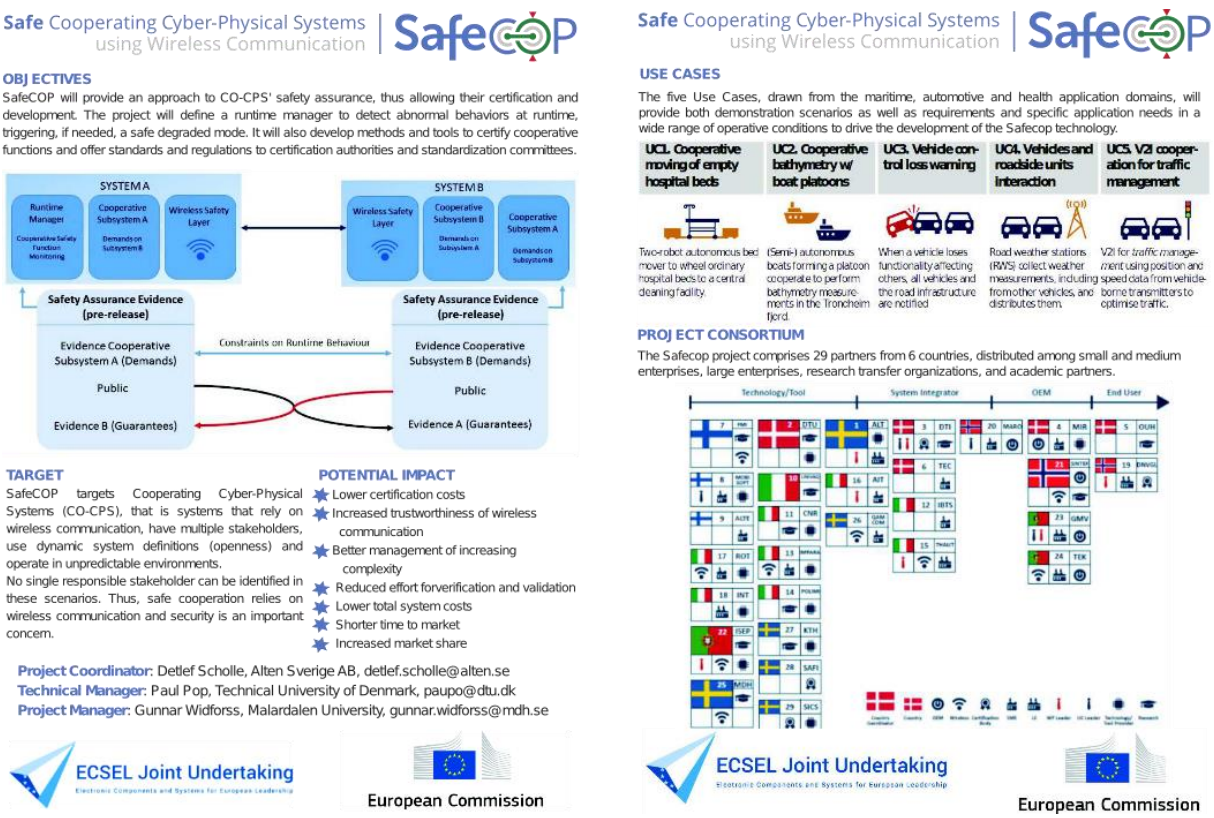

Figure 8: SafeCOP flyer

Publications - journals and proceedings, book

Project results will be submitted for publications to scientific journals, conferences and workshops relevant to the project's topic. This will ensure the high visibility of SafeCOP partners' work within the scientific community. The submission of papers jointly written by various project's partners will be especially encouraged. In addition, a book collecting the innovative technologies developed within the project will be published at the end of it. The goal here is to invite University instructors and professionals to adopt the book and to learn how to deploy similar techniques in CO-CPSs.

Events

Project's partners will organize and actively participate in conferences, workshops and special sessions to transfer the knowledge resulting from the project to the international scientific community and to standardization bodies (key target of SafeCOP). This will foster a two-way communication with relevant stakeholders that can help cross-dissemination and, ultimately, enhance the research outputs and form the basis for collaborations that can lead to future cutting-edge projects. Booths at international conferences, tutorials at special venues, demos at trade events will also be organized to further disseminate the research outputs and give sustainability to the project.

According to the project plan, the SafeCOP project runs a yearly advisory board meeting, which will be three times. The first advisory board meeting was the early 2017 and will be followed with two meetings late in 2017 and late 2018. The value of having a second opinion from an expert panel is a strong support the project.

Educational material
Curricula of relevant graduate courses will be updated with the project's results, i.e. developed design methodologies and tools. In addition to this, Master and PhD students will be invited to work on specific topics linked to the project.

Partners' specific dissemination plans

Aitek
Aitek is the WP6 leader, thus it coordinates the dissemination and exploitation activities of all the partners in the project. Even if it is in charge of leading the exploitation actions, Aitek has planned dissemination actions for the second year of the project. Such plan consists in providing support to academic and research partners in writing papers and jointly submitting them to international conferences and journals.
Moreover, Aitek is currently organizing the SafeCOP booth at the Digital Innovation Forum 2017 (DIF 2017) which will take place in Amsterdam in May 2017. This workshop will be a good opportunity to disseminate the project outcomes, even if in a very preliminary status, spreading relevant information to industries, stakeholders and research institutes.

ALTEN Finland
ALTEN Finland has disseminated SafeCOP results in several occasions, i.e. by taking part in two seminars on new EU Data Protection Regulation and Directive that will be in place in 2018 and by discussing the project with various stakeholders, thus raising awareness of the ideas and new regulations (these discussions are still ongoing). In addition, ALTEN Finland has organized the Finnish Delegation Steering and Technical meetings together with TEKES national funding authority and various internal project meetings.
Beyond raising awareness of the project within their organization through internal monthly reviews, ALTEN Finland has disseminated SafeCOP ideas to organizations and institutes they have collaborated with during the development of a new portal to support the cooperation between local research organizations and local metal industries.

ALTEN Sweden
Alten Sweden has contributed to the dissemination of SafeCOP results by participating to the Euromicro Conference on Digital System Design 2016 with a paper, co-written with other project partners, that has won the Best Paper Award. In addition, Alten Sweden has run regular "quarterly" internal Alten workshops (in 2016: June, October, December; and for 2017: January, March,) where it presented the progress of the research done within the project.
In 2017, Alten Sweden plans to publish two other paper together with the MDH's partner Irfan Sljivo and act as main author. Both papers are already submitted.

CNR-IEIIT
IEIIT has contributed, together with other Italian partners, to the article "V2I Cooperation for Traffic Management with SafeCOP," presented at the Euromicro Conference on Digital System Design (DSD) 2016. In the future, IEIIT will contribute to the dissemination of SafeCOP results by targeting relevant conferences, such as IEEE Global Communications Conference (GLOBECOM) 2017 and IEEE International Communication Conference (ICC) 2018, and relevant journals, such as IEEE Transactions on Intelligent Transportation Systems and IEEE Transactions on Vehicular Technology.

DNV GL

DNV GL has presented the work it is carrying out within SafeCOP internally in several occasions and it is planning on doing it again in the next year. In addition to these internal presentations, DNV GL has been part of the ASSURE 2016 Panel on Assurance Challenges for Safety-critical Autonomous Systems. As for the coming year, DNV GL will participate in the ESREL 2017 Conference in Slovenia with the paper "Risk-based- versus control-based safety philosophy in the context of complex systems" (to be published in June 2017).

DTI

DTI living labs have around 5,000+ visitors every year, attending tours and demonstrations around their facilities. In that regard, most of the technological developments produced by DTI in the SafeCOP project are on semi-permanent display and will thus be part of the presentation provided to visitors, along with a discussion of the underlying purpose and perspective of SafeCOP itself.

In the second year of SafeCOP, DTI plans to produce at least five publicly viewable videos to demonstrate SafeCOP technology as well as progress and results of UC1. The videos will be made available on DTIs YouTube channel, DTIRobot:

https://www.youtube.com/user/DTIRobot/videosYouTube

Further, DTI plans to publish at least three news stories in their biweekly eNewsletter - presently reaching 3.500 recipients – directly or indirectly referencing SafeCOP related results. Additionally, DTI will plan at least one academic publication in collaboration with one or more of the other project partners.

DTU

DTU will continue to disseminate research results through high quality conference and journal publications. In particular, DTU plans to publish three journal articles and six conference papers. The journal articles will be submitted to the Real-Time Systems Journal, the ACM Transactions on Design Automation of Electronic Systems and the ACM Transactions on Embedded Computing Systems. They will submit the conference articles to DATE, DAC, RTSS, and to the conferences under the Embedded Systems Week (ESWEEK) umbrella.

DTU will present research results and tool prototypes at leading conference participating in University Booths (e.g. DATE and DAC).

They will participate in special-purpose dissemination workshops organized by the SafeCOP project. In addition, DTU will use its media relationships within Denmark to publicize the project topics and results within the technical media in Denmark and Nordic countries, such as the magazine Ingeniøren. DTU is participating in a National industrial innovation network, InfinIT. Results from SafeCOP will be disseminated to Danish industry through this network. They will organize events to showcase the technology developed in the SafeCOP project. DTU has indeed experience in using such venues for the results of the earlier RECOMP and EMC2 projects.

The project results will also be integrated in relevant graduate-level courses (fundamentals of Modern Embedded Systems and Fault-Tolerant Systems) and in the PhD-level course on System-Level Design of Embedded Systems at DTU.

FMI

FMI has already participated in the dissemination of SafeCOP results in several ways. In particular, FMI has attended the ITS Europe Conference 2016 in Glasgow where it run a special session, and it participated to Car 2 Car Communication Consortium 2016 forum in Gaydon, UK. As for the future, FMI will join the ITS European Conference 2017 in Strasbourg where it will be a panelist in a special interest session hosted by the Finnish transport agency, and it will co-author a technical paper. FMI will also participate to the Car 2 Car Communication Consortium 2017 forum.

In addition to these dissemination activities and depending on the results available, FMI aims at preparing one or two additional conference papers. Finally, FMI will be involved in national level dissemination activities, e.g. the FMI internal stakeholder event in March 2017.

GMV

GMV has contributed to the dissemination of SafeCOP results through articles distributed to all GMVs departments and offices via an internal magazine. Use Cases results will be listed in this internal publication after the first demonstration results are available.

As for the future, GMV plans on participating in the WFCS 2017 with a special session on "Cooperative and Dependable Wireless Cyber-Physical Systems", focusing on their work on use case 3 from the industry perspective.

IBTS

During the first year of the project, the main dissemination activities of IBTS focused on creating awareness among the project partners of their technical design capabilities. To this purpose, IBTS also cooperated with POLIMI in the organization of the project kick off, where the company profile has been presented to the entire consortium.

Beside such internal dissemination actions, IBTS created a specific section on its website () to report on the progress and achievements of the activities carried out during the SafeCOP project.

The plan for the future is to keep on using the website as the main tool for external public dissemination, while cooperating with the partners of the use case where IBTS is involved to write papers for conferences and magazines. The presence during public events will be taken into account when the platform under development will be mature enough.

Impara

Impara has helped disseminating SafeCOP project's results by presenting at Euromicro Conference on Digital System Design (DSD).

In the following years, Impara will target various relevant conferences, such as IEEE Global Communications Conference (GLOBECOM) 2017 and IEEE International Communication Conference (ICC) 2018. Impara will also send articles for publication to IEEE Transactions on Intelligent Transportation Systems and IEEE Transactions on Vehicular Technology.

Intecs

Intecs dissemination will be focused on collaborating in joint publications with the academic and research partners for submission to international conferences and industrial workshops.

Intecs will also approach relevant entities in the customer base, stakeholders, technological partners and system integrators to create interest and to promote the outcomes of the SafeCOP project. In particular, Intecs will:

- Undertake internal awareness actions to propagate the use of SafeCOP technologies within the Intecs Industrial Divisions
- Encourage embedded systems based customers to develop applications using development methods and property with SafeCOP technologies and development methods
- Monitor development and business improvements achieved from using SafeCOP tools and technologies and share these successes at industry level and commercial events
- Support the standardization of SafeCOP project technologies through awareness and consensus building amongst key embedded systems technology vendors.

ISEP

ISEP will disseminate the project results through high quality publications in prestigious journals (IEEE, ACM), books (Springer), flagship conferences (ECRTS, RTSS, ICC, RTAS, Globecom, etc), international workshops and seminars. ISEP will also work closely with other SafeCOP partners to produce joint publications. They aim at delivering two books that summarize the main achievements, namely with respect to WP3 and WP5 results about use case deployment.

ISEP will organize/host international conferences/workshops where project brochures and materials will be distributed. These materials, including on-going progresses and interim reports, will be published on the CISTER (ISEP) website. University courses and lectures will be organized on the theme of this project and students (Master and PhD) will be given the opportunity to get hands-on work experience in the area of cooperative embedded systems. There is also a possibility of an international patent on the proposed work.

KTH Stockholm

For the coming year, KTH Stockholm plans to contribute to the dissemination of SafeCOP results by submitting papers to IMBSA 2017, and QEST 2017, and by targeting relevant journals such as Journal of Software Testing and Verification and Reliability (JSTVR). In addition to this, they will integrate their machine learning results into the teaching material of international PhD summer schools and workshops (e.g. HSST). Finally, capitalizing on the organization of the Dagstuhl workshop in 2016, KTH Stockholm will organize in 2017 a follow-up workshop in Shonan (Japan).

Maritime Robotics

Maritime Robotics is actively disseminating its RnD activities in a variety of fora, such as conferences, international exhibitions and social media. In many of these occasions, the SafeCOP project is indirectly as well as directly mentioned. Maritime Robotics believes in fact that the standardization of SW and systems for autonomous vehicles are of crucial importance for the market adaption of this technology.

In 2017, Maritime Robotics will carry out project experiments, whose highlights will be demoed for the international market during visits in their facilities. In addition to this, Maritime Robotics will be one of the speakers in the Autonomous Ship Technology Symposium in Amsterdam (6-8 of June 2017). Here they will present one of the SafeCOP use cases to show a cooperating fleet of USVs could reduce costs and risks in maritime mapping operations.

MDH

The main form of external dissemination for MDH will be through publications and conference presentations. A secondary mean for dissemination will be to present SafeCOP results within related projects (that in most cases include regional, national and/or European companies). Additional forms of dissemination will be via talks at industrial conferences and meetings with industrial audience, such as the Automation region breakfast seminars.

Specific dissemination actions will be the organization of conferences and workshops, and in particular:

- Conference on Computer Safety Reliability and Security (SafeCOMP) 2018
- International Conference on Software Test (ICST) 2018

Finally, MDH will work on a DVA438 Embedded Systems Project course, developing RTOS for a customer from automobile industry.

Odense University Hospital

Odense University Hospital doesn't have a dissemination plan for the coming years as its role within the SafeCOP project is to support the testing and validation of the technologies developed by the Danish use case.

POLIMI

POLIMI has created, is hosting, is maintaining and is regularly updating the project internal and external website. POLIMI has also created the Twitter and LinkedIn account linked to the project, which are regularly updated too with information about the project, the project members, upcoming and interesting events, and relevant links to other projects or activities.

POLIMI has written, together with the other Italian project's members, two articles that have been presented at DSD and SAMOS in 2016, and it is planning on participating in more conferences and workshops in the coming year.

POLIMI has already organized and hosted two events linked to the project - the kick-off meeting in April 2016 and the technical meeting of the Italian delegation in February 2017 – and it plans on organizing more workshops and special sessions in the future. Currently, POLIMI is helping Aitek in the organization of the SafeCOP booth at DIF 2017.

In addition to this, technological transfer towards industrial consortium partners and other partners identified through the technology transfer office and exploitation of project results in future research projects are the actions proposed by POLIMI.

Quamcom

During this first year of the project, Quamcom has helped disseminating SafeCOP results in the following ways:

- By presenting ideas for "Coordinated Emergency Braking" at the 2017 HH ITE PhD conference
- By participating in the writing of the article "Functional Safety and Evolvable Architectures for Autonomy. In Automated Driving" together with other project partners

In the future, Quamcom aims at publishing two peer reviewed research articles on ideas generated within the SafeCOP project and to submit them to conferences.

SICS

SICS dissemination plan can be summarized in the followings:

- Act as member of program committee for the 3rd International Workshop on Vehicular Networking and Intelligent Transportation Systems (VENITS2017), August 3, 2017 · Vancouver, Canada
- Organize a special session on Cooperative and Dependable Wireless Cyber-Physical Systems with other project partners, including ISEP and GMV in 13th IEEE International Workshop on Factory Communication Systems (WFCS2017), May 31 - June 2, 2017, Trondheim, Norway
- Attend the European Truck Platooning Challenge: Networking event, which will take place in Brussels on 21st March 2017.

In addition to this, we would like to point out that Ali Balador working at RISE SICS within the SafeCOP project has been selected as young professional representative for IEEE Vehicular Technology Society.

Ro Technology

The dissemination actions of Ro Technology are twofold. On the one hand they are preparing a Technical Report on Stamp methodology used in the safety of CPS, which will be presented in May 2017 at the "5th Scandinavian Conference onSYSTEM & SOFTWARE SAFETY". On the other hand, they aim at raising awareness of the project by, for instance, informing the Italian Ministry of

Defence, with which they are currently collaborating as part of a project concerning the WSN. In particular, Ro Technology made the Ministry aware of both the Stamp approach and the relevant use-case, thus eliciting great interest and expectations on the final results. They have also disseminated SafeCOP results and activities to Leonardo Finmeccanica SpA and Poste Italiane with which they are collaborating in a H2020 Research Project.

Safety Integrity

Safety Integrity has disseminated SafeCOP results in this first year mainly via educational material. In particular, it has designed two online courses available to all SafeCOP partners. The first course is on safety management of functional safety, while the second course is on ISO26262 and safety management. In addition to this, Safety Integrity has provided several courses at Autoliv during 2016, where it has presented several features of the project.

In the future, Safety Integrity plans to publish jointly with other SafeCOP partners and to present at relevant conferences, such as MDH/SICS.

Sintef

In 2016, Sintef has presented SafeCOP results at multiple venues and, in particular at the Maritime Communication Seminar hosted by Norwegian Forum for Autonomous Ships, at the FPGA Forum in Trondheim and internally. As for next year, Sintef is planning on disseminating SafeCOP results at the IEEE WFCS 2017 conference it will host in Trondheim at the end of May 2017 (www.wfcs0271.org), by presenting at relevant national or international seminars (2 or 3 presentations) and by publishing at 1 or 2 papers.

Sito

During this first year of the project, Sito has presented and advertised SafeCOP to academics, industry, businesses and the general public. In particular, in 2016 and then in 2017 Sito has presented the SafeCOP project to the regional and national ITS networks such as ITS Factory, ITS Finland and Aurora. Sito has also presented the project to the Ministry of Transport and Communications, the Finnish Transport Agency and the Finnish Transport Safety Agency.

Sito will help disseminate SafeCOP results actively by contributing with news to the project website, offering inputs to be included in the newsletters, participating to workshops, seminars, etc. Sito will also use its networks to promote SafeCOP and its results, following the guidelines of the SafeCOP dissemination plan.

Technicon

Technicon's role in the dissemination of SafeCOP results will begin later on in the project. It has therefore not contributed to dissemination yet and it will present its plan next year.

UNIVAQ

UNIVAQ is strongly involved in dissemination activities. In particular, with respect to the SafeCOP project, the dissemination activities planned are the followings:

- To do internal dissemination mainly through seminars
- To give external presentation in networking events and workshops
- To participate to conferences (DATE, ESWeek.)
- To submit papers to several international journals (IEEE, ACM)

More specifically, UNIVAQ aims at preparing at least 2 conference papers and at least 1 journal by the end of 2017.

VOD

VOD started communicating internally its participation to the SafeCOP project to enhance the possibility of exploitation of the project outcomes towards several internal and external stakeholders.

A specific presentation meeting of the project will be scheduled by VODAFONE innovation as soon as the participation of VOD to SafeCOP will be formally finalized.

Moreover, VOD plans to include specific information on the achievements of the project on its website and to present the dissemination material during the exhibitions and public events pertaining the automotive market segment VOD participates to every year, such as:

- Mobile World Congress
- TU-Automotive Europe
- IoT Solutions World Congress
- IoT Tech Expo

VOD is also planning to cooperate in writing papers for conferences and magazines on the SafeCOP results, without disclosing any confidential information on its long term roadmap.

First Year Dissemination Highlights

Publications

Alessio Agneessens, Francesco Buemi, Stefano Delucchi, Massimo Massa, Giovanni Agosta, Alessandro Barenghi, Carlo Brandolese, William Fornaciari, Gerardo Pelosi, Dajana Cassioli and Luigi Pomante, Leonardo Napoletani, Luciano Bozzi, Enrico Ferrari, Carlo Tieri, Maurizio Mongelli
Safe Cooperative CPS: A V2I Traffic Management scenario in the SafeCOP project
Proceedings of the SAMOS XVI Conference, Agios Konstantinos, Greece, July 2016.

Ali Balador, Carlos T. Calafate, Juan-Carlos Can, Pietro Manzoni
A Density-Based Contention Window Control Scheme for Unicast Communications in Vehicular Ad Hoc Networks
International Journal of Ad Hoc and Ubiquitous Computing, 24(1-2): 65-75, 2017.

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Cognitive Radio Network with Secrecy and Interference Constraints
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Design optimization for security- and safety-critical distributed real-time applications
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Conferences organized
Dagstuhl Seminar 16172
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Organised by Amel Bennaceur, Dimitra Giannakopoulou, Reiner Hähnle, and Karl Meinke
24-27 April 2016, Schloss Dagstuhl, Germany

Workshops organized
Kick-off meeting
Organized by POLIMI and IBT, Milano (Italy)
18-22 April 2016

Technical meeting of the Italian delegation
Organized by POLIMI, Milano (Italy)
12 February 2017

WP Workshops
Organized by DTU, Copenhagen (Denmark)
14-15 November 2016

RISE SICS has organized several meetings with other partners to plan some collaborations, such as MDH, Qamcom Research & Technology, ISEP, GMV, KTH, SAFI

Educational material
Safety Integrity has designed and run two online courses available to all SafeCOP partners. The first course is on safety management of functional safety, the second course is on ISO26262 and safety management. In addition to this, Safety Integrity has provided several courses at Autoliv during 2016, where it has presented several features of the project.

Invited tutorials
Hans Hansson
Challenges in functional safety for future cooperative and autonomous systems

8th International Workshop on Software Engineering for Resilient Systems
Göteborg, Sept. 6, 2016

Hans Hansson
Can Cloud-enabled Autonomous Machines be Safe and Secure?
Volvo Exploration Forum 2016
Sept. 9, 2016

Panel members
DNV GL
Panel on Assurance Challenges for Safety-critical Autonomous Systems
ASSURE 2016

FMI
Special Interest Session SIS38 Intelligent Road Weather Applications and Services in Support of ITS. Hosting of SIS38, and acting as one of the panelists in the SIS
ITS European Congress, Glasgow (UK), June 2016

Conferences, Seminars and Workshops' presentations
Ali Balador, Annette Bohm, Elisabeth Uhlemann, Carlos T. Calafate, Juan-Carlos Cano
A Reliable and Efficient Token-Based MAC Protocol for Platooning Applications
12th Swedish National Computer Networking Workshop (SNCNW 2016)
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Ali Balador, Annette Bohm, Carlos T. Calafate, Juan-Carlos Cano
A Reliable Token-Based MAC Protocol for V2V Communication in Urban VANET
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Valencia, Spain, September 2016

Ali Balador
Connected vehicles and C-ITS
Mälardalen University, October 2016

Dag Rognlien
Challenges with using FPGA for Functional Safety
FPGA Forum, Trondheim, February 2017

Elena Lisova, Elisabeth Uhlemann, Johan Åkerberg, Mats Björkman
Delay Attack versus Clock Synchronization – A Time Chase
IEEE International Conference on Industrial Technology (ICIT 2017), March 2017

FMI
Car 2 Car Communication Consortium Forum 2016
Gaydon (UK), October 2016

Hans Hansson
Automation region breakfast seminar on "*Cloud solutions and services-- scientific challenges and progress*"
Västerås, December 2016

Irfan Sljivo, Barbara Gallina, Jan Carlson, Hans Hansson
Configuration-aware Contracts
4th International Workshop on Assurance Cases for Software-intensive Systems (ASSURE2016), September 2016

Jeroen van Lent
Presentation of Master Thesis work: *The impact of team alignment on the innovative potential of European project teams*
Technische Universität Berlin, Centre for Entrepreneurship &, EIT Digital Master School, 2016

Kasper Camillus Jeppesen
Autonomous robots as an enabler for autonomous vehicles
Cluster event on "Disruptive innovation in the mobility sector"
October 2016

Kasper Camillus Jeppesen
Talk and discussion about mobile robots for transport and logistics and the inherent problems herein, e.g. safety.
"Automation and Danish competitiveness" event organized by Omron and held at DTI's Center for Robot Technology
February 2017

Lars Dalgaard
Robots and their usage in storage facilities and hospitals
"Transport- and Logistics-cluster Greater Copenhagen" - Theme: Automation in supply chains
February 2017

M. Santic, L. Pomante, W. Tiberti, C. Centofanti, L. Di Giuseppe
LabSmiling: a framework, composed of a remotely accessible testbed and related SW tools, for analysis and design of low data-rate wireless personal area networks based on IEEE 802.15.4
Conference on Design and Test Automation in Europe (DATE) – University Booth, March 2017.

Nils Müllner, Saifullah Khan, Md Habibur Rahman, Wasif Afzal, Mehrdad Saadatmand
Simulation-Based Safety Testing Brake-By-Wire
1st International Workshop on Testing Extra-Functional Properties and Quality Characteristics of Software Systems (ITEQS2017), March 2017

Omar Jaradat, Iain Bate
Systematic Maintenance of Safety Cases to Reduce Risk
4th International Workshop on Assurance Cases for Software-intensive Systems (ASSURE2016), September 2016

Paul Pop
Safety Systems Engineering
The Nordic Systems Engineering Tour, 2016 http://www.nordic-systems-engineering-tour.com/nose-history/nose-2016/safety-systems-engineering-2/

Quamcom
Presentation of ideas for "Coordinated Emergency Braking"

2017 HH ITE PhD conference

RISE SICS
Seminar "Connected vehicles and C-ITS" at data communication group in Mälardalen University
October 2016

RISE SICS visited and gave a presentation at AstaZero, the world's first full-scale test environment for future road safety
January 2017

Stig Petersen
Safe and Secure Communication
Workshop on Agile Safety hosted by SINTEF, Trondheim, May 2016.

Stig Petersen
Safe Maritime Communication
Maritime Communication Seminar hosted by Norwegian Forum for Autonomous Ships, Trondheim, February 2017

Stephan Baumgart, Joakim Fröberg, Sasikumar Punnekkat
Analyzing Hazards in System-of-Systems: Described in a Quarry Site Automation Contex
IEEE Systems Conference 2017 (Syscon), April 2017

Tran Hung, Hans-jurgen Jepernick
Proactive Attack: A Strategy for Legitimate Eavesdropping
(IEEE ICCE), July 2016

Vegard Evjen Hovstein
Unmanned Vehicle Systems - and how we benefit from the EU programs for research and innovation
Europakonferansen (organized by the EU committee of Norway), Bergen, Norway, October 2016

Posters
RISE SICS
Poster presentation at BMW Summer School in Germany, July 2016

Ali Balador
A Token-Based MAC Protocol for Achieving High Reliability in VANET
BMW Summer School, Lake Tegernsee, Bavaria, Germany, July 2016. http://soda.swedishict.se/6043/

Articles for the general public
The Danish newspaper "Politiken" featured two articles related to self-driving cars based on discussions and inputs from DTI. Some of the problems being addressed in SafeCOP were highlighted and discussed:

- SUPERCOMPUTER: Remembers potholes and shares information with the other cars (Lasse Foghsgaard, DTI reference Thomas Madsen Almdal (THAL)
  January 2017

- This is how a driver-less car sees, hears and feels.
  Lasse Foghsgaard, DTI reference Thomas Madsen Almdal (THAL)

January 2017

Lars Dalgaard
Transport of hospital beds shall be an enabler for autonomous vehicles
DTI biweekly e-newsletter
June 2016

3 EXPLOITATION

Exploitation of SafeCOP results is a fundamental measure to maximize the project impact. According to the project proposal, "the objective of the exploitation phase is to identify and implement the actions necessary to maximize the market value, the business potential and the social benefits for the European Union of the project outcomes". During the first year of project there are only preliminary results which are not directly exploitable. Nevertheless, it is necessary to outline the exploitation strategy which will be implemented during the next years when there will be available more mature results. In particular, in this first year two preparation activities have been executed:

- Develop the **initial business model** hypotheses to generate market value;
- Outline the **exploitation plans** of the consortium participants.

It is worth noticing that new solutions, new architectures and new methodological approaches will be available during the project; the exploitation effort of the whole project consortium is finalized to maximize project results impact and to capitalize such innovative results and knowledge. To reach this goal is crucial to have a detailed strategy already now, at the end of the first year of project. This strategy includes:

- An updated market analysis. It is organized per use case, considering the different topics covered by each use case.
- A reference approach to develop and present a business model for the project outcomes. Such business model follows a common structure for all the use cases but in the future there will be a verticalization of the general structure according to each use case topic.
- A general exploitation plan which is customized for each use case, including industrial, academic and standardization actions.

3.1 MARKET ANALYSIS

3.1.1 Healthcare automation// Use Case 1

a. General description of the market

Hospital beds have to be cleaned thoroughly before each new patient. In most hospitals this cleaning is performed manually - even where the hospital has a Centralized Bed-Washing Facility (CBWF). The reasons for this is mainly that transporting the empty bed to and from the CBWF takes about as long as cleaning the bed manually on the ward; and until recently manual cleaning was considered at least as good as cleaning performed by any available CBWF system. Cleaning beds thoroughly and transporting beds to a CBWF are both tasks demanding hard physical labor and non-ergonomic motions and positions.

There are currently several devices on the market to assist the porter when moving beds. This include "Moving Beds"[1] which was developed in a project between OUH and the company Make-it-Move A/S. The device is a self-propelled machine which the porter steers under one end of the bed and it lifts the bed wheels off the floor and then drives the bed under direct human control. The porter can also ride the device standing on a footplate, but this is only permitted when the bed is

[1] http://www.make-it-move.com/?page_id=19

empty. The device (and bed) can travel at nearly 10km per hour, but normally it is not safe to go even half that fast in public or cluttered corridors.

Similar products include "Hospital Bed Mover" by Master Mover[2], "Gzunda" by Electrodrive[3], and "StaminaLift 5000"[4]. All of these require a person to control them and are designed for beds containing patients. Recently the "Flexbed"[5] was developed, which can navigate itself autonomously around hospitals even with patients on board. These beds are not yet commercially available and are expected to be expensive, even when their safety has been sufficiently verified, which is not yet the case.

The work conducted in association to SafeCOP Use-Case 1 does not target any of the above products. Rather, the work targets a solution that should be usable with ordinary (non-automated) hospital beds. In addition, Use Case 1 targets only transport of empty beds, at this stage.

b. Benefits of cooperative systems for this particular market

The healthcare sector is beginning to use professional service robots for logistics in payload transportation tasks in which the payload is typically relatively small and carried inside the robot (e.g. Aethon's TUG[6]) or fastened directly on the robot in a rigid manner (e.g. MiR100[7]). Since the robot is roughly person-sized, it can navigate almost anywhere that a person can. A typical hospital bed is larger than a one-person bed ("single bed"), designed for homes. Transporting a large and long object is non-trivial, because there is limited space available for maneuvering, for instance in a hospital elevator or in a patient's room. This is further complicated by the presence of static and often fragile obstacles such as chairs and bedside tables, in addition to the potential presence of people, and the relatively small clearance between the bed and the door. Furthermore, hospital corridors are often filled with obstacles such as other beds, trolleys and people, all of which can be static and/or dynamic, and add to complexity of maneuvering and cornering.

Humans are inherently good at maneuvering relatively large objects in tight spaces, but a single mobile robot in a vehicle-and-trailer setup cannot perform this task because efficient maneuvering of a large and long hospital bed requires detailed control of both ends of the bed. One solution is to add electronics to each bed, but this becomes expensive and also causes problems for automated CBWF, since electronic components are fragile to both physical action and water. Removable electronics such as autonomous (small) robots are a better solution. Since all four bed corners must be tightly controlled, a cooperative multi-robot logistics system is necessary, providing complementary pulling and pushing forces at both bed ends, because of the greater degree of maneuverability that such a setup offers, especially when reversing. A pair of robots linked by a long and rigid bed need to move in perfect synchrony, even assuming that some compliance is built into the joints. For this reason the guaranteed wireless communication of SafeCOP is necessary, to ensure that a wireless signal that is sent will actually arrive in the right timescale, while guaranteeing its reliability without interfering with hospital equipment.

c. Description of the use case and its market impact

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[2] http://www.mastermover.com/product-groups/healthcare/bm185-hospital-bed-mover
[3] http://www.electrodrive.com.au/products/patient-moving/gzunda-gz10.aspx
[4] http://staminalift.com/transfer_solutions/ts5000_transfer_system/
[5] Wang, Chingyue, et al. "An Intelligent Robotic Hospital Bed for Safe Transportation of Critical Neurosurgery Patients Along Crowded Hospital Corridors." (2014).
[6] http://www.aethon.com/tug/benefits/
[7] http://mobile-industrial-robots.com/en/

Automated CWBFs exist in many hospitals, including OUH. However, these are normally only used when a bed has been contaminated with blood or vomit. Otherwise, the bed is washed manually in place in the patient rooms. This takes about 15 minutes per bed for a thorough wash. Taking a bed from the ward to the CBWF takes about 6 minutes each way on average, and beds washed by the current CBWF still have to be finished off manually (the machine does not reach into very narrow spaces and does not dry the beds adequately). The time required for staff to take one empty bed to and from the CBWF is therefore about the same as the time required for a manual washing.

Currently, about 160 beds are washed daily at OUH, each taking 15 minutes on average to wash. If all beds are washed manually, this corresponds to 5.4 full-time equivalent staff positions, simply to cover the washing time. If all beds where to be washed at the CBWF, an additional 4.3 full-time equivalent staff positions are required to cover the transit time of the beds to and from the CWBF. For these reasons, the CBWF is presently and underutilized, albeit expensive resource. This, combined with a general desire and tendency of introducing automation to reduce costs, entails that OUH is very interested in an automated solution.

The final automated system resulting from the proposed scenario of SafeCOP Use Case 1 would significantly reduce the manual effort required for transporting beds to and from the CBWF. Further, since the automated nature of the CBWF is utilized, the manual time used for washing the beds is also significantly reduced. The remaining manual overhead is thus mainly related to cleaning the parts of the bed missed by the CBWF, and drying off the bed. In relation to the manual effort required to compensate for the insufficient CBWF wash, it has been pointed out that although the first CBWF at OUH did not wash the beds as well as a trained person, the newer ones are more effective and provide an acceptable, and even cleaning.

According to Eurostat, there were 526 beds per 100,000 inhabitants in the EU-28 in 2013[8], and 508 million people in the EU in 2015, if each of these beds is washed only once per week, the EU-wide market in autonomous hospital bed transport is significant. This suggests over 2.6 million hospital beds, and over 25 million worldwide, providing the market basis of Use Case 1. Importantly, as hospital stays become shorter, bed washing (which is essential before each new patient) becomes more frequent, thus adding to the potential of the use case.

Proposed Scenario

In Use Case 1 we propose a scenario where a patient is discharged from hospital. Current system, assuming use of the CBWF: When the patient leaves, their empty bed is taken to the CBWF, where the dirty linen is stripped off and sent to the laundry, the mattress is removed and the bed carefully slotted into the CBWF machine. The machine is started and cleans the bed. The service assistant (porter/cleaner) cleans and dries the bits that the machine does not reach, and fetches a clean mattress. When the clean bed is dry and its floor space in the ward has been cleaned, the bed is taken back up to the ward ready for the next patient.

Immediately after SafeCOP:

SafeCOP will have no direct effect on OUH procedures, since the SafeCOP demonstrator will not be a fully functional TRL9 system, but just a stage on the way to that goal. SafeCOP will provide a set of fundamental technology components to enable this.

Final automated system (after SafeCOP and further development of the system):

[8] http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tps00046&plugin=1

When the patient leaves, two small mobile robots bring a clean and made hospital bed up to the ward and take the dirty bed to the CBWF. There the linen is stripped off and sent to the laundry, the mattress removed and the bed fed into the CBWF machine by the robots. The small mobile robots then go through the robot cleaning facility and collect a clean and potentially made up bed for the next empty space. A hospital bed is already large and expensive. Adding robotic elements to each bed adds to the expense, and an alternative of moving the beds using a large robot adds to the size, which causes problems guaranteeing safe and robust maneuverability in the hospital environment and makes the system unable to use many hospital lifts.

A system of small robots is the answer, however, a pair of robots linked by a long and rigid bed need to move in perfect synchrony, even assuming that some compliance is built into the joints. For this reason the guaranteed wireless communication of SafeCOP is necessary. In this line, SafeCOP will develop a communication system that will allow our pair of robots to communicate with each other reliably and robustly without interfering with hospital equipment. Also, small robots which are partially under a bed have a very restricted field of view. The presence of people in the environment means that following a map is not sufficient, full-scale perception of the current location of each nearby person is needed and some prediction of their movement is desirable. Therefore this demonstrator includes a network of inexpensive cameras at each doorway and at intervals along the corridors. The cameras act as remote eyes, allowing the robots to maneuver in restricted spaces and keep out of peoples' way.

The WP5 hospital bed demonstrator will implement the SafeCOP system onto a pair of robots in V2V communication and onto a set of low-cost wireless distributed vision modules able to provide sufficient I2V safety coverage for the robot-bed-robot train, and demonstrate coordinated bed movement in a realistic lab environment and later in the real hospital environment of OUH.

We expect SafeCOP to go only part way towards making an automated bed mover. We will learn more about what is needed for such an automated system to be possible, which we will use in follow-up projects where the automatic bed-mover is more central to the project itself. We will study the specifications for the new OUH building and ensure that they are sufficient to support automated bed-moving.

The impact of a functioning TRL9 system able to transport beds to an automated central washing system would be very significant. Different types of impact are envisaged:

1. Staff savings.
   Saving the 15 minutes per bed x 160 beds per day, so 40 hours per day or 5.4 full-time staff. The current system uses service assistants to strip and make up the bed, and to move the bed up and down the ward. The porter time that would be spent moving the beds from wards to the CBWF and back in OUH is similar - about 32 hours, also 100km per day, even if they never walk the route without a bed. In SafeCOP we replace on-ward cleaning time with bed transport time -- but fully automated, not using staff.
2. Reduction in staff muscular strain injuries caused by working in non-ergonomic ways.
   Much of the cleaning takes place in non-ergonomic positions and staff get bio-muscular injuries that result in sick leave. Switching the cleaning-on-ward for portering does not make much difference - both are hard on certain muscle groups. On the other hand, moving the

beds about (porters pushing them) can also result in back injuries[9]. An automated system would promote a reduction in sick leave, along with associated costs of cover or temporary ward closures due to understaffing.

3. Reduction in staff exposure to pathogens.
   Regulations state that the bed has to be cleaned because of the possibility of transmitting disease from one patient to the next - but pathogens can also be transmitted to the cleaner
4. Reduction in hospital-borne infections by not stripping beds in the ward.
   Changing bedlinen causes air currents, lifting pathogens into the air where they can more easily infect both staff and patients.
5. Improvement in the environment on the ward by removing the bed-cleaning from the patient rooms, reducing patient and staff exposure to residues from cleaning chemicals.
6. Potential improvements in bed cleanliness.
   Currently the CBWF does not clean as well as the OUH service assistants, since it misses the narrow spaces and does not dry the bed properly. However, CBWF technology can be expected to improve in the future. Also, the fragile nature of the electronics in the beds currently mean that the CBWF is restricted to using gentle cleaning techniques similar to those used by people. This may also change in the future. See DTI's cLEAN BED project[10].
7. Potential savings in water and cleaning chemicals.
   Economy of scale means that the central facilities can be better equipped for water/detergent/heat recycling than happens on the ward, thus using less than a human cleaner. This is not true for currently-available CBWF, but they are also improving.

Improvement in overall bed cleanliness will not happen with OUH's current CBWF - the manual system is currently better than the automated system which has difficulty getting into narrow spaces and in drying the bed properly after cleaning. However, automated bed-cleaning systems will improve. Notice, that for instance, the automated system can reach under the beds better than a person, and can itself tolerate higher temperatures and harsher chemicals, however, current normal hospital beds include delicate electronics e.g. for raising and lowering the bed. SafeCOP does not tackle bed cleaning, but OUH already has the bed-cleaning facility, and just needs to be able to get the beds there cheaply and reliably in order to use it.

3.1.2 Maritime Application Domain // Use Case 2

a. General description of the market

The volume of international seaborne trade has been "increasing by 4.3 per cent annually". "The performance of international seaborne trade remains, nevertheless, vulnerable to downside risks as well as the uncertainty affecting the world economy and trade." [UNCTAD, Review of Maritime Transport, 2013] The fleet rates remain low due to oversupply and new shipbuilding, which reached historical highs in 2012. The main countries building ships are China, the Republic of Korea and Japan, which together built 92 per cent of the world's new tonnage (GT) in 2012, with China alone accounting for more than 40 per cent. Shipyards from the European countries and other countries had a somewhat higher share among the offshore structures (e.g., offshore windmills or Oil&Gas offshore exploration and exploitation structures), offshore supply and passenger vessels. These are considered to be complex and highly technological vessels.

[9] Applied Ergonomics, Volume 45, Issue 4, July 2014, Pages 849–856 "Effectiveness of powered hospital bed movers for reducing physiological strain and back muscle activation" by Nathan Daniell, Simon Merrett, Gunther Paul. DOI: 10.1016/j.apergo.2013.11.001

[10] DTI's cLEAN BED project, Online, http://www.dti.dk/projects/project-clean-bed/32892

The economies of EU and EEA countries need to maintain and increase their market share in building technologically advanced ships. Some of the EU and EEA countries, like Finland and Norway, intend to change their flag regulations in order to allow use of autonomous ships in their territorial waters. This can have a positive effect on multiple industries. The market acceptance of autonomous systems in the maritime domain is low; most of the contracted systems are for the military and for oil & gas companies.

b. Benefits of cooperative systems for this particular market

Keddie [KEDDIE, I. (2012), Analysis: UMVs set on course for naval service, Jane's Defence Weekly 1 March-2012, HIS Global Ltd] reports that the market for unmanned or autonomous marine vessels and systems has increased by 43% between 2008 and 2011, and the trend is predicted to continue as the demand for such systems increases. A boat-autopilot which is capable of automatically identifying surrounding obstacles, can provide reliable information when changing a predefined route (medium-term actions) or can engage in automatic emergency avoidance maneuvers (short-term actions), to help increase navigation safety; the IMO (International Maritime Organization) reported that more than 75% of ship accidents worldwide were due to human error. However, to enable this degree of automation, it will increasingly be necessary to ensure that the automation, command and control are safe. SafeCOP brings an important development in this area.

The introduction of fully maritime UAVs – launched and operated from a boat and also landing on a boat or a ship –, increases the reliability and security of systems that benefit from mixed sea/air operations. Furthermore, once this system has been proven on the market, it may be applied to new domains, such as commercial aviation, fishing and other maritime use cases, mitigating failures resulting from human error. SafeCOP components are of the upmost importance to support this, guaranteeing a resilience to external attacks.

Developing greater levels of automation and the ability of autonomous vehicles to collaborate and cooperate in a flexible manner to implement critical safety and security rules will thus improve in the safety and security of maritime activities in many application fields. In this context, we will prototype SafeCOP methods to perform "incremental" certification of ships and offshore structures, according to DNV Class Rules and international safety standards respectively.

Autonomous, intelligent technologies can contribute to safer, greener and more efficient operations at sea, and have the potential to assist or free humans from:

1. Activities that are too lengthy are repetitive, and where humans may make mistakes out of boredom. Examples include deep sea navigation with very rare encounters of other traffic; general inspection rounds; continuous monitoring.
2. Activities in remote environments where direct human control is infeasible or very expensive. Space and subsea are good examples. But arctic environments may also pose prime applications.
3. Activities in hostile environments. Examples include subsea operation (high water pressure); fires; nuclear radiation; explosive risks; etc.
4. Activities in dirty environments. Examples are oily spaces, double bottoms, etc.

c. Description of the use case and its market impact

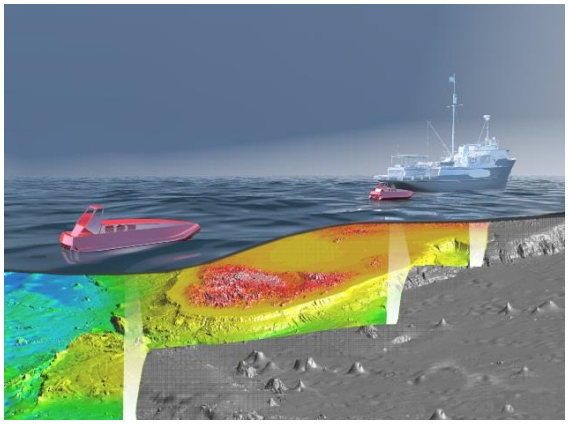
In this use case, (semi-) autonomous vessels and other vehicles cooperate to perform bathymetry measurements for a portion of the Trondheims fjord, an inlet of the Norwegian Sea, in Norway. The methods and tools in the SafeCOP project will be applied on proof-of-concept autonomous vessels, which are capable of collecting sensor data, identifying obstacles, providing reliable information to change of a predefined route (medium-term actions) or to engage emergency avoidance manoeuvres

(short-term actions).

Proposed Scenario

In the use case, we will evaluate technology to perform collaborative collection of bathymetry data from multiple (most likely two) Unmanned Surface Vehicles, in cooperation with a manned survey vessel. The test system will be installed on the MAROB Unmanned Surface Vehicles with multibeam echo-sounder installed in a moonpool internally in the USV. One of the vessels Maritime Robotics Mariner USV is a 5.80 meter multipurpose boat with about 50h endurance in 5kts, and can be monitored/controlled by a human operator using the Vehicle Control Station (VCS). The main communication systems for the USVs are VHF and C-band link systems, additional 3rd party carrier based systems can be integrated, such as GPRS and Iridium. The vehicles will exchange coordination information, such as status of the task, task updates, task changes, direction changes, and detected surrounding objects, in sum, all types of information that can affect the completion of the task or the safety of the boats. This use case requires 2 USVs equipped with bathymetry measurements equipment and a manned survey vessel.

The boats will cover an area of interest that needs seabed mapping, and will calculate an optimal path (considering fuel cost and time) to perform the measurements. One of the vehicles will assume the role of group leader and it will coordinate the task. In a collaborative bathymetry task, it is important that the measurements of the bathymetry sensors of the boats overlap with a certain percentage. The boats need to maintain a minimum distance between them in order to make the sensor footprint have the correct overlap. Also in case of encounters with obstacles along the route (e.g., buoys or boats), it is essential that the USVs share information among the units in the platoon, to ensure safe navigation in accordance with the set of rules at sea (COLREGs).



Cooperative platoon collecting bathymetry data

The technology from SafeCOP will be used to secure that the multiple autonomous vehicles collaborate by using wireless communication in a safe manner during the mission of collection of data. This use case is becoming increasingly relevant, since in oceanography, unmanned surface vessels (USVs) gain rapidly in popularity. There are many advantages in using USVs for oceanographic data gathering:

1. The USVs operate at very low speed. This allows long endurance. If renewable energies (solar, wind or wave power) are used, autonomous vessels may operate for years uninterrupted on a mission.
2. The low speeds of oceanographic robots mean also very low noise operation. This is advantageous in acoustic measurements and to avoid disrupting echo-locating mammals such as dolphins.

3. There are negligible operational costs. It is now much cheaper to use a robot to gather data than to employ a manned ship to be at sea for months at time.
4. Swarms of robots at sea allow real-time data transmission which is important in many metro-oceanographic applications.

One advantage of small autonomous robots is the ability to form swarms. Autonomous underwater and surface vessels have stimulated progress on cooperative (swarm) marine robotics. Here cooperation may be intended in different ways, from simply having different vessels pursuing related preplanned missions in different areas, to interaction among the vessels during the mission (for instance, to avoid repeated sampling or exploration at the same location by different vessels), to strict formation control, the strongest form of cooperation.

3.1.3 Vehicles platoon // Use Case 3

The number of vehicles in operation in the world broke the 1 billion barrier in 2010 and by 2020 it is expected to be between 1.3 and 1.5 billion vehicles. This rate of growth translates into a need for vehicle manufacturers and their suppliers to manage costs using common global platforms and looking to produce more units per platform – either vehicle platforms, embedded software or ECUs.

According to the European Automobile Manufacturers Association, there is a total 12.2 million people employed which accounts to 5.6% of total EU employment; 16 million passenger cars were produced in 2015, accounting for 22% of global passenger car production. The trade balance of the automotive industry accounted for EUR 100.4 billion in 2015.

Embedded software in the automotive market has been growing exponentially in the last years. Most vehicles today have more than 100 million lines of software code powering their navigation, infotainment and communications features, as well as their advanced fuel management, braking and drive train technologies. This is a much larger number of Lines of Codes (LOCs) than found in other transport industries: for example, an F-22 Raptor has around 1.7 million LOCs, and the new Boeing 787 has around 6.5 million LOCs.

Today most automotive systems still operates autonomously with services provided through multiple ECUs connected with in-vehicle networks. However mechanical backup systems still exist, thus the basic functions of a car are preserved even if an electronic system fails.

However, the current trends in the automotive embedded software market are based on the use of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I), commonly known as V2x, and in the fact that mechanical systems will be replaced by ECUs, thus implementing true automotive by-wire systems.

It is expected that V2x communication technology will be used not only for infotainment and comfort functions, but also safety critical applications. Examples of these are vehicle-platooning, control of autonomous vehicles and active safety functions. In all these applications, input to control the vehicle may originate or be heavily influenced by an outside source.

Roll out of V2x communication in road vehicles will happen in the coming years. The OEMs in Car-to-Car consortium (including VAG, Volvo Group and Volvo Cars) signed a memorandum of understanding on “Deployment of C-ITS” in 2012 with the intention to start roll-out C-ITS equipped vehicles by 2015 in Europe. In the United States of America, the National Highway Traffic Safety Administration (NHSTA) announced in February 2014 a coming agency decision to make connected vehicle technologies mandatory in light vehicles. Decision for heavy vehicles is also anticipated. These two facts imply that there is a large need for services and suppliers with competence in this area, to tackle issues like:

1. Safety: a failure of an automotive electronic system or ECU may be life-critical;

2. Increasing development cost and time;
3. How to achieve high Reliability and Safety with acceptable costs?
4. How to effectively reuse existing software?

On the other hand, and according to a June 2014 Gartner survey of over 6,000 consumers, *nearly two-fifths of U.S. and German vehicle owners are interested in purchasing a fully or partially autonomous vehicle the next time they shop for a vehicle*. The same report highlights that by 2025, *vehicle-to-vehicle and vehicle-to-infrastructure communication will be available in approximately 30 percent of passenger vehicles in use in mature markets, which will increase the reliability and accelerate the rollout of autonomous vehicles. By 2030, autonomous-driving-capable vehicles will represent approximately 25 percent of the passenger vehicle population in use in mature markets*.

Morgan Stanley in the study "Autonomous Cars: Self-Driving the New Auto Industry Paradigm" (November 6th, 2013) estimated that the cost savings in the USA due to automated driving, as follows:

- *Fuel savings: US$ 158 billion per year.*
- *Accident savings (including injuries and fatalities): US$563 billion per year.*
- *Productivity gains (ability to work in cars): US$422 billion per year.*
- *Congestion savings: US$149 billion per year.*

Performing a simple calculation by comparing the EU gross domestic product with the one of the USA, the total cost savings in Europe can be estimated in the range from 1300 to 2000 billion euros.

3.1.4 Vehicles and roadside units interaction // Use Case 4

Weather services are common part of everyday life; one can collect weather information from television, radio, newspapers and from various Internet weather service portals, among others. The term "road weather service" refers here to a somewhat more focused type of weather service. This special type of weather service is delivered directly to the vehicles and aims to provide up-to-date information related to local road weather phenomena, therefore being more advanced than general weather data and subject to extra benefits. The services delivered to vehicles needs to be wireless in nature, and therefore they also incur extra costs as requiring advantageous communication methodologies.

The general road weather service markets are closely related to the automotive markets described in the previous use case overview. In addition, road weather information can be partially exploited also by vehicle passengers, both public and private transport passengers. Therefore, the market potential is even wider than general automotive market.

One clear difference for the automotive markets is that a typical vehicle or vehicle passenger is not ready to spend too much money (if any) to the road weather services. Therefore the direct cost-based service providing will not necessarily produce large market volumes. However, the road weather service is closely related to the public safety and public service provision, and therefore the group of potential customers and high-level investors can be expanded to include national and international governments and other public bodies.

In vehicular networking the method which would satisfy the security demands of the car industry has not been found yet, regardless of intensive research continued over almost a decade. Vehicle manufacturers state their interest in common networking systems if the security and capacity demands can be fulfilled, but recent activities focus more towards commercial cellular networking systems. However, the local area networking approach contains several advantages (e.g., instant

data delivery, operator-free communication) making it valuable as a commercial solution if only the appropriate solution in terms of security and capacity is promoted.

Vehicle manufacturers are the primary players as they possess the vehicle data and generally limit equipment deployment in the vehicles. Currently Daimler, Volkswagen group and BMW seem to have the most advanced systematic research activities, but also other manufacturers like Toyota group and Volvo are promoting specific advanced systems related to vehicular communication. The Ford motor company has even published an open development platform for vehicle data exploitation, but with limited success in terms of global interest. Electric vehicles, as well as automated car developers have straightforward linkage to vehicular networking and sensing, therefore very potential adapters of this kind of services and systems. In this sector, Google, Apple and Tesla are worth noting, along with the "traditional" vehicle manufacturers listed above. Device manufacturers such as Bosch and service providers near to vehicle manufacturers are representing the next level of players, followed by general device and software manufacturers.

3.1.5 V2I cooperation for traffic management // Use Case 5

On November the 30th European Commission adopted a European Strategy on Cooperative Intelligent Transport Systems (C-ITS). This decision represents a milestone initiative which paves the way to a new cooperative and connected mobility. As a matter of fact the objective of this strategy is to allow for a wide-scale commercial deployment of C-ITS as of 2019.

C-ITS will have a disruptive impact on the mobility of the future. They will allow road users and traffic managers to coordinate their actions in order to improve road safety, traffic efficiency and comfort of driving, fostering the diffusion of future automated vehicles.

A common list of priorities has been proposed in the aforementioned strategy. It consists of a list of technologically mature C-ITS services quickly deployable. They are called *"Day 1 and Day 1.5 C-ITS services"* and they will have a significant market impact. In fact, a benefit cost ratio of up to 3 to 1 based on cumulative costs and benefits is forecasted from 2018 to 2030. This means that every euro invested in Day 1 C-ITS services should generate up to three euro in benefits[11]. Moreover according to a European Commission Fact Sheet[12] "the market potential of cooperative, connected and automated driving is estimated to be worth dozens of billions of euro annually and to lead to the creation of many new jobs". As a consequence, C-ITS deployment is a priority also in several Member States. The most important example of ongoing activities is represented by the EU cooperative corridor which is the results of a strategic partnership between Netherlands, Germany and Austria. Thanks to this initiative C-ITS solutions can be tested and evaluated under real traffic conditions in the highway that links Rotterdam to Frankfurt and Vienna[13].

Also stakeholders have positive expectations about C-ITS services. In particular, as reported in a poll[14] conducted by the European Community ("Deployment of C-ITS in Europe: Analysis of responses to the public consultation - October 2016") *"a majority of stakeholders feel that C-ITS deployment would have a positive impact, with increasing road safety generating the most positive response among stakeholders (72% responding 'very positive' and 23% responding 'positive'), followed by: reducing congestion (38% responding 'very positive' and 50% responding 'positive'), increasing the competitiveness of the European automotive industry (31% responding 'very positive' and 43%*

[11] http://ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v5.pdf
[12] http://europa.eu/rapid/press-release_MEMO-16-3933_en.htm
[13] http://c-its-korridor.de/?menuId=1&sp=en
[14] http://ec.europa.eu/transport/sites/transport/files/2016-c-its-deployment-study-public-consultation.pdf

responding 'positive'), and facilitating multimodal transport (26% responding 'very positive' and 40% responding 'positive')".

More in detail, considering the UC focus, actual "dummy" traffic lights have to be innovated in order to increase safety and reduce congestion. In fact, it is projected that over 10% of time spent driving is wasted in traffic jam, 12% of urban traffic is created by vehicles looking to park, and up to 17% of urban fuel is wasted at traffic lights when there is no cross-traffic. With vehicles connected together and connected with roadside infrastructure, all of these problems can be mitigated.

Despite all the positive consideration expressed above security aspects can limit the diffusion and the adoption of C-ITS services. According to a poll conducted by UMTRI in USA, UK and Australia, at least 30% of interviewed are *'very concerned'* about security issues and data privacy, while another 37% are *'moderately concerned'* even if they agree in C-ITS usefulness, in terms of improved safety and traffic management. A twofold strategy is necessary to overcome this diffidence: standardization procedure to certify safety and security of C-ITS and a whole set of showcases and pilots to show the new developed services fostering their diffusion and consequently increasing stakeholders and consumers trust. Additionally, automotive market needs an effective business plans to capitalize the innovative ideas which arise from the research projects (including SafeCOP) regarding the C-ITS. These plans are targeted to identify the parties that will primarily benefit from vehicle communications and to define the exploitation actions for revenue generation.

C-ITS are also crucial to increase the safety of future autonomous vehicles and their integration in the transport system. They will play a key role also in the next future, when will be necessary to handle a transition period in which autonomous vehicles will coexist with the human driven vehicles. Moreover autonomous vehicles are available already now and they are rapidly crowing and improving in the correct direction to approach the commercial maturity. They may constitute a reality in the next decades as Google, Nissan, and other companies expect that by 2020 cars on the market will be completely driverless in many situations. All the aforementioned considerations show the market size of the C-ITS. It is possible to easily extend this analysis to whole field of the V2X communications.

3.1.6 General principles// Use Case 6

UC6 is of a different character than the other UCs as it is on a more conceptual level and does not aim for or target any product. For this reason, neither market analysis neither exploitation activities are planned. In fact the aim of this use case is an integrated demonstration of (selected) technical aspects in WPs 2-4 in the context of a simulated platooning scenario (or multiple scenarios) i.e., the focus is on demonstrating the mutual benefits of integrating a broad range of technical results in a single application; albeit on abstracted more conceptual level. This will provide complementary insights to those obtained in the other more concrete Use Cases. Current efforts are focusing on establishing the simulation environment and on identifying the scenario(s) to be simulated, as well as the forthcoming technical work that will be demonstrated.

3.2 Business Models

The SafeCOP partners have outlined a preliminary strategy for the preparation of a business model in the next year of project. Such strategy will drive both the joint and the individual activities of the project and will identify a specific business model with respect to each use case. The business model further identifies the revenue streams and stakeholders to be targeted as part of the project's exploitation activities. The business model of the project is reflected in the "Business Model Canvas" depicted in the following Table 1. This model summarizes identified exploitation opportunities at proposal stage, bringing together the overall offering, stakeholders, and distribution channels. The

table further summarizes costs and possible revenue sources. As the business model shows, and as is clear from the exploitation plans provided below for each project partner, exploitation does not only encompass direct commercial opportunities, but also increased skills and knowledge to strengthen the capabilities of the partners, as well as internal exploitation, consultancy, and, not least, training and Intellectual Properties exploitation (reference design, patents, trademarks, brands, copyrights).

Within SafeCOP, a Business Plan will be a general framework for the exploitation of the results of the project to support the actions that bridge the developed innovation into the market. Such a framework should be considered very preliminary. Moreover, for the technologies developed, there will be different markets and different approaches.

SafeCOP will investigate and develop a reference architecture for cooperative cyber physical system, that will be a common solution for all application domains and will also develop very specific solutions to solve problems and issues in vertical scenarios (healthcare, maritime, automotive, traffic and road infrastructure). Also these solutions *should* fit into complex ecosystems of other technologies and should adapt not only from a technical point to other technological components but should also consider other customers and business requirements to have a chance of success

During the second year of project will be defined the preliminary business models that address the specific sectors of the different use cases and provide a reference framework for the activities of dissemination, communication, exploitation and even standardization within the vertical domains at a global level (i.e. addressing a common market). In more detail, dissemination activities are oriented to increase the awareness of the project results to various groups of interested stakeholders. Communication activities are aimed at providing tools to facilitate the cooperation within the consortium but also at establishing international cooperation. Exploitation activities will pave the way to achieve market value using the innovation results produced by the project. Finally, standardization activities will be conducted to maximize impact through the establishment of appropriate standards.

For each use case the business model will be organized as follow. First a table is introduced to give a general overview of the key aspects composing the business model. Then each aspect is detailed to provide a full explanation of the model. The table and the detailed descriptions will be filled in the next deliverable that will be released at the end of the second year of the project.

<table>
<tr><td rowspan="2">Key Partners</td><td>Key Activities</td><td rowspan="2">Value Proposition</td><td>Stakeholders</td><td rowspan="2">Customers Archetypes</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td colspan="2">Pricing Model // Cost Structure</td><td>Positioning</td><td colspan="2">Revenue Streams</td></tr>
</table>

Table 1 - Template of the Business Model table for each use case

3.3 GLOBAL EXPLOITATION PLAN

A general exploitation strategy is described in this chapter, listing the pillar activities for an effective exploitation strategy. These actions are grouped considering which are the focus of partner,

industrial, academia and standardization, which will implement them. In the next chapter is reported the description of how to put in practice the general strategy, in each use case of the project. The actions reported for each use case are taken from the proposal, with an update, considering the work done in the first year of the project. It is worth noticing that such exploitation actions will be carried out in the final phases of the project and after its conclusion. In this first year of project the exploitation effort is mainly focused on the definition of a common strategy, verticalized for each use case, which will be applied in the following months of the project.

The general exploitation strategy is provided in Table 2. Action are grouped as Industrial Exploitation (IE), Standardization Exploitation (SE) and Academic Exploitation 1 (AE).

Industrial exploitation (IE)	Standardization exploitation (SE)	Academic exploitation (AE)
IE1 - Mature demonstrators close to market by increasing its TRL	SE1 - Establishment of a dialogue and cooperation, with standardization bodies and certification authorities	AE1 - Creation of spin-off and startup focused on the project topics.
IE2 - Development of new products and services starting from project results	SE2 - Definition and proposition of new safety standards and certification procedures based on project results.	AE2 - Perform technological transfer to industries concerning project topics
IE3 - Application of project results to existing products and services to improve them		AE3 - Include new courses and subjects to teaching program
IE4 - Application of project results, to reduce the costs to develop products and services.		
IE5 – Diffusion of project results to consolidate or and/or create new relationships and partnership.		

Table 2 - General Exploitation strategy

3.3.1 Industrial Exploitation actions

- IE1 - Mature demonstrators close to market by increasing its TRL: each demonstrator developed during the project will be a complete system, tested in a real but controlled environment. It is clear that neither of them will be ready to be commercialized. As a consequence this action could represent a good opportunity to evolve them, increasing their TRL and bringing them closer to the market.
- IE2 - Development of new products and services starting from project results: for industrial partners this could be a precious competitive opportunity to be able to offer their customers, new products and services developed during the project or just after its conclusion, applying the new technologies developed.
- IE3 - Application of project results to existing products and services to improve them: several methodologies, approaches and solutions will be available at the end of the project. Including them in already available productions could represent a very concrete exploitation opportunity for the industrial partners. In this way they are able to improve and renew such products.

- IE4 - Application of project results, to reduce the costs to develop products and services: applying the project solutions and technologies, as well as the standardization and certification procedures in the development process of products and services will be possible to reduce their costs. This represents a great exploitation possibility for industrial partners.
- IE5 – Diffusion of project results to consolidate or and/or create new relationships and partnership: these actions represent a crucial step for each industrial partner to strengthen its position on market for the specific area of interest. As a matter of fact, thanks to the knowledge and the experiences gained during the project, but also thanks to the project outcomes, each partner could retrieve an advantage position with respect to their competitors, increasing its reputation and consequently attract more customers. To capitalize this advantageous position it is crucial for all industrial partners to create or consolidate partnerships, connecting together other partners, stakeholders and end-users, creating a framework where each subject involved could benefit. Typically this action is performed by grouping partners according to the use case they are associated to. Furthermore, to foster this process, partners have to establish partnerships in particular with key players with complementary competences to avoid to overlap their roles and to maximize the benefits deriving from their integration.

3.3.2 Standardization Exploitation actions

- SE1 - Establishment of a dialogue and cooperation, with standardization bodies and certification authorities: a fruitful partnership with standardization bodies and authorities can increase the visibility and the prestige of the project partners. This relationship can facilitate the participation in the definition of new standards, which represents for both industrial and academic partners another important exploitation action, as reported below.
- SE2 - Definition and proposition of new safety standards and certification procedures based on project results: it is quite similar with respect to the previous exploitation opportunity, considering also that proposing a new standard or certification procedure is a good way to promote and disseminate the project results and foster its adoption by stakeholders and end user, attracting new customers.

3.3.3 Academic Exploitation actions

- AE1 - Creation of spin-off and startup focused on the project topics: an important source of funding for academic partners is the creation of spin-off companies. The experiences derived from this project can provide to startups the methodology, the artifacts and the products necessary to move into new markets with greater confidence.
- AE2 - Perform technological transfer to industries concerning project topics: this represents a win-win opportunity of cooperation between academia and industry. The first one could benefit of the partnership with a commercial and business oriented actor while the second one could obtain research results to be applied in its product. Moreover the organization of thematic workshops specifically targeted to the industries fall in this group of actions.
- AE3 - Include new courses and subjects to teaching program: in particular the project topic, focused on safety assurance and standardization is a hot topic that could be included in several new university and Master courses

3.4 EXPLOITATION PLANS PER USE CASE

The general approach of this project is the definition of innovative safety insurance procedures and certifications and their applications to heterogeneous use cases. Starting from the general

exploitation pillars exposed in the previous chapter, those actions are applied to the specific use cases.

3.4.1 Healthcare automation// Use Case 1

IE1: Application for follow up funding to mature demonstrators close to market

As reported in the project proposal, the partner involved in the UC1, intend to apply to new project proposals, starting from the UC1 outcomes. As a matter of fact the hospital bed demonstrator will be developed to about TRL6. It will be a complete system which could be tested in a real hospital environment. Nevertheless it will not yet be mature enough to be commercialized. The best exploitation opportunity for the UC1 participants is to apply for follow-up funding to mature the demonstrator closer to market. To put in practice this strategy, during the project will be crucial to define which are the components of the demonstrator that needs to be improved to reach the desired TRL. Consequently it will be necessary to identify the calls to which apply (i.e. Eurostars, more general EU funding like ICT-Robotics or national funding opportunities, as suggested in the proposal) to improve such components. Moreover, currently the project is at the end of the first year and it is too early to have a precise and detailed answer to both issues. These issues will be deeply considered in the following phases of the project, when the demonstrator will be more concrete and its development will be ongoing.

IE 2: Develop of new solutions for customers starting from project results

Considering the definition of new products, the UC1 participants have to identify which are the main exploitable opportunities (ExO), arising from the demonstrator. At the same time, it is crucial to establish where to apply the UC1 results to obtain a significant technical improvement and/or commercial revenue. As suggested in the proposal, such ExO and their possible target products are the following:

Exploitation Opportunities	**Target Products and Revenues**
Robust local motion planning and global path planning system for safe multi-robot cooperative payload transportation	This will be used in a wide variety of future solutions, e.g. collaborative robot transportation of large bulky objects, for instance, wooden planks or glass windows.
Low-cost wireless distributed vision modules able to provide sufficient safety coverage for the robot-bed-robot train	This will be used by in various kinds of mobile logistic robot scenarios, for example reverse parking a mobile robot with a trailer against a wall on a factory floor – here helping to avoid collision with people hidden behind the trailer and out of the robots sensor range – and in other industrial contexts where cheap safety coverage is required
A method for system design of the robot-sensor infrastructure leading to safe and robust integrated solutions	This will be used to strengthen commercial consultancy activities helping mainly Danish SMEs realize robust collaborative mobile robot solutions

To foster the above ExO for each of them a business plan will be developed already during project runtime. More details concerning such products will be available during the project and in the first period after its conclusion.

IE5: Involvement of new customer, stakeholders and end-users and consolidation of already existing relationships and partnerships.

UC1 partners planned to attract new customers, stakeholders and end-users, individually or cooperating together, benefiting of the consolidation of strategic partnership. As highlighted in the proposal, the following actions are planned, expecting the following benefits for the participants to UC1.

Planned actions	Target benefits
During the project runtime DTI expects to develop solutions applying SafeCOP knowledge and results	Attract at least 5 industrial customers and at least 3 hospital customers
Maximum 1 year after project completion DTI will have used each of the ExO reported in the previous table in developing solutions and products	Attract industrial customers or being itself part of consortium for other projects
Exploitation of the demonstrator developed by and of the knowledge and experiences gained by DTI working on the use case	Consolidation of DTI position as one of Europe's foremost robotics innovators, strengthening of its link with the healthcare market and its leading position in hospital logistics using mobile robots
Commercialization by DTI, of low-cost wireless distributed vision modules, defined during the project.	Get heterogeneous customers which could be attracted during the project and after its conclusion
TEC will propose the SafeCOP demonstrator as a reference system to showcase to potential clients	Increasing of TEC's reputation as a good system integrator for mobile robot solutions Participation to the construction of the six new "super hospitals" in Denmark.
Establishment of strategic partnership between DTI, TEC: • TEC is one of their retailers and solution integrators. • DTI provides the necessary expertise to TEC on robotics, sensors, electronics, control, and software	This setup creates a win-win situation for all partners and ultimately leads to more mobile robot systems installed in Danish (and European) industry and health care sectors

The exploitation plan and the operations included in the proposal and here reported, has to be put in practice, also in this initial period of the project. Strategic partnership with other partners and relations with customers and stakeholders have to be consolidated already during the project, identifying which are the subject to be involved, as a first preliminary step. As for the previous exploitation actions, a more precise and detailed plan will be available starting from the end of the second year of the project, when demonstrator components and preliminary results will be available.

AE2: Perform technological transfer to industries concerning the project topics and results.

DTI, as a large research institute is active also in the exploitation by means of technological transfer to industries. In particular it will create a course for industry (on commercial terms) on how to employ safe and robust collaborating mobile robot systems in production, not referred only to UC1

topics. This course will be developed and offered during project life time. Moreover, DTI will also organize two workshops, specifically focused on UC1. Hospital logistics groups and other potential end-users, university partners and technology suppliers will participate to these workshops.

SE1: Establishment of a dialogue and cooperation, with standardization bodies and certification authorities

DTI plays an important role also in the standardization of safety assurance procedures and methodologies. Consequently, it plans to do some exploitation activities concerning this topic. It is worth noticing that DTI is not focused only on the standardization aspects referred to its use case, but more in general to the Safecop framework. As a consequence it intends to exploit such activity by participating in Notified Working Group Machinery to bring the recommendations resulting from the project to the attention of safety standard authorities.

3.4.2 Maritime Application Domain // Use Case 2

IE1: Mature demonstrators close to market by increasing its TRL

The autonomous boat demonstrator will be TRL from 5 to 6 at the end of the project. It will not be ready to be commercialized. In the proposal UC2 participant do not have explicitly considered to apply for future follow up project to evolve the demonstrator. Nevertheless this objective will be deeply considered during the project, determining the best way to reach this goal.

IE2: Develop of new solutions for customers starting from project results

SINTEF aims to include SafeCOP concepts in at least 3 new project applications within a year of project end and 5 in the following two years, and to apply SafeCOP components in commercial projects where relevant. Moreover DNVGL intends to apply SafeCOP concepts and experience in building an unmanned ship demonstrator to perform environmental surveillance of Norwegian Sea and Arctic areas. This could represent both a new product on the market but at the same time could represent an opportunity to disseminate the use case results to stakeholders and end-users interested.

IE5: Involvement of new stakeholders and end-users and consolidation of already existing relationships and partnership.

As previously said, DNVGL intends to build a unmanned ship for sea monitoring starting from SafeCOP and use case 2 experience. In this way, it will be possible to attract and involve new stakeholders and key players in the maritime field. To take advantage of this opportunity it is crucial to individuate which are the subjects to be involved, already during the project. By means of this showcase the whole consortium can gain large visibility and a significant increment in its reputation. Also MARO intend to exploit the project and in particular the use case 2 outcomes by means of a consolidation of its relation with end-users. In particular it expects, as reported in the proposal, to enhance its on-going dialogue with users within markets like the Oil & Gas sector, geophysical surveying, bathymetry and oceanography.

Both MARO and TEK expect to benefit greatly from the experience offered by the close collaboration with DNVGL and SINTEF in this project, and expect follow-on opportunities in cooperation and collaboration with other industries especially in the development and in the integration of new autonomous boat functionalities.

SE1: Establishment of a dialogue and cooperation, with standardization bodies and certification authorities

DNVGL plans to exploit the results of the standardization activity coming from the use case promoting such results with particular reference to maritime safety aspects, towards the International Maritime Organization (IMO), to foster their diffusion. Again this represents an opportunity for all use case 2 participants. As a matter of fact, IMO is a very influent authority in the maritime sector, but it is conservative and slow towards accepting the usage of new safety assurance

approaches and methodologies. In this way it will be possible to promote innovative approach in this conservative scenario.

SE2: Definition and proposition of new safety standard and certification procedures based on the ideas and approaches developed during the project.

DNVGL will exploit results of the use case and project by means of standardization and certification activities. In particular it intends to development new certification concepts and approaches and also to integrate such new concepts and approaches into its class rules and recommended practices. In this way new technology certification services will be available on market attracting new customers.

AE2: Perform technological transfer to industries concerning the project topics and results.

The technological transfer of the project results has been proposed by SINTEF as a possible exploitation activity. In particular, being an independent research institute, its purpose is to support the industries in the adoption of concepts and solutions developed during the project. In particular, SINTEF goal is to convert the research results, with particular reference to wireless safety concepts developed in SafeCOP into solutions, products and services for industry.

3.4.3 Vehicles platoon // Use Case 3

IE1: Mature demonstrators close to market by increasing its TRL

At the end of the use case 3 the resulting prototype will be a Control Loss Warning (CLW) application for vehicle platoon, running on a commercial available Electronic Control Unit (ECU) provided by GMV. The demonstration will be based on a set of mobile robots, attesting the whole system to TLR6. As for the other SafeCOP use cases, the demonstrator TRL is not sufficient to directly commercialize it, but needs to be increased before doing so. As a matter of fact, the most important exploitation opportunities arising from this use case will be the availability of a real test bed for robotic system platoon. At the end of the project, the demonstrator will become a new test service, especially target to vehicular manufacturers. This service will represent a better and more realistic alternative for the actual test solutions, which are mainly based on simulation software. This represents a twofold opportunity: on one hand it represents a new test service that will be sold to customers, on other hand it will represent an important way to attract stakeholders, end-users and new customers. All the participant of this use case will benefits from these exploitation opportunity, in particular GMV, as a large enterprise, focused on the development and manufacturing of OEM and aftermarket equipment in the automotive sector. As a matter of fact it can directly exploit the results of this use case, integrating them in new solutions and products related to the autonomous driving domain.

During the project will be defined in more detail the aforementioned plan, identifying how to evolve the demonstrator, which components are critical to increase the TRL and how to do that, from a technical and economical viewpoint. As a matter of fact the strategy to bring the demonstrator to the market will be defined inside SafeCOP but it will be implemented starting during its conclusion. So it is crucial to quantify the new investments needed and how to obtain them (e.g., applying for follow-up funding, internal funding by one or more use case participants, and external funding through partnerships with car manufacturers)

IE3: Application of project outcomes to existing products, services and solutions to improve them

As reported also in the proposal both GMV and IMPARA intend to exploit project results by applying them in their products. In particular, GMV has preliminary identified some of its own products which can be improved by applying project outcomes. In particular it refers to fleet management, car-sharing and car-pooling solutions, remote diagnosis and vehicle health report, multimedia and infotainment, stolen vehicle tracking, tow notification. Similarly, IMPARA plans to exploit the project results creating a new vertical application for its machine learning platform, called Rulex, with particular reference to the vehicle platoon framework, considered in this use case. As a matter fact,

Impara software is a general purpose one and can be applied in different real-world fields. Acquiring knowledge in the field related to SAFECOP gives IMPARA the opportunity to develop a new range of vertical applications starting from its existing computational engine. In more detail, IMPARA intends to analyze the data from the platoon prototype, composed by robots, to execute performance and safety analysis and collision predictions, by means of which, intelligible models to govern and control the platoon will be available. Such models and rules will be applied and evaluated in more realistic scenarios. In this way IMPARA machine learning software will be use in new fields, representing an important exploitation opportunity to differentiate and expand its reference market.

IE4: Application of the project methodologies and tools, to reduce the costs to develop products and services.

GMV intends also to apply SafeCOP results to decrease the costs for designing, integrating, testing and certificate new products, with particular reference to the development of ECU hardware and software. During this initial phase of the project it is not easy to quantify such costs reduction. Nevertheless GMV targets a decrease of 5% in those costs in order to have a positive commercial impact, strengthen its market position in the automotive sector. This forecast will be update in the next months, when the preliminary project results will be available and it will be clearer how those results will impact the production processes and how they can be used to reduce costs.

IE5: Involvement of new stakeholders and end-users and consolidation of already existing relationships and partnership.

The automotive sector, and in particular the Electronic and Telematics Control Units (ECUs and TCUs) domain, represent the core business for GMV so it is in an advantageous position to directly exploit the results coming from this use case. Moreover it is OEM and Tier-2 supplier providing a Tier-1 company with the embedded software for several major car manufacturers, such as Renault, Nissan and Daimler, and thanks to the project results it will be able to attract more customer or to establish new partnership, strengthen its position inside this market. The use case 3 demonstrator, focused on the vehicles platoon control by means of a CLW application, represents itself an opportunity to involve new stakeholders and new customers. In more detail the use case 3 demonstrator will be a lower cost, realistic test bed which enables vehicular manufactures to test their platoon mechanism to capture more effects that could not be seen through simulations, in particular for those aspects related to safety assurance.

For a SME, like IMPARA such type of exploitation actions are crucial, to gain visibility, to broaden its customers portfolio and to establish collaborations and strategic partnerships. For reach this goal, maximum 1 year after project end, IMPARA will have used the data analytics platform in developing solutions for a customer or as part of another project in the automotive sector, with particular reference to the vehicle platoon scenario.

AE2: Perform technological transfer to industries concerning the project topics and results

While GMV and IMPARA, respectively Large Enterprise (LE) and small/medium Enterprise (SME) are more focused on industrial exploitation activities, ISEP, being a research institute, will focus on academic exploitation by means of technological transfer of use case and more in general of project outcomes. Moreover, they intend to propose new research avenue regarding safe and secure cooperation in embedded systems.

3.4.4 Vehicles and roadside units interaction // Use Case 4

IE1: Mature demonstrators close to market by increasing its TRL

The use case is focused on the interaction between vehicles and Road Side Units (RSUs) for a twofold goal, on one hand improve the weather forecast, on one hand provide information to vehicles to reduce road traffic accidents. A challenging aspect, considered as an open issue in the project is the safety assurance and security enforcement of this information exchange (which become crucial

aspects with the future autonomous vehicles). Also in this use case, a fundamental exploitation action is related to the evolution of the demonstrator needed to reach market readiness. It is worth noticing that at the end of the project the use case 4 demonstrator will be composed by simulated components and procedures for data acquisition with different level of accuracy; emulation and adaptation of existing Road Weather System (RWS). Consequently it will be at TRL 4 (technology validated in lab) with some of its component at TRL 5 (technology validated in relevant environment). Starting from the demonstrator, which will be available at the end of the project, the partners involved in this use case foreseen an evolution period of 4-5 years to reach the appropriate TRL to commercialize the demonstrator.

A roadmap to guide the prototype improvement and modification is needed to foster its ripening process, especially for those components which are simulated and emulated. Such a road map must be available already during the final phases of the project and must be put in practice just after the project conclusion.

IE3: Application of project outcomes to existing products, services and solutions to improve them

A fundamental exploitation action planned by FMI is the application of project results, regarding wireless communication between vehicles and RWS, to improve security of data exchange. In particular, the idea is to enlarge the amount of weather information to improve the reliability of the forecast, including also data from passing cars acquired by the RWS. In this way it will be possible to dispose of local measurements, which usefulness in the forecast is currently under investigation. As a matter of fact, such information could be very detailed but also unreliable, if the value of these local data will be proven, FMI will add them to its weather forecast.

IE5: Involvement of new stakeholders and end-users and consolidation of already existing relationships and partnership.

Project participants could benefits from the diffusion of the project results to attract new customers, stakeholders, authorities and end-users. More specifically, a way to catalyze interest of external key players is to present the use case 4 demonstrator as a showcase of security system against hostile attack in the field of the communication between RWS and passing vehicles. This is a hot topic deeply considered by several different industries and research institutes. As a matter of fact successful demonstrations of resistance are expected to be of great interest to all communications and security related enterprises. Again, even if such actions will be carried out in the following project phases it is crucial to identify, starting from now, the possible audience of such demonstrator to begin a dissemination activity.

3.4.5 V2I cooperation for traffic management // Use Case 5

IE2 - Development of new products and services starting from project results

AIT has a consolidated position in the development of software solutions for electronic toll collection. Thanks to its participation to the project and in particular to use case 5 it will be able to offer new product and service in the field of the V2X technology referred not only to the electronic payment. Moreover starting from the project results AIT will be able to propose new products to its customer for traffic management and monitoring system, focusing on the road side infrastructure.

INT intends to exploit project outcomes increasing its competitiveness and strengthening its position in its market. The best way to achieve this goal is to propose new services to attract more clients and this will be possible thanks to the knowledge and the experience gained during the project and exploiting the results will be available at the project end. In more details INT will expand and integrate its consultancy portfolio in the development of embedded system, with particular reference to vehicular onboard system. This exploitation plans is put in practice by INT in three steps:

i) the internal dissemination of the developed technologies and the results achieved in the use case, to promote their utilization to develop new services and solutions; *ii)* evaluation of such technologies, in order to determine if they are applicable also in more general scenarios with respect the ones addressed in the project and *iii)* application of such technologies and results to be use in delivering commercial services, related to the software development in heterogeneous fields.

IBTS will exploit the results of the project to enlarge its portfolio of competencies and products. In particular a vehicular telematics box that is under development will be designed in order to match the requirements on sensing coming out from the project and to host the communication strategies tailored for V2I interaction that is the goal of this use case. Such "mobile lab" will constitute the base for future products to be proposed internally to the project partners as well as to other potential customers at the end of the project timeframe. Moreover IBTS platform will be ready to enable future services considering monitoring of driver behavior and active interaction with the roadside infrastructure.

IE3 - Application of project results to existing products and services to improve them

CNR and IMPARA, respectively a research institute and a SME, are focused on the same topic, having common knowledge and skills related to the machine learning. Moreover IMPARA has its own software platform (Rulex, previously described in the use case 3) to analyze a big amount of data implementing machine learning techniques in heterogeneous fields. As an important exploitation opportunity it intends to increase the applicable framework for its software, including also the traffic control and management. According to its vision, machine learning could largely improve the performance of the traffic management system. As a matter of fact this framework is characterized by a large amount of heterogeneous data that are perfectly handled by machine learning. The proposed application of such technique to collect and elaborate data represents a quite significant innovation in the traffic management and control, and represents a great opportunity for IMPARA to enter in new market proposing valuable solutions and consequently a concrete and important exploitation opportunity.

VOD plan to exploit the results of the SafeCOP project to enlarge the range of services and market of its telematics boxes. Up to now the systems is composed of independent geo-localized sensing devices installed on the cars and communicating to a control room. The expectation is to make such solution ready to encompass also V2I communication and to improve the range of services and possible customers, as well as to perform a deeper analysis and profiling of the driver behavior. A new and important new market opportunity is going to be opened by the project outcome.

IE5 – Diffusion of project results to consolidate or and/or create new relationships and partnership

All the partners working on UC5 agree that an important exploitation opportunity arises from the establishment of cooperation and collaboration with stakeholders, end-users authorities and key partners. To increase the visibility and the diffusion of the project results the UC 5 participants intend to contact for demos and showcases at least a dozen of main players already in the first years after the project conclusion. The starting point of these activities is the use case demonstrator, which will be at the end of the project a complete prototype, attested at TRL 6. It is worth noticing that it will be not ready to be directly put on market and commercialized, nevertheless it will be mature enough to be presented during exhibitions, attracting possible interested new partners and/or future customer. In this way it will be possible also to precisely identify which are the interests and the needs of the subject involved, determining how to evolve the prototype, which parts and functionalities add and/or modify to reach TRL 9 and bring it directly to the market, adopting a customer oriented evolution roadmap (following also another exploitation opportunity, the IE1, previously described). Moreover, to foster this proposed evolution, significant alliance with at least one or two key customers and stakeholders, is needed already during the project and after its

conclusion. In this way the visibility of the project results and of the demonstrator will increase and it will be possible to make wider the set of its functionalities according to customers' needs, fostering its evolution in the correct direction. This is the general idea already included in the project proposal and confirmed during the first year of the project. During the next two years, the plans will be refined and updated, following the project directive. Moreover, as reported below, starting from this general strategy, some partners propose more specific actions to implement it.

AIT can provide a precious contribution to create a network of partners, stakeholders and customers, thanks to its position within the traffic and transportation market. As a matter of fact it has been working in this sector for a long time, as a partner of the main Italian road authorities such as ASPI-Autostrade per l'Italia, Sitaf, Autostrada Brescia-Padova Serenissima, Autostrada dei Fior. Consequently, it is in an ideal position not only to directly exploit the business potential of the use case but also to establish and promote relationships and partnerships with key players in the main sectors of the use case 5.

IBTS will cooperate with the rest of the partners participating to the use case to produce a demo system on the car-side, valuable to obtain results from in field-validation and to address more effectively possible stakeholders. A first experiment will be carried out with VOD, which being one of the leaders in the field of automotive telematics is the ideal test case to check the possible acceptance from the market.

A preliminary analysis of such market revealed that there is a strong potential: around half a dozen of main players, installing telematics boxes on cars with a penetration of millions of clients adopting customized insurances per European country. In Italy now there are around 2 million cars with a black box; considering that in 2012 the number was 1.2 million, the growing rate of the market during the last year has been of 40%, according to Association of the Insurance companies (ANIA).

A success in demonstrating the feasibility of the approach will contribute to establish partnerships and alliances. Becoming the reference group in the design of black boxes for the automotive industries, will facilitate the attraction of new partnership and new collaborations with stakeholders, road authorities and end-users. In this case, VOD could provide to UC5 participants a substantial benefit, being active in such market, developing a product currently installed on over 200K cars in Europe.

Finally also ROT intends to disseminate the use case outcomes by developing a detailed business plan. To augment the visibility of the developed systems the business plan will be spread among its worldwide network of partners, to consolidate these relationships and hopefully to establish new cooperation and partnerships.

<u>AE2 - Technological transfer to industries concerning project topics</u>

Technological transfer towards industrial consortium partners and other partners identified through the technology transfer office and exploitation of project results in future research projects are the actions proposed by POLIMI. It is worth noting that this partner, which is a top level Italian University, is more oriented to the academic dissemination while its commercial exploitation is performed in cooperation with IBT.

3.4.6 General principles// Use Case 6

As reported and motivated in Section 0 no exploitation plan is presented for this use case.

4 STANDARDIZATION AND CERTIFICATION

Even if this task has not started yet some related activities have been performed in other parts of the project. In particular in Work Package (WP) 2 and in the use case 6 some project partners have worked on trying to extend the scope of the ISO26262 standard for vehicles to also encompass cooperative vehicles. This work is ongoing and there are no definite results yet. It looks promising and if it works out it will be possible to disseminate the result to the ISO26262s standardization committee.

As reported also in the project proposal, the standardization activities are focused on promoting the project ideas and disseminating them inside standardization and certification communities, fostering the diffusion and the adoption of the SafeCOP results. The standardization actions address all the domains covered by the project use cases (i.e., automotive, communication, robotics and maritime). Moreover multiple standardization bodies are targeted (e.g., ISO, ETSI, CEN and C2CCC).

To maximize the impact of the standardization process the SafeCOP consortium needs a detailed plan preliminary outlined already in this first year of project. The general strategy is based on three pillars: *i)* identification of components and methodologies to be standardized, *ii)* identification of the most relevant standardization bodies and establish a cooperative link with them *iii)* disseminate results to relevant standardization committees.

To achieve these objectives an active support provided by the standardization leader inside the project is needed. Monitoring and coordinating the progress of the work, promoting the cooperation internally between the project participants as well as the external information exchange with the standardization communities are fundamental priorities. As a matter of fact, at least three workshops are already planned for the next year with persons from the standardization committees of the relevant bodies.