

C-MOBILE

Accelerating C-ITS Mobility Innovation and deployment in Europe

D1.5: Innovation Management Plan

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Abbreviations

Abbreviation	Definition
C-ITS	Cooperation Intelligent Transportation Systems
DoA	Description of Action
KIE	Key Innovation Element
IM	Innovation Metric

Executive Summary

In the past years, there has been tremendous progress in the field of intelligent transport systems; several successful cooperative mobility have proven potential benefits of cooperative systems in increasing both energy efficiency and safety for specific transport modes. However, the large variety of cooperative applications have been designed for different goals, stakeholders or specific settings / environments and have been developed on a silo-based approach and deployed independently from each other, serving however, at higher level, similar goals and functionalities for the end-user. Scalability, IT-security, decentralization and operator openness are some of the most important properties that a technical and commercial successful solution must provide.

C-MoBILE aims to stimulate / push existing and new pilot sites towards large-scale, real-life C-ITS deployments interoperable across Europe. Well-defined operational procedures will lead to decentralized and dynamic coupling of systems, services and stakeholders across national and organizational borders in an open, but secure C-ITS ecosystem, based on different access technologies, the usage of which is transparent for service providers and seamless and continuous for the end-users across different transport modes, environments and countries.

The present report, titled D1.5 Innovation Management Plan, aims to establish a structured, yet flexible mechanism and related processes, which will penetrate all project's activities throughout the entire project's lifetime, in order to ensure that high levels of innovation are maintained, as expected and described in the project's contract.

The ambitious objectives of C-MoBILE are placed within the complex landscape of cooperative and connected mobility (C-ITS), currently co-shaped by several actors, stakeholders, other research projects and policies. It is therefore of paramount importance that a large-sized project, with the cooperation of 37 partners of diverse backgrounds (industry, research, policy, planning), coming from 9 EU-member states requires a coordination and monitoring of all its activities, with a view of constant innovation in all its activities.

To ensure that innovation is maintained, that the project activities are well connected and placed within the other, project-external developments and that the innovation goals of C-MoBILE do not lose relevance, clear definitions, targets, indicators, methods of monitoring and re-orienting in case of deviations or course changes influenced by project external factors (e.g. changes in technologies or policies, not controlled by project partners) are required.

The report describes the Innovation Strategy Plan, which is comprised by the Innovation Management Strategy, a detailed analysis of previous and ongoing research and innovation activities in the C-ITS deployment field at EU level, the Key Innovation Elements in C-MoBILE as well as those deliverables of the project that have a high innovation potential and will be closely monitored during the course of the project. The report concludes with the framework for assessing innovation throughout the course of the project, which sets specific Innovation Metrics, related to the Key Innovation Elements of the project.

1. Foreword on innovation

For the benefit of all partners, with varying backgrounds as well as different objectives within the C-MobLE project, as well as for the benefit of a structured approach towards effective innovation management at project level, a clear definition for innovation is needed and provided hereafter.

Innovation

The definition of innovation adopted herein is based to a large extent upon the one provided by Melissa Shilling (New York University). The definition of innovation adopted in the present report is *“The act of introducing a new device, product or method for application to commercial or practical objectives. Invention may or may not be needed, since innovation may include the introduction and use of known ideas and solutions in a new context”*.

Innovation Management

The definition of innovation management adopted herein is *“The way that an organization and its members manage their innovation activities, including processes and structures for monitoring and controlling of innovation”*.

There is a wealth of various other definitions regarding innovation management. These are included in Annex I of the present report, for informative purposes.

2. Introduction – Motivation - Context

2.1. C-MobILE at a glance

The C-MobILE (Accelerating C-ITS Mobility Innovation and depLoyment in Europe) vision is a fully safe & efficient road transport without casualties and serious injuries on European roads, in particular in complex urban areas and for Vulnerable Road Users. We envision a congestion-free, sustainable and economically viable mobility, minimizing the environmental impact of road transport. C-MobILE will set the basis for large scale deployment in Europe, elevating research pilot sites to deployment locations of sustainable services that are supported by local authorities, using a common approach that ensures interoperability and seamless availability of services towards acceptable end user cost and positive business case for parties in the supply chain.

2.2. Innovation management in C-MobILE

As described in the Grant Agreement and the Description of Action of the C-MobILE project, an “Innovation management plan (D1.5)” is planned to be delivered at Month 3 of the project. The aim of this report is to establish a structured, yet flexible mechanism and related processes, which will penetrate all project's activities throughout the entire project's lifetime, in order to ensure that high levels of innovation are maintained, as expected and described in the project's contract.

The ambitious objectives of C-MobILE are placed within the complex landscape of cooperative and connected mobility (C-ITS), currently co-shaped by several actors, stakeholders, other research projects and policies. It is therefore of paramount importance that a large-sized project, with the cooperation of 37 partners of diverse backgrounds (industry, research, policy, planning), coming from 9 EU-member states requires a coordination and monitoring of all its activities, with a view of constant innovation in all its activities.

To ensure that innovation is maintained, that the project activities are well connected and placed within the other, project-external developments and that the innovation goals of C-MobILE do not lose relevance, clear definitions, targets, indicators, methods of monitoring and re-orienting in case of deviations or course changes influenced by project external factors (e.g. changes in technologies or policies, not controlled by project partners) are required.

2.3. Document structure

An **Executive Summary** is provided at the beginning of the present report.

Section 1 provides a foreword on innovation and innovation management, by defining the terms to maintain a common understanding throughout the project lifetime.

Section 2 introduces innovation management within the context of the C-MobILE project and its necessity as well as provides an overview of the structure of this report (present section).

Section 3 presents the Innovation Strategy plan, including the approach for innovation management adopted in the C-MobILE project, an assessment of the C-ITS policy and research projects' landscape in Europe, the Key Innovation Elements defined in C-MobILE and a list of the deliverables of C-MobILE with a high innovation potential.

Section 4 presents the framework for the assessment of innovation throughout the lifetime of the C-MobILE project.

References and Annexes are included at the end of this report.

3. Innovation Strategy Plan

3.1. Innovation Management Strategy

As per the definition of innovation management adopted in C-MobILE, innovation management includes processes and structures for monitoring and controlling of innovation within the C-MobILE project.

Innovation management includes processes and structures, as referred to also in the respective definition provided at the beginning of this report, in order to manage and control activities that, starting from end users' needs, aim to continuously identify and check new ideas with the final objective of developing new products or services which can satisfy these needs.

The activities of the Innovation management strategy within C-MobILE will include the following processes:

- / Identification and dynamic management of the innovation management approach.
- / Understanding of the landscape, including market, key stakeholders, trends, technologies, needs and opportunities.
- / Continuous monitoring of the landscape.
- / Assessment of the innovation potential of research results.
- / Liaise with project management and take corrective measures if needed, to ensure that market needs are best met.

The innovation management strategy will be implemented through activities, which are planned in a way that allows their execution in iterations, so as to allow being continuously in line with ongoing evolution at market, technological and non-technological level.

Having defined the innovation management strategy, the activities to implement it include a very good understanding and continuous (throughout the whole lifetime of the project) monitoring of the C-ITS landscape/domain, in terms of market needs developments and opportunities. This monitoring of project-external activities allows making comparative assessment between these and the project-internal activities, so as to ensure that all project internal activities remain relevant within the global context and preserve always a high degree of innovation. In case of major changes or problems faced either at project-external or at project-internal level, the innovation management process foresees interactions with the C-MobILE project management team, so as to adopt the project plans as necessary.

The activities of the C-MobILE Innovation Management strategy are schematically presented in Figure 1 below.

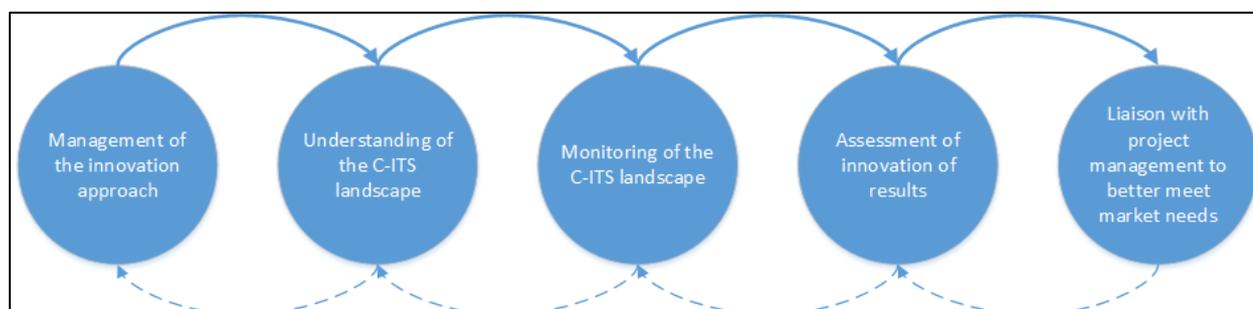


Figure 1: Schema of the C-MobILE Innovation Management Strategy activities

Innovation management within C-MobILE is the primary responsibility of the Innovation Manager. According to the C-MobILE Grant Agreement and DoA, the responsibilities of the Innovation Manager include:

- / Establishment of processes to maximize exploitation of the results by C-MobILE partners.
- / Responsible for the identification of C-MobILE innovations.
- / Responsible for taking together with the Technical Management Team and the Exploitation Manager necessary actions to ensure favorable conditions for innovation and for the effective exploitation of innovations during and after the end of the project.

To achieve these goals and fulfill the responsibilities, the Innovation Manager of the C-MobILE project will:

- / Define the Innovation Management strategy approach, plan all related activities and inform all project partners accordingly.
- / Continuously monitor market, technology and policy trends in the C-ITS domain.
- / Liaise with end user groups to acquire their feedback on the usability of the services to be offered.

- / Inform at a regular basis the C-MobILE consortium partners about emerging trends on the above. This will be done through a “C-MobILE Innovation Outlook update” in the form of an electronic newsletter.
- / Continuously monitor all major project activities related to the deliverables with high innovation potential (Table 2).
- / Continuously liaise with Work Package leaders to assess the innovation level of the activities executed therein against the Innovation management plan (present report). This will be done also collectively for all Work Packages, due to the high degree of interconnectivity and interdependency of the project activities.
- / Assess the level of innovation at project level, utilizing Innovation Metrics, a set of performance indicators, which are related to the Key Innovation Elements of the project (Table 3).
- / Report at M18 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the First Period Report.
- / Report at M36 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the Second Period Report.
- / Report at M42 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the Final Report.
- / Report about innovation management activities undertaken as well as about the major achievements related to innovation at project level during the project meetings during a dedicated session.
- / Provide inputs to business, exploitation and market roll-out plans to be developed within the framework of WP4, WP6 and WP7.
- / Provide inputs to the strategic agenda for innovation and deployment of C-ITS within the framework of WP4.
- / Ensure the innovation level during all meetings, workshops and consultations that will take place during the project.
- / Ensure the innovation level of the Hackathon that will be organized within the framework of the activities of Task 7.2.
- / Provide support during potential introductions of C-MobILE commercially exploitable results to third parties or candidates for technology transfer.

3.2. Analysis of the C-ITS landscape in Europe

3.2.1. EU C-ITS policy setting

The first EU-level legal framework was the Directive 2010/40/EU (ITS Directive), aiming to coordinate Intelligent Transportation Systems (ITS) implementation and to define the importance of vehicle’s connection with the road infrastructure [1], [2]. The 2011 White Paper “Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system” characterized new technologies for vehicles as a key enabler for innovation [3]. The common vision for the deployment of C-ITS services was represented through the “strategic alliance” of the Amsterdam Group (AG) [4]. AG defined the “Roadmap between automotive industry and infrastructure organisations on initial deployment of Cooperative ITS in Europe” (Roadmap AG), the list of “Day 1 applications” and the “AG White Papers” [5]. In 2014 European Commission services (DG MOVE) set up the “Platform for the Deployment of C-ITS in the European Union” (C-ITS Platform), which delivered in its first phase the “C-ITS Platform – Final Report – January 2016 (Phase 1)”, addressing the main technical and legal issues concerning C-ITS [6]. The European Commission (EC) presented the Roadmap “A Master Plan for the deployment of Interoperable Cooperative Intelligent Transport Systems in the EU” (C-ITS Master Plan), in order to support and promote seamless C-ITS development in Europe [7]. The release of the “Declaration of Amsterdam – Cooperation in the field of connected and automated driving” (2016) aimed to establish a coherent framework for C-ITS deployment [8]. That year, the automotive and telecom industries created Europe’s first Automotive – Telecom Alliance, the European Automotive Telecom Alliance (EATA), facilitating the “European Strategy on Cooperative Intelligent Transport Systems” (EU C-ITS Strategy) [9]. Having completed Phase 2, the C-ITS Platform published in 2017 the “C-ITS Certificate Policy for deployment and operation of European C-ITS”, a guide for the development of a common security and certificate policy for C-ITS [10].

3.2.2. EU large-scale C-ITS deployment setting

In 2006 the EC, under the European Union’s (EU) funding scheme FP6-IST (Information Society Technologies: thematic priority under the specific programme “Integrating and strengthening the European research area”), launched the SAFESPOT project, (2006-2010), “Cooperative systems for road safety Smart Vehicles on Smart Roads”, aiming to develop a “Safety Margin Assistant”, using “infrastructure and vehicles as sources (and destinations) of safety-related information for drivers” [11]. The COOPERS project (2006-2010),

“Co-operative networks for intelligent road safety”, under the same funding scheme, envisioned the provision of “real-time safety related traffic/ infrastructure information” to vehicles and drivers, distributed via I2V [12]. The CVIS project (2006-2010), “Co-operative Vehicle-Infrastructure Systems”, aspired to transform mobility for travellers and goods, by developing and integrating C-ITS technologies [13]. The project Aktiv (2006-2010), “Adaptive and Cooperative Technologies for the Intelligent Traffic”, was a German research initiative, aiming to improve traffic safety and traffic flow in Germany [14]. The project consisted also of the project CoCarX, “Cooperative Cars”, a basic research project for Car-to-Car (C2C) and Car- to-Infrastructure (C2I) communication for future C-ITS applications [15].

The SAFERIDER project (2008-2010), funded by EU’s Research and Innovation funding programme for 2007-2013 (FP7), focused on the provision of Advanced driver-assistance systems (ADAS) and In-vehicle infotainment (IVI) systems in motorcycles, in order to increase riders’ safety and comfort. Under the same funding scheme, the euroFOT project (2008-2012), “European Field Operational Test on Active Safety Functions in vehicles”, intended to identify and coordinate an “in-the-field testing” of new Intelligent Vehicle Systems (IVS) for the improvement of European road traffic [16]. The project TeleFOT (2008-2012), “Field Operational Tests of Aftermarket and Nomadic Devices in Vehicles” was an attempt to conduct an assessment of the impacts of “in-vehicle aftermarket and nomadic devices, in order to raise wide awareness of their traffic safety potential” [17].

Understanding driver interactions with In-Vehicle Technologies was the main objective of INTERACTION project (2008-2012), “Differences and similarities in driver INTERACTION with in-vehicle technologies” [18]. The PRE-DRIVE C2X project (2008-2010) set the target to develop “a detailed system specification and a verified prototype based on the overall description of a common European architecture for an inter-vehicle and I2V communication system” [19]. At a national level, Germany through the simTD project, (2008-2013), “Sichere Intelligente Mobilität Testfeld Deutschland”, envisioned shaping “tomorrow’s safe and intelligent mobility” by researching and testing Car-to-Everything (C2X) communication and its applications[20]. With the purpose of “creating the prerequisites for a sustained increase in efficiency and safety in road traffic, by means of V2V and I2V communications”, Germany launched also the DIAMANT project (2008-2013), “Dynamic Information and Applications for assured Mobility with Adaptive Networks and Telematics infrastructure” [21].

In 2009 the EC founded under the Competitiveness and innovation framework programme for 2007-2013 (CIP) the FREILOT project. The project FREILOT (2009-2012), “Urban Freight Energy Efficiency Pilot”, aimed to increase energy efficiency in road goods transport by developing C-ITS services [22]. The Ko-FAS project (2009-2013), “Kooperative Sensorik und kooperative Perzeption für die Präventive Sicherheit im Straßenverkehr”, was a German research initiative aiming to make “a significant contribution” to the improvement of road safety [23]. The Netherlands introduced a national research and development project titled SPITS. The SPITS project (2009-2011), “Strategic Platform for Intelligent Traffic Systems”, focused on the area of defining “an open and scalable platform for C-ITS future systems and applications” [24].

Under the FP7 funding scheme, the project SISCOGA (2010-2011), “SIStemas COoperativos Galicia”, focused on the preparation and implementation of a permanent “intelligent corridor” in Spain to test and validate C-ITS [25]. The project eCoMove (2010-2014), “Cooperative Mobility Systems and Services for Energy Efficiency”, intended to create an integrated solution for road transport energy efficiency [26]. Towards the goal of accident-free traffic, the interactIVe project (2010-2013), addressed the development and evaluation of “next-generation safety systems for Intelligent Vehicles, based on active intervention” [27]. The OVERSEE project (2010-2012), “Open VEHiculaR SEcurE platform”, deployed an “open vehicular IT platform that provided a protected standardized in-vehicle runtime environment and onboard access” [28]. Under the funding scheme CIP, the project COSMO (2010-2013), “Cooperative systems for Sustainable Mobility and Energy Efficiency”, aimed to demonstrate the benefits of integrating advanced cooperative traffic management systems (TMS) and to quantify their positive impact in energy efficiency [29].

During 2010 France set a national Field Operational Test (FOT), titled SCORE@F (2010-2013), “Système COopératif Routier expérimental en France”, aiming to test C-ITS standards, by implementing ITS stations, which communicated and shared information using a standardized communication architecture (ITS Station Reference Architecture) [30]. In the same year Netherlands gathered a consortium of industries and knowledge institutes to introduce the CCC project (2010-2012), “Connected Cruise Control”, with the main objective of developing a cruise control system [31].

In 2011 the EC introduced a series of projects, funded by FP7. The DRIVE C2X project (2011-2014), “DRIVE C2X\nDRIVING implementation and Evaluation of C2X communication technology in Europe”, pointed to carry out a comprehensive assessment of C-ITS through FOTs in various places in Europe [32]. The PRESERVE project (2011-2015), “Preparing Secure Vehicle-to-X Communication Systems”, aimed to provide and test a security and privacy subsystem for Vehicle-to-Everything (V2X) communication systems [33]. The COMeSafety2 project (2011-2014), “Communications for eSafety2”, ambioned the coordination of “the activities towards the realization of C-ITS on European roads” [34].

In the field of FOTs, the FOTsis project (2011-2015), “European Field Operational Test on Safe, Intelligent and Sustainable Road Operation”, was “a large-scale field testing of the road infrastructure management systems needed for the operation of seven close-to-market I2V and Infrastructure-to-Infrastructure (I2I) technologies (the FOTsis Services)” [35]. The ITSSv6 project (2011-2014), “IPv6 ITS Station Stack for Cooperative Systems FOTs”, aimed at developing “a reference open-source IPv6 ITS Station stack, available to European and national third parties (projects, industry and academia) using IPv6 for Internet-based communications in FOTs of C-ITS” [36].

The EU introduced in 2011 the Co Cities project, “Cooperative Cities extend and validate mobility services”. The scope of the project was to close the “feedback loop of C-ITS lacking in delivering information from the traveler to traffic management, and to elaborate a development path for traffic management in European cities” [37]. During the same year and under the CIP funding scheme, the HeERO project (2011- 2014), “Harmonised eCall European Pilot”, aimed to prepare the deployment of the necessary infrastructure in Europe for the “Pan-European in-vehicle emergency call service, eCall” [38]. The EC introduced, under the European Research Area Net (ERA-NET) funding programme, the COBRA project. The objective of the COBRA (2011-2013) project, “COoperative Benefits for Road Authorities”, was to provide support for decision makers on C-ITS [39]. At a nationwide level, Austria through the Testfeld Telematik project (2011-2013), aimed for “developing, operating and demonstrating C-ITS services and systems within the framework of a test field in the greater Vienna area”. [40]. Basic objective of the Dutch “Brabant In-Car II: ParckR” project (2011-2012), was the development and trial of “an intelligent truck parking app, the ParckR, which provided an overview of all truck parking areas along a route [41].

In 2012 the MOBiNET project (2012-2017), “Europe-Wide Platform for Cooperative Mobility Services”, funded by FP7, targeted in developing, deploying and operating the technical foundations of an “open, multi-vendor platform for Europe-wide mobility services” [42]. Financed by the South-East Europe Transnational Cooperation Programme of the EU, the SEE-ITS project (2012-2014), “Intelligent Transport Systems in South East Europe”, aimed at “stimulating cooperation in South East Europe (SEE) for the seamless deployment of ITS technologies”, based on the ITS Directive framework [43].

Regarding C-ITS deployment activities on a national level, the German CONVERGE project (2012-2015) was a research initiative, which “concerned itself with the technical and operational framework of a V2X cooperative architecture for the communication of vehicles with the transport infrastructure, service providers and other vehicles” [44]. Another German project, titled UR:BAN (2012-2016), “User-oriented assistance systems and network management”, brought together thirty partners, in order to develop ADAS and TMS for cities [45]. Finland introduced the same year the CoMoSeF project (2012-2015), “Co-operative Mobility Services of the Future”, focusing on “creating C-ITS mobility solutions, devices and applications, feasible for large scale deployment” [46].

In 2013 the EC proceeded in the funding of four projects, all under the FP7 Programme. The P4ITS project (2013-2016), “Public procurement of innovation FOR cooperative ITS”, had the goal of creating a network of individuals and organisations experienced in procurement of C-ITS [47]. With the introduction of the VRUITS project (2013-2016), “Improving the Safety and Mobility of Vulnerable Road Users through ITS applications”, the EC aimed to achieve the “development of an architecture for the integration of the Vulnerable Road Users (VRUs) into the C-ITS” [48]. The project COMPANION (2013-2016), “Cooperative dynamic formation of platoons for safe and energy-optimized goods transportation”, focused on the development of “co-operative mobility technologies for supervised vehicle platooning”, in order to improve fuel efficiency and safety for goods transport [49]. The project AutoNet2030 (2013-2016), “Co-operative Systems in Support of Networked Automated Driving by 2030”, headed for the “development and testing of a co-operative automated driving technology, based on a decentralized decision-making strategy” [50].

An extension of the HeERO project, the HeERO2 project (2013-2014), “Harmonised eCall European Pilot – Phase 2”, was introduced in 2013. The objective of HeERO2 was to “involve new Member States or associated countries to demonstrate the scalability of the HeERO solution and to widen the acceptance of eCall” [51]. The CIP funded project Compass4D (2013-2015), “Cooperative Mobility Pilot on Safety and Sustainability Services for Deployment”, brought together “seven European cities (Bordeaux, Copenhagen, Eindhoven-Helmond, Newcastle, Thessaloniki, Verona and Vigo) who joined forces, in order to implement three cooperative services, Road Hazard Warning, Red Light Violation Warning and Energy Efficient Intersection service” [52].

The CIVICO project (2013-2016), under the 2013-2016 National Plan for Scientific Research, Development and Technological Innovation and the European Regional Development Fund (ERDF), was a Spanish initiative focused on “finding solutions that guarantee security, privacy and access control to vehicle information” [53]. ECo-AT (2013-2017), “European Corridor – Austrian Testbed for Cooperative Systems”, was an Austrian project to “create harmonized and standardized C-ITS applications jointly with partners in Germany and the Netherlands” [54].

In 2014, “key logistics stakeholders” from seven European cities/ logistics hubs (Bordeaux, Frankfurt, Thessaloniki, Trieste, Arad, Bilbao and Vigo) joined their forces under the CIP funded project CO-GISTICS (2014-2017), “COoperative loGISTICS for sustainable mobility of goods”. CO-GISTICS aimed to implement services that would increase energy efficiency and equivalent CO2 emissions, bringing additional benefits in road safety and cargo security [55]. The SCOOP@F project (2014-2018), funded by the CEF Programme, was a C-ITS pilot deployment project that intended to connect approximately 3000 vehicles with 2000 kilometers of roads [56]. Another project funded by the CEF Programme was the Repsol Security Parking project (2014-2016), aiming to contribute to the “optimal use of parking places, through the provision of static and dynamic parking information” [57]. Regarding national activities, the Netherlands introduced the “Beter Benutten (Optimising Use) programme” (2014-2017). Under this programme the Dutch government and various stakeholders agreed on “working together to improve road accessibility in the busiest regions” by supporting C-ITS deployment [58].

The PROSPECT project (2015-2018), “PROactive Safety for Pedestrians and CyclisTs”, under the EU Research and Innovation programme Horizon 2020, aimed to the “evolution of the first generation of Autonomous Emergency Breaking (AEB) systems for the protection of the VRU” [59]. Under the same programme, the CIMEC project (2015-2017), “Cooperative ITS for Mobility in European Cities”, constituted “a plan for the

deployment of C-ITS at city level with the support of the competent bodies” [60]. The CODECS project (2015-2018), “COoperative ITS DEployment Coordination Support”, a Horizon 2020 funded Coordination and Support Action (CSA), aimed to “support the EC and stakeholders involved in C-ITS deployment in finding strategic and technical policy solutions and processes for a consolidated C-ITS rollout” [61]. The XCYCLE project (2015-2018), “Advanced measures to reduce cyclists’ fatalities and increase comfort in the interaction with motorised vehicles”, had the aim to develop C-ITS technologies, such as “active and passive detection of cyclists, informative systems for hazard at junctions and cooperative systems for cyclists’ collisions reduction” [62].

During 2015 the EC funded under CEF two projects. Within the I_HeERO project (2015-2017), “Infrastructure Harmonised eCall European Pilot”, “fourteen EU Member States and one associated country analysed the feasibility and robustness of the eCall service with pilot installations on both the public-safety answering point (PSAP) and vehicle side” [63]. The NordicWay project (2015-2017) constituted a “pre-deployment pilot of C-ITS services” in four countries, Finland, Sweden, Norway and Denmark, aiming to promote wide-scale deployment in Europe [64]. At a national level, German, Dutch and Austrian road operators set the basis for “a European-wide C-ITS implementation” under the Cooperative ITS Corridor project (2015-ongoing). The corridor Rotterdam - Frankfurt/M. - Vienna includes the implementation of two C-ITS services, Road Works Warning and Vehicle Data for improved traffic management [65]. The Netherlands through the DITCM Architecture project (2015-ongoing) aimed to develop an overall architecture for C-ITS, while the UK launched the A2/ M2 (London to Dover) Connected Vehicle Corridor project (2015-2018), in order to create a living laboratory for testing and evaluating C-ITS technologies [66], [5].

In 2016 the EC introduced, under CEF, the CITRUS project (2016-2019), “C-ITS for Trucks”, that targeted in developing an app for the provision of safety-related warnings and routing information to truck drivers [67]. The SolC-ITS project (2016-2019), “SOLRED C-ITS Monitoring Network”, supported also by CEF, focused on developing an “automatic real-time calculation of the smartest route plan”, estimating as well the required fuel [68]. The InterCor project (2016-2019) set the target to develop a harmonized strategic rollout and common specifications on C-ITS implementation among four EU members with the financial aid by CEF [69]. The CEF funded project C-Roads (2016-2020) focused on the deployment of harmonized and interoperable C-ITS services in Europe [70]. The project C-The Difference (2016-2018), funded by the EC DG MOVE, aimed to upgrade two pilot sites, Bordeaux and Helmond, in order to establish progress towards full scale implementation of C-ITS in them [71]. The national project SCOOP@F Part 2 (2016-2018) included the “validations of C-ITS services in open roads, cross border tests with other EU Member States (Spain, Portugal and Austria) and the development of a hybrid communication solution (3G-4G/ITS G5)” [72].

The C-MobILE project (2017-2020), “Accelerating C-ITS Mobility Innovation and depLoyment in Europe”, funded under H2020, envisions “a fully safe and efficient road transport without casualties and serious injuries, in particular in complex urban areas and for VRUs”. The project will deploy C-ITS services for specific mobility challenges in eight C-ITS equipped cities/ regions, Barcelona, Bilbao, Bordeaux, Copenhagen, Newcastle, North Brabant, Thessaloniki and Vigo [73].

All above reported initiatives at EU level are schematically depicted in Figure 2 next.

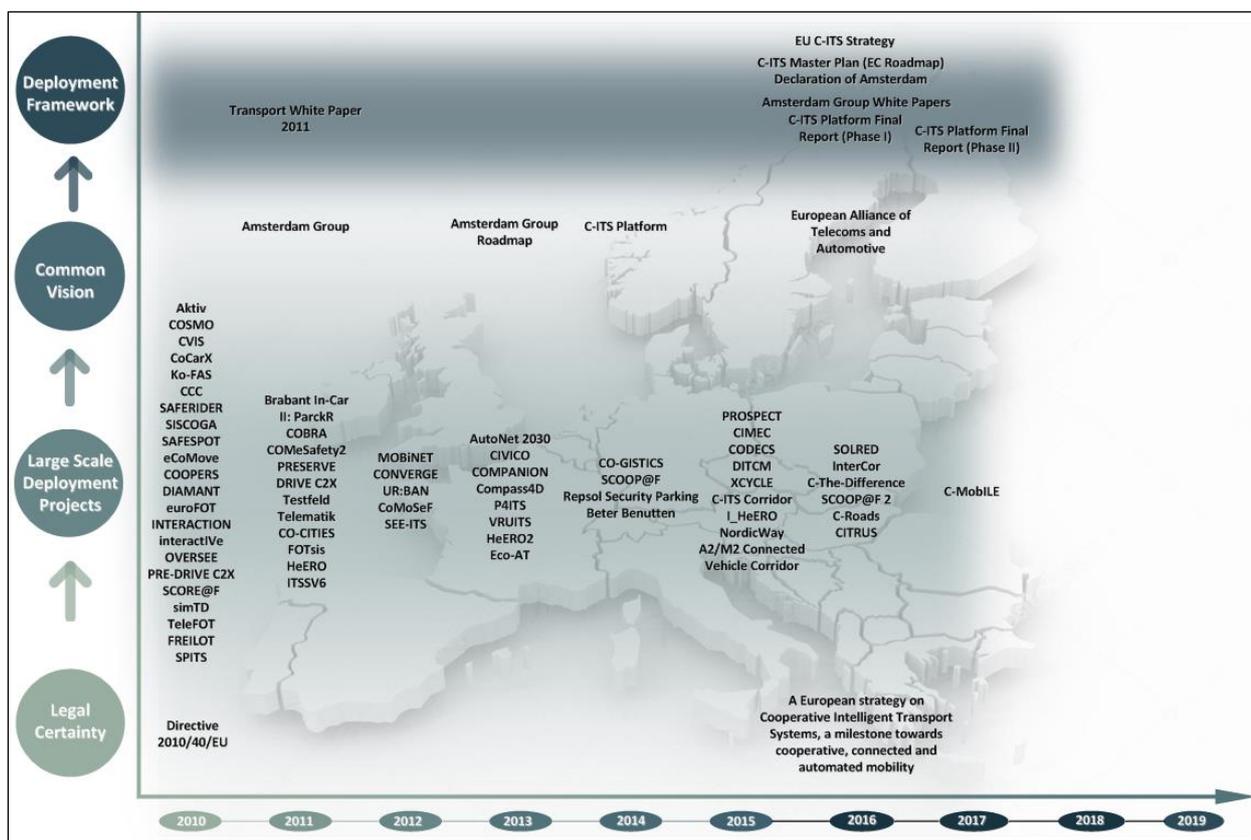


Figure 2: C-ITS related initiatives in Europe

3.3. Key Innovation Elements in C-Mobile

The C-Mobile project envisages to develop solutions, frameworks and processes of technological and non-technological nature that will assist in the wide-scale deployment of C-ITS in the cities that participate in the project, as well as in other cities across Europe. In this respect, several known barriers of technical and non-technical nature need to be overcome. The ways that will be followed and the solutions that will be adopted by C-Mobile require a high level of innovation, in order to overcome these known barriers- to achieve large scale deployment of C-ITS in Europe. These will comprise also the key innovation elements of the C-Mobile. The following table aims to provide an overview of the innovation elements of C-Mobile. The key innovation elements are dynamic and therefore this table will be continuously updated during the course of the project, by monitoring the technological and market landscape of the C-ITS domain. Its current version presents the status as of Month 3 of the project (August 2017).

KIE ID	Key Innovation Element description
KIE1	Provision of C-ITS solutions that address technical, business and legal aspects simultaneously
KIE2	Bundling of C-ITS services
KIE3	Collaboration of stakeholders in the C-ITS domain
KIE4	Large-scale deployment of C-ITS services in complex urban environments, paving the way for large-scale deployment of C-ITS in cities, regions and countries beyond the C-Mobile consortium
KIE5	Development and use of commonly accepted assessment frameworks, including Cost-Benefit-Analyses
KIE6	Contribution to harmonized and integrated C-ITS deployment across Europe, with contribution to and use of standards as well as integration of C-ITS services into the European Wide Service Platform
KIE7	Support of evidence-based decision making to relevant decision makers and key stakeholders, through the provision of roadmaps, guidelines and training
KIE8	Development of a pan-European C-ITS architecture and C-ITS deployment

	platform
KIE9	Harmonization with C-ITS developments in countries outside the EU
KIE10	Multi-actor perspectives on viable business models for large-scale and sustainable C-ITS deployment
KIE11	Support of open innovation and innovative entrepreneurship

Table 1: List of Key Innovation Elements in C-MobILE

3.4. Deliverables with high innovation potential

The C- MobILE project deliverables, which have a high potential for innovation are listed in the table below. These deliverables will be monitored with particular attention at all stages of their development by the Innovation Manager, to ensure that the level of innovation is maintained at high level.

Del. No	Deliverable title	Del. date	Task No.
D2.1	Ex-ante Cost-Benefit Analysis	M6	T2.1
D2.2	Analysis and determination of use cases	M9	T2.1
D2.3	Requirements for C-ITS implementation	M6	T2.2
D2.4	Operational procedures guidelines	M18	T2.3
D2.5	Initial business models	M9	T2.4
D3.1	High-level reference architecture	M4	T3.1
D3.2	Medium-level Concrete architecture and services definition	M8	T3.2
D3.3	Low-level implementation-ready architecture and services definition	M12	T3.3
D3.4	Shareable XMI-Model of the architecture	M12	T3.4
D4.1	Training material on C-ITS for professional drivers	M24	T4.1
D4.2	C-ITS framework for city-led business partnerships	M42	T4.1
D4.3	Training material on C-ITS for public authorities	M36	T4.2
D4.4	Operational processes for large-scale C-ITS deployment	M42	T4.2
D4.5	Final business models	M36	T4.3
D4.6	Business and exploitation plans for market roll-out	M42	T4.3
D4.7	Standardisation and interoperability for global harmonisation	M42	T4.4
D4.8	Strategic agenda for innovation and deployment	M42	T4.5
D5.1	Pilot site adaptations for C-ITS deployment	M21	T5.1
D5.2	C-ITS software modules for end-user devices	M21	T5.2
D5.3	C-ITS software modules description	M21	T5.2
D5.4	Verification of large-scale C-ITS integration	M24	T5.3
D5.5	Validation of C-ITS roll-out procedures	M40	T5.3
D5.6	Demonstration of current and future C-ITS applications	M40	T5.4
D6.1	Validation and impact assessment methodology	M6	T6.1
D6.3	Report on impact of C-ITS on stakeholders and end-users	M40	T6.3
D6.4	Report on impact of C-ITS on surface transport system	M40	T6.4
D6.5	Ex-post Cost-Benefit analysis and guidance report	M42	T6.5

Table 2: List of C-MobILE deliverables with high innovation potential

Further to the above listed deliverables, the Innovation Manager will place particular attention on the level of innovation during all meetings, workshops and consultations that will take place during the project, as well as to the Hackathon that will be organized within the framework of the activities of Task 7.2.

4. Framework for the assessment of innovation in C-MobILE

4.1. Assessment framework

The objective of assessment of innovation throughout the entire lifetime of the C-MobILE project is to have means of verification that the C-MobILE research and innovation activities are of consistently high level of innovation, valid, relevant within the broader landscape and context and of course aligned with the objectives of the project with respect to innovation. To do so, the framework for the assessment of innovation in C-MobILE will include a set of Key Innovation Elements (as described in the previous section), which will be continuously monitored throughout the project's duration. Monitoring of these Key Innovation Elements will allow to have an overview of the impacts of C-MobILE at technological and market level. It will also allow taking corrective measures, in case of deviations from strategic objectives and innovation related goals.

This approach relies upon the innovation management strategy defined herein and it is schematically depicted next.

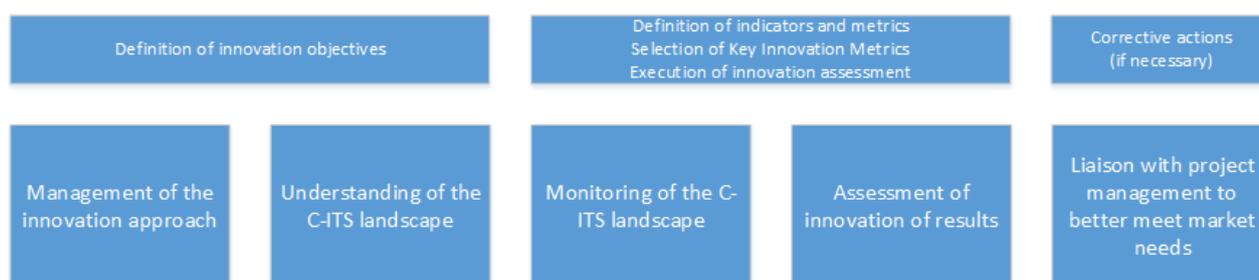


Figure 3: Schema of the C-MobILE Innovation Management assessment framework

The list of actions to be undertaken during the project includes the following list of sixteen (16) activities. This list is dynamic by nature and will be adjusted as needed during the course of the project.

- / Define the Innovation Management strategy approach, plan all related activities and inform all project partners accordingly.
- / Continuously monitor market, technology and policy trends in the C-ITS domain.
- / Liaise with end user groups to acquire their feedback on the usability of the services to be offered.
- / Inform at a regular basis the C-MobILE consortium partners about emerging trends on the above. This will be done through a "C-MobILE Innovation Outlook update" in the form of an electronic newsletter.
- / Continuously monitor all major project activities related to the deliverables with high innovation potential (Table 2).
- / Continuously liaise with Work Package leaders to assess the innovation level of the activities executed therein against the Innovation management plan (present report). This will be done also collectively for all Work Packages, due to the high degree of interconnectivity and interdependency of the project activities.
- / Assess the level of innovation at project level, utilizing a set of innovation performance indicators, which is a set of Innovation Metrics related to the Key Innovation Elements of the project (Table 3).
- / Propose corrective actions, based on the analysis of Innovation Metrics to the project management team.
- / Report at M18 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the First Period Report.
- / Report at M36 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the Second Period Report.
- / Report at M42 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the Final Report.
- / Report about innovation management activities undertaken as well as about the major achievements related to innovation at project level during the project meetings during a dedicated session.
- / Provide inputs to business, exploitation and market roll-out plans to be developed within the framework of WP4, WP6 and WP7.
- / Provide inputs to the strategic agenda for innovation and deployment of C-ITS within the framework of WP4.
- / Ensure the innovation level during all meetings, workshops and consultations that will take place during the project.

- / Ensure the innovation level of the Hackathon that will be organized within the framework of the activities of Task 7.2.
- / Provide support during potential introductions of C-MoBILE commercially exploitable results to third parties or candidates for technology transfer.

4.2. Innovation Metrics

A list of innovation performance indicators, herein named Innovation Metrics (IM), has been defined and will be utilized during the course of the C-MoBILE project. These Innovation Metrics are presented in the following table, including the relation to Key Innovation Elements, which have been presented in Table 1.

IM ID	Innovation Metrics description	IM category	IM target value
IM1	Number of scientific publications and conference/congress presentations on advanced methods and tools supporting C-ITS services provision	Science	≥5
IM2	Number of new methods, tools, systems, services and processes supporting C-ITS services provision	Technology	≥10
IM3	Number of new C-ITS architectures and deployment platforms supporting large-scale deployment of C-ITS in Europe	Technology	≥1
IM4	Number of commonly accepted methods and tools for impact assessment of C-ITS services	Science	≥1
IM5	Number of non-EU projects with which cooperation is established (e.g. USA)	Science & Technology	≥1
IM6	Number of established and functional stakeholders' partnerships in the C-ITS	Policy	≥1
IM7	Contributions to C-ITS standards (new standards, enhanced/revised existing standards)	Standardization	≥2
IM8	Number of new business models developed and adopted for large-scale C-ITS deployment	Business	≥3
IM9	Number of new commercially available and exploitable products in the C-ITS domain (by the end of the project)	Business	≥3
IM10	Number of events organized to promote the use of C-MoBILE solutions to third parties (e.g. Hackathon)	Business & Technology	≥1

Table 3: List of Innovation Metrics used in C-MoBILE

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Annex 1

Most probably due to the diverse background of all those (persons and sectors) where the development of innovative solutions, products or technologies is an important target, no clear and commonly acceptable definition of innovation exists. The nature of this report is not to provide a commonly agreed definition. However, it is important to have some definitions that provide a setting and a starting point. The following list contains a variety of definitions for innovation (retrieved by Eric Shaver, The many definitions of innovation).

- / "...the successful conversion of new concepts and knowledge into new products, services, or processes that deliver new customer value in the marketplace."
- / "Something different that has impact."
- / "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace."
- / "Innovation is significant positive change."
- / "Innovation represents the core renewal process in any organization. Unless it changes what it offers the world (product/service innovation) and the ways in which it creates and delivers those offerings (process innovation) it risks its survival and growth prospects."
- / "...the development and intentional introduction of new and useful ideas by individuals, teams, and organizations..."
- / "...the creation of a new product-market-technology-organization-combination."
- / "...is the creation and capture of new value in new ways."
- / "...innovation is the process that turns an idea into value for the customer and results in sustainable profit for the enterprise."
- / "A change in a product offering, service, business model or operations which meaningfully improves the experience of a large number of stakeholders"
- / "...the art of applying creative ingenuity to either solving business problems or creating material value through a product, service or experience."
- / "...production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome."
- / "...adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization."
- / "...the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organisational set-ups."
- / "Innovation is change that creates a new dimension of performance."
- / "Innovation is creativity with a job to do."
- / "...new ideas that are implemented to create business value."
- / "...a product, process or service new to the firm, not only new to the world or marketplace."
- / "The design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm."
- / "People implementing ideas that create new value."
- / "Innovation is the creation of a new product, service, or process that provides value for customers and/or other stakeholders."
- / "Innovation is an invention that has demonstrated its' ability to create value."
- / "A new idea, method, or device. The act of creating a new product or process, which includes invention and the work required to bring an idea or concept to final form."
- / "Innovation is the set of capabilities (individual, company, societal) that allows the continuous realization of a desired future by transforming what is possible into what is valuable for many."
- / "Innovation is executing new ideas to create value."
- / "Innovation transforms the useful seeds of invention into solutions valued above every existing alternative - and widely adopted."

- / "...a viable offering that is new to a specific context and time, creating user and provider value"
- / "...innovation is the conversion of a new idea into revenues and profits."
- / "Discontinuous improvement."
- / "...the synchronized intersection of a meaningful insight or market need, the new product, service or business model that meets that need, and the communication and commercialization strategy."
- / "The introduction of transformational change into inherently stable systems from which a user derives meaningful value."
- / "...the introduction of new products or services that add value to your business."
- / "...any novel product, service, or production process that departs significantly from prior product, service, or production process architectures."
- / "The act or process of introducing new ideas, devices, or methods"
- / "...the function of an interaction among the motivation to innovate, the strength of obstacles against innovation, and the availability of resources for overcoming such obstacles."
- / "...any policy, structure, method or process, product or market opportunity that the manager of the innovating unit perceived to be new."
- / "Making connections to bring something new to the world."
- / "Innovation is the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization."
- / "Innovation = Creativity + Exploitation"
- / "...is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations."
- / "...the transformation of knowledge into new products, processes, and services..."
- / "...directed creativity implemented."
- / "...a change that breaks trade-offs."
- / "Innovation = Invention + Exploitation"
- / "...an idea, practice, or object that is perceived as new by an individual or another unit of adoption."
- / "The commercialization of any new product, process, or idea, or the modification and recombination of existing ones."
- / "Newness that proves its worth."
- / "...a process of finding novel solutions to important problems."
- / "...the practical implementation of an idea into a new device or process."
- / "...the act of generating more value for the customer and the business by fulfilling a job to be done better than anyone else."
- / "...innovation is a process of turning opportunity into new ideas and of putting these into widely used practice."
- / "...is the process through which value is created and delivered to a community of users in the form of a new solution."
- / "...catalyzes positive change in the way we do things and fundamentally alters our views."
- / "Innovation = theoretical conception + technical invention + commercial exploitation"
- / "Innovation is the management of all the activities involved in the process of idea generation, technology development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment."
- / "Innovation is the successful exploitation of new ideas."
- / "...an invention which has reached market introduction in the case of a new product, or first used in a production process, in the case of a process innovation."
- / "...the process of developing and implementing a new idea."
- / "...is anything new that is actually used ('enters the marketplace') - whether major or minor."

/“...the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, the organization or wider society.”

/“Change that creates value.”

/“...any idea, practice, or material artifact perceived to be new by the relevant unit of adoption.”