- CIRCUIT -

Holistic approach to foster CIRCUlar and resilient transport InfrasTructures and support the deployment of Green and Innovation Public Procurement and innovative engineering practices

– Deliverable 7.1–

Project inception report

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Executive Summary

The current document, D7.1 – Project Inception Report, constituting the first Deliverable released in CIRCUIT project, consists of a) the project management plan with the full definition of governance scheme layers with tasks and roles assigned to each, also addressing the project Advisory Board and its liaison to the project, and, b) the inception report detailing the specific methodology and expected outcomes for each planned project task, including task scheduling, allocation of responsibilities among Partners, deliverables and milestones planning, interdependencies among tasks, risks, requirements and barriers.

Although slight revisions may emerge in the future, its core content is expected to remain as presented in this document.

Abbreviation list

Abbreviation	Definition
CA	Consortium Agreement
DMP	Data Management Plan
DoA	Description of Action
EU	European Union
GA	Grant Agreement
GDPR	General Data Protection Regulation
KER	Key Exploitable Result
KPI	Key Performance Indicator
PMT	Project Management Team
PQB	Project Quality Board
SME	Small and Medium-sized Enterprise
SoA	State-of-Art
WP	Work Package

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1 INTRODUCTION

1.1 PURPOSE AND STRUCTURE OF THE DOCUMENT

This Deliverable encompasses:

- the project management plan with the full definition of governance scheme layers with tasks and roles assigned to each, also addressing the project Advisory Board and its liaison to the project, and,

- the inception report detailing the specific methodology and expected outcomes for each planned project activity, including task scheduling, allocation of responsibilities among Partners, deliverables and milestones planning, interdependencies among tasks, risks, requirements and barriers.

CIRCUIT, being a large project with a set of diverse experts from different fields and backgrounds, a core principle guiding internal processes is open participation and flexibility. Transparency about the project status is an additional principle that the project partners are committed to.

To ensure an efficient and timely implementation of the planned activities of CIRCUIT's multidisciplinary team, we have defined and agreed in certain communication mechanisms and procedures, which will enhance the management and coordination of the project.

In addition to this deliverable, the project is also guided by important reference documents, which define the contractual objectives, the work plan, and the operational procedures of the CIRCUIT project. These documents are as follows:

- The CIRCUIT Grant Agreement including its Annex I (Description of Action), Annex II (Estimated budget for the action), Annex 3 (Accession Forms), Annex 4 (Model for the financial statements), Annex 5 Specific rules.

- The Consortium Agreement (CA) as signed by all beneficiaries.

- Guidance documents provided by the European Commission, i.e.: Annotated Model Grant Agreement.

This deliverable is structured as follows. Chapter 1 of the deliverable introduces the purpose of the document, the intended audience and the interrelations, Chapter 2 introduces the essential info about the CIRCUIT project (vision, aim, objectives, key scope and approach, key innovation intended and expected impacts), Chapter 3 provides the key project features and work plan, Chapter 4 elaborates on the project governance (layers, bodies, and roles), Chapter 5 details the key project management processes, Chapter 6 provides the inception report, while Chapter 7 concludes the Deliverable. Annexes 1 and 2 provide templates for handling partners requests on management level.

1.2 INTENDED AUDIENCE

The main target group for this Deliverable is the consortium partners themselves as this document defines the project internal processes for securing smooth overall management and internal communication performance as well as for all the work to be held in the context of the project. It serves as a reference document for all project team members and may be especially helpful for individuals or organizations joining in the project at a later stage. Each project beneficiary must ensure that every project team member is aware of the provisions of this document. Apart from that, being a public document, it addresses anyone interested in the scope and expected outcomes of the CIRCUIT project.

1.3 INTERRELATIONS

The current Deliverable is cross-cutting to the whole project workplan, as the activities described herein are either referring to horizontal governance principles and mechanisms or to the work approach to be followed in its single activity.

2 ABOUT THE CIRCUIT PROJECT

The overall objective of CIRCUIT is to develop a holistic approach supported by digital solutions and guidelines to foster the introduction of innovative engineering practices in the whole construction supply/value chain enabling circular, sustainable resilient and smart transport infrastructure and a wider deployment of Green Public and Innovation Procurement. This will be achieved by:

i. developing and deploying an innovative open-source digital platform (with advanced Circularity analytics and Supply/value chain matchmaking tools) interoperable with traditional engineering/design (BIM, Digital Twin LCC, LCA) and traffic simulation tools.

ii. introducing modular solutions, ecodesign and reusing concepts as alternative to traditional designs.

iii. maximizing the use of biobased, Secondary Raw Materials (SRM) and Secondary Construction Elements (SCE) as alternative to traditional ones.

iv. including in the decision-making process of transport infrastructures design and route planning, information from updated traffic simulation tools to reduce incidents, accidents, congestion and future scenarios with autonomous vehicles).

New elements and technologies for Circular, Smart, Resilient and Sustainable transport will be included in the design process to facilitate infrastructures upgrading and a quick adaptation to smart mobility and operations. CIRCUIT will also provide knowledge and technical solutions by exploiting the potential of four strategic pillars: Digitalisation, Recycle, Reuse and Energy. Different technologies will be validated in each of the pillars to deliver a holistic approach suitable for different transport modes, the urban and interurban environment, and the different stages of the life cycle of infrastructures.

2.1 THE VISION & THE AIM

CIRCUIT vision is to develop a holistic approach supported by digital solutions and guidelines to foster the introduction of innovative engineering practices in the whole construction supply/value chain.

CIRCUIT aims to deliver circular, sustainable resilient and smart transport infrastructure (both at urban and interurban level) and foster wider deployment of GPP and IP.

2.2 OBJECTIVES AND EXPECTED RESULTS

CIRCUIT objectives and related expected results (KERs) and achievement indicators are described in Table 1.

Table 1 CIRCUIT Objectives, expected results

Objective O1: Co-creation of the CIRCUIT holistic approach, setting up the scope, indicators, supply/value chain roles and the requirements and functionalities of the associated digital platform	
O1 will include the co-creation process to define the CIRCUIT holistic approach scope, supply/value chain roles, Indicators included for Circularity, LCC, LCA, Resilience, etc. and the contribution to the digital transformation and innovative and green procurement. **Main target groups**: designers, construction materials producers, recycling companies, certification and regulation bodies, infrastructure authorities and owners and the civil society. **Linked to WP1, WP4 and WP6**	
Associated key results	**Means of verification/Achievement indicators**
KER1: The CIRCUIT open-source digital platform + Guidelines and training materials	Consensus building on the holistic approach reached by means of 5 devoted workshops (one per pilot country) and results of surveys circulated to ERF and FEHRL members and sectorial associations (target: +50 answers). **D1.1** Integration of the holistic approach in tenders using innovative or green public procurement for 4 pilot projects within CIRCUIT and Novel Governance models and Innovation and GPP guideline issued. **D4.2** CIRCUIT Guideline issued +Training materials for courses and workshops issued by the academic partners in the consortium. **D6.4**
Objective O2: Development of an open-source digital platform for the whole supply/value chain to facilitate the uptake of CIRCUIT principles and link with the selected engineering, environmental and economic tools and with traffic simulation, prediction and environmental monitoring tools	
O2 aims at the development of an **open-source digital platform** enabling **digital and automated traceability** of materials and components along the entire construction value chain and will include functionalities such as an analytics tool, a digital matchmaking tool, traceability systems and interoperability with existing digital tools (e.g., LCA (e.g. OpenLCA), BIM (e.g.. open source ifc.js, Revit), digital twin (e.g. open source iTwin.js), infrastructure design (Civil3D, Istram, Novapoint etc.), traffic simulation prediction (open-source SUMO, VISSIM) and environmental monitoring tools (web based monitoring platform)). **Main target groups**: designers, contractors, infrastructure authorities and owners, infrastructure software toll providers, materials producers and recycling companies. **Linked to WP2 and WP5**	
Associated key results	**Means of verification/Achievement indicators**
KER1: The CIRCUIT open-source digital platform + Guidelines and training materials	Digital platform and interoperability validated by CIRCUIT partners. **D2.1** 10 projects (including bridges, motorways, tunnels) from HAC (using Cross-asset management system) will be digitalized and integrated into digital matchmaking tool Set up a digital structure compatible with the Digital Product Passports. **D2.2** Deployment in Pilot 1: Croatia (HAC, IP, DTT) **D5.1.**
Objective O3: Development of digital product passports (DPPs) aligned with current Construction Products Regulation, Ecodesign for Sustainable Products Regulation on climate and environmental sustainability and the certification of quality and environmental impacts for selected construction materials and components in the construction value chain	
O3 intends to move one step forward current state of development of DPPs delivering an innovative proposal for selected construction products and linked to quality assessment and certification procedures in construction industry by means of DLTs technologies	

Main target groups: certification and regulation bodies, construction materials producers, recycling companies, designers, contractors, infrastructure authorities and owners. **Linked to WP2 and WP5**	
Associated key results	**Means of verification/Achievement indicators**
KER2: A blueprint of digital product passports (DPPs) for selected construction materials and components in the construction value chain	3 DPPs developed for 3 selected construction materials included in the CIRCUIT pilot demonstrations (e.g., DPPs of the new modular solution or 3D printed elements included in the Slovenian pilot, DPP of the green asphalt material used for the Spanish pilot). **D2.2**, **D5.2, D5.4**
Objective O4: Propose and demonstrate modifications in 1) actual engineering and procurement processes and practices and 2) novel governance and procurement models for a wider green and innovative procurement deployment in transport infrastructures through effective training and recommendations.	
O4 aims at the integration of the CIRCUIT digital platform into actual engineering practices (from design to construction and operation) and procurement processes which will facilitate a circular shift of the transport infrastructures aligned with CIRCUIT principles. **Main target groups:** Infrastructure Managers, Designers, Contractors, Construction Products Industry **Linked to WP4, WP5, and WP6**	
Associated key results	**Means of verification/Achievement indicators**
KER1: The CIRCUIT open-source digital platform + Guidelines and training materials	CIRCUIT Guideline issued +Training materials for courses and workshops issued by the academic partners in the consortium. **D6.4** Deployment in Pilot 1: Croatia (HAC, IP, DTT) **D5.1.** Additional validation by ERF and FEHRL members (EU transport research laboratories and infrastructure owners). Target: +25 validations.
KER3: Governance models and the CIRCUIT helpdesk to integrate the project principles into innovative and green procurement and facilitate replication	Novel Governance models and Innovation and GPP guideline and Manual for a successful deployment of GPP in CIRCUIT pilots. **D4.1, D4.2** Integration of new governance models or elements aligned with the CIRCUIT principles into the 5 public procurement processes linked to the project pilots. **D5.1, D5.2, D5.3, D5.4, D5.5** Creation a devoted support Helpdesk. **D4.3**
Objective O5: Developing, assessing, and validating the most suitable technologies for the four CIRCUIT Strategic Pillars	
The following technologies will be developed in order to achieve **O5**: • Development of new methods and technologies to construct, manage and maintain pavements using more sustainable binders, upcycled and reused materials and construction elements. • Development of smart techniques for effective construction, maintenance and decommissioning of bridges, geotechnical structures and quay walls. Solutions will include modular, standard and prefabricated solutions using additive manufacturing techniques (e.g., 3D printed), recycling and reuse of materials. • Design and development of solutions for reduction of emissions through more efficient energy management on transport infrastructure operations by, for example energy harvesting on infrastructure and its verges, adaptive lighting systems, self-powered signalling systems and innovative tunnel ventilation systems.	

Target groups: designers, contractors, infrastructure authorities and owners. **Linked to WP2, WP3, and WP5**	
Key results	**Means of verification/Achievement indicators**
KER4: Innovative bridge solutions: Modular bridge superstructure consisting of reused girders and prefabricated slabs designed for disassembly and adaptability, complemented with a 3D printed concrete safety wall.	Laboratory validation of the concrete mixes designed for prefabricated slabs, superstructure prototype and 3D printed safety wall prototype. **D3.1** Design and numerical analysis of the superstructure (reused girders+prefabricated slabs) and 3D printed safety wall. **D3.2** Technical approval and DPP for production of prefabricated slabs. Deployment in Pilot 4: Slovenia (ZAG, CRNA, BL, IP, IECA, UC, UZ). **D5.4** Site validation by the means of load test on the constructed full-scale bridge
KER5: Asphalt concrete mixtures using innovative binders, upcycled and reused materials	Laboratory validation of the asphalt concrete mix designs for maximising the use of RAP, validating the alternative binders and assessing the new long-term performance wearing courses (**D3.1**) Deployment in Pilot 2: Spain (MITMA, UC, ACC, UB). **D5.2**
KER6: Design and development of solutions for adaptive lighting systems, self-powered signalling, and innovative tunnel ventilation systems	Simulation modelling validation Monitoring of Energy consumption reductions reported as part of the Spanish and Italian pilots. Deployment in Pilot 3: Italy (ANAS, ALG), **D5.5** and Pilot 2: Spain (MITMA, UC, ACC, UB). **D5.2**
KER 7: CIRCUIT innovative solutions for geotechnical structures including: New approaches to Geosynthetic Reinforced Soil (GRS) technologies, and soil stabilization using recycled materials.	Laboratory validation of soil strengthening solutions using recycled industrial waste **D3.1** Deployment in Pilot 3: Netherlands (WSD, ING, UZ, IP) and Pilot 4: Slovenia (CRNA, ZAG, UZ). **D5.3 and D5.4**
KER 8: Smart solutions to mitigate congestion and minimise accidents, incidents and fatalities based on real-time traffic simulation and prediction and environmental monitoring tool	Results from the Living lab organized with the EU JRC on smart infrastructures **D2.4** Integration of human integration and traffic modelling in the CIRCUIT platform. **D2.5** Deployment in Pilot 2: Spain (MITMA, UC): Test case of the proposed solutions as a smart dynamic traffic management system. **D5.2**
Objective O6: Demonstrating in an operational environment the potential of CIRCUIT to limit the overall emissions from construction, maintenance, operation and decommissioning of the infrastructures, increase their resilience and upgrade them to Smart, Resilient and Sustainable.	
O6 is to validate proposed solutions in five demonstration pilots at minimum TRL7, considering different environments, transport modes and stages of the infrastructure life cycle (from design to construction, maintenance and operation) and quantifying the benefits in terms of LCC, LCA, resilience and increase of the smart infrastructure elements considered and smart upgrades included. **Target groups:** the whole supply/value chain of transport infrastructures. **Linked to WP5**	

Key results	Means of verification/Achievement indicators
KER1: The CIRCUIT open-source digital platform + Guidelines and training materials	Results of the Impact assessment performed for all 4 pilot projects included in the CIRCUIT guidelines broken down by Impact Assessment key performance indicators: (Targets: Reduction of LCC by at least 30%, decrease of emissions and carbon footprint of the whole life cycle of transport infrastructure by 20%, 100% reutilisation of construction materials, increased availability of transport infrastructure and increased safety). **D5.6** Deployment in Pilot 5: Croatia (HAC, IP, DTT). **D5.1**
Objective O7: Effectively disseminate and communicate project results and outcomes to engage the relevant stakeholders in the supply/value chain of infrastructures: from authorities to citizens. Liaise with relevant initiatives and organizations. Assess and deploy suitable exploitation strategies.	
O7 aims at facilitating means to disseminate and communicate the project results to the relevant stakeholders, authorities and end-users, especially the benefits of the integrated circular principles into transport infrastructure management for different user groups. **Target groups:** Scientific community, sectorial associations, infrastructure authorities and owners, civil society **Linked to WP6**	
Key results	**Means of verification/Achievement indicators**
KER1: The CIRCUIT open-source digital platform + Guidelines and training materials	Dissemination materials and communication strategy. **D6.1.** CIRCUIT Guideline issued +Training materials for courses and workshops issued by the academic partners in the consortium. **D6.4**

2.3 THE SCOPE AND THE APPROACH

The CIRCUIT project will emphasise on infrastructures upgrading and on updating actual engineering practices: following a whole life cycle approach and bearing in mind sustainability and circular economy principles to lowering transport infrastructures environmental impact. It will also consider actual and future climate and mobility scenarios to facilitate the transition to smart and resilient transport infrastructures.

The project will follow a co-creation approach involving different experts and organizations in the supply-value chain of transport infrastructures and external transport infrastructures authorities, members of civil society organizations, NGOs, scientists, academics, etc. Taking into consideration the whole life cycle of infrastructures, different technologies will be validated in an operational environment to demonstrate the achievement of the expected impacts accelerating the transformation towards CE and greener, more digital, and resilient transport infrastructures.

This will be achieved by combining technological and non-technological innovations and validations:

CIRCUIT Technological Innovations will cover four strategic pillars to cover Digitalisation gaps and facilitate upgrading of existing assets to become smart infrastructure, mitigate congestion and minimise accidents, to validate in an operational environment, different technologies selected to lower environmental impacts, boost CE, resilience and

performance-based designs, as well as Recycling and Reusing (both for structural and non-structural elements). Finally technological innovations will tackle different strategies to reduce Energy consumption of transport infrastructures (during both, its construction and operation). Figure 1 summarizes the technologies infrastructures involved per each of the pillars.

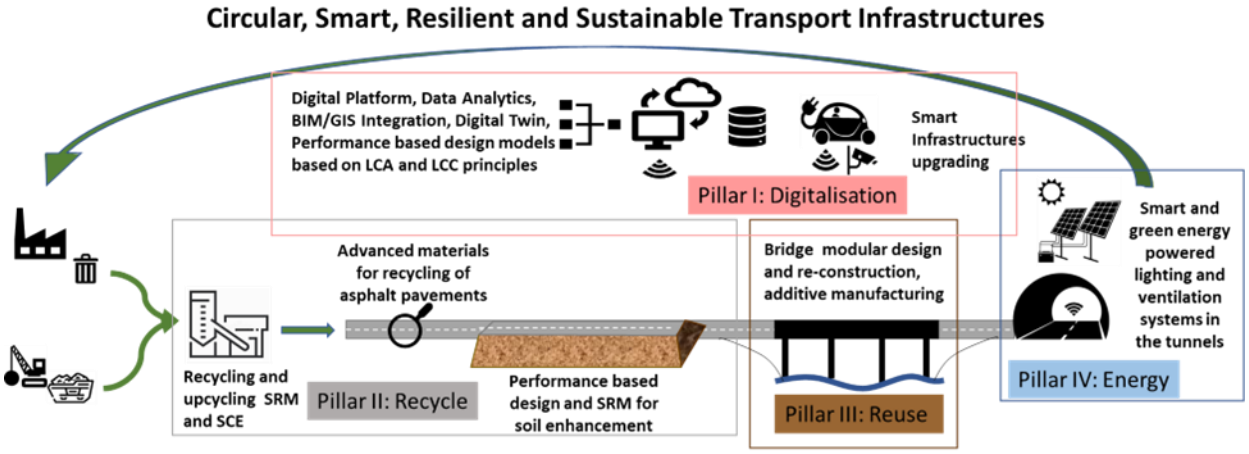

Figure 1 CIRCUIT pillar and main technological elements in the CIRCUIT project

The technologies considered will be tested in operational environments, in five pilots in different EU countries, see Figure 2, covering different lifecycle stages of infrastructure as defined in EN 15643- Sustainability of Construction Works. These range from A0 - Pre-construction stage, through Use stage B1 to B8 to End of Life C4. This application is facilitated by CIRCUIT partners as infrastructure owners:

- Pilot 1: Croatia. Authority HAC. Focus Pillar: Digitalisation. Infrastructures included: Roads and bridges Stages: A0 Pre-construction. Preliminary studies consultation and costs.

- Pilot 2: Spain. Authority: MITMA; Focus Pillar: Recycle; Infrastructures included: Roads and Tunnels. Stages A0 Pre-construction. Tender process. B1-B8 Use stage. Focus on: B2 Maintenance, B3 Repair, B4 Replacement. B5 Refurbishment, B6 Operational Energy use and B7 Other operational processes.

- Pilot 3: The Netherlands. Authority: WSHD; Focus Pillar: Recycle; Infrastructures included: Roads and Embankments; Stages: B1-B8 Use stage. Focus on: B2 Maintenance, & B3 Repair.

- Pilot 4: Slovenia. Focus pillar: Reuse, Authority: CRNA; Infrastructures included: Local roads, Bridges and Geotechnical structures; Stages: A0 Pre-construction. Tender process. A4-A5Construction process, B1-B8 Use stage. Focus on: B4 Replacement and B5 Refurbishment and C1-C4 End of life, focus on C1 Decommissioning, C3 Procession for Reuse, Recovery and Recycling

- Pilot 5: Italy, Authority: ANAS Focus Pillar: Energy; Infrastructures included: Roads and Tunnels. Stages: A0 Pre-construction. Tender process. B1-B8 Use stage. Focus on B4 Replacement, B5 Refurbishment, B6 Operational Energy use & B7 Other operational processes.

The set of CIRCUIT Non-Technological Innovations will address the necessary changes in regulations and governance linked to the new procurement approaches. In particular, CIRCUIT will execute particular procurement processes modifying if necessary actual governance, to assess the real barriers and constraints for GPP and IP in their entities, identify solutions, mitigation measures and include in a real tender the new technical, environmental and economic elements from CIRCUIT. The link with the collaborative frameworks and the development of specific training materials suitable for the whole supply/value chain are also included in this set of innovations.

In addition to the validation of the CIRCUIT (non-technological and technological) innovations in an operational environment, replicability strategies are designed in order to boost the deployment of CIRCUIT innovative solutions across the EU. Thanks to the early adopter's engagement of a few infrastructure owners and authorities within CIRCUIT, a replicate of CIRCUIT innovations is programmed at National, regional or infrastructure level.

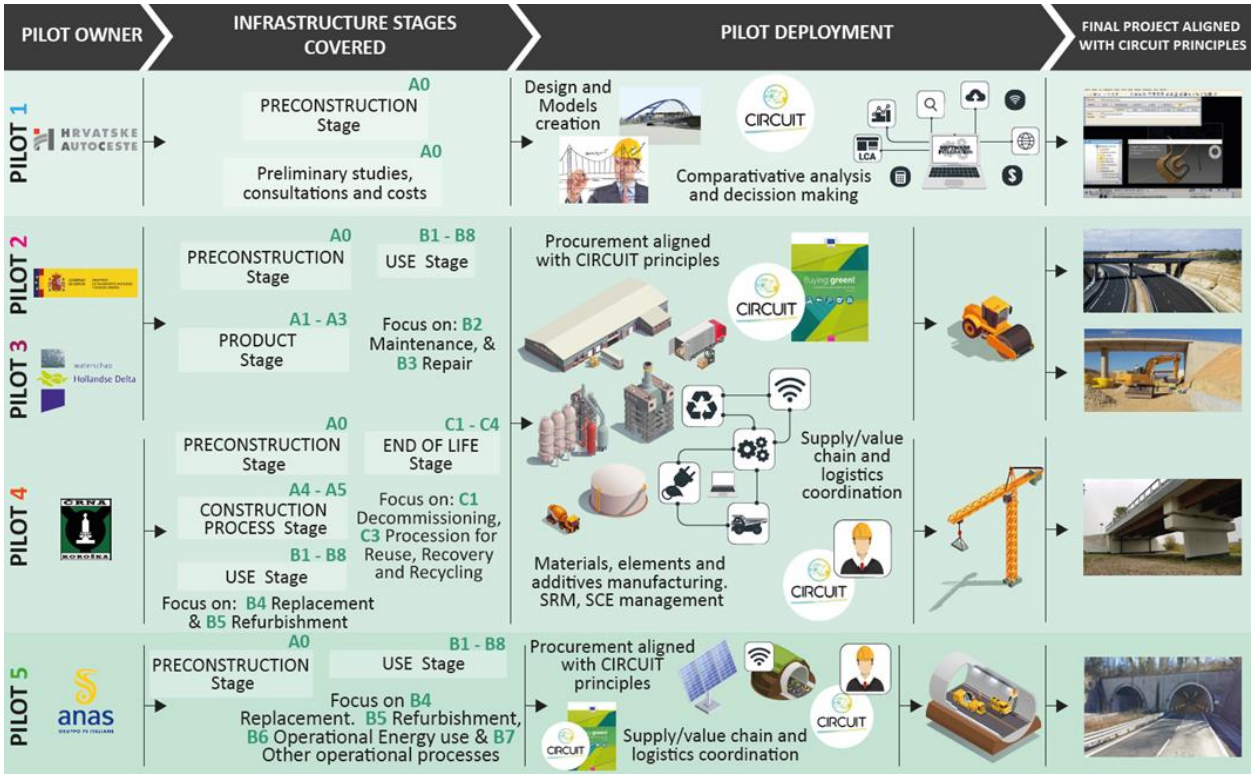

Figure 2 CIRCUIT pilot demonstrator's summary

2.4 METHODOLOGY

CIRCUIT represents a transdisciplinary research, demonstration and replicable project designed to foster circular, smart, resilient and sustainable transport infrastructures and facilitate wider deployment of GPP and IP in the EU. It is structured to identify, select, and develop technological and non-technological solutions overcoming current methodological, technological, environmental, economic, social, organizational, financing, regulatory and training gaps hindering the transition towards the implementation of principles of the Circular Economy to achieve greener, digitalised, smart, and resilient transport infrastructures.

The whole infrastructures supply/value chain (from authorities to citizens including procurers, engineering, construction, maintenance companies and infrastructures operators) will be tackled and involved in the co-creation of the CIRCUIT holistic approach and digital platform to cover the whole life cycle of transport infrastructure and limit the overall emissions from construction, maintenance, operation and decommissioning of the infrastructure.

CIRCUIT is divided into 3 phases:

- Phase 1 (Definition phase) will be focused on establishing the framework and holistic approach for CIRCUIT activities regarding policy, governance, methodologies, indicators and protocols to be followed. It will also include the definition of the software and hardware requirements to deliver the desired digital platform and interoperability.

  During this phase, and under a co-creation process the analysis of all factors influencing smart, resilient and sustainable transport infrastructures will be defined, classified and properly selected and organised according to CIRCUIT principles to develop the pursued holistic approach (WP1). Finally, it is intended to identify actual barriers to IP and GPP, to define the most suitable strategy to facilitate a wider deployment of IP and GPP and the development of novel governance models to overcome the barriers identified (WP4).

- Phase 2 (Execution phase): will focus on developing the digital platform and the digital solutions for smart mobility (WP2) and on the validation at laboratory scale or in a controlled environment of the different technologies included in the four CIRCUIT pillars (WP3).

  This phase also includes the design and development of facilitators, novel governance and procurement models for a wider GPP and Innovative procurement deployment in transport infrastructure management through effective training, adaption measures and recommendations and by creating a novel Helpdesk and EU competition on GPP and Innovation procurement to support their deployment and replication across Europe (WP4).

- Phase 3 (Validation and impact generation phase): will leverage on the validation of: (1) the digital platform and communication systems developed; (2) the innovative technologies proposed for each CIRCUIT pillar; and (3) the novel

governance models proposed to facilitate a wider deployment of IP and GPP (WP5). This will be done in five pilots as described above.

In order to coherently generate methodologies, operational procedures, governance models, training methods and materials, communication strategies and procurement recommendations through cross-fertilization among the pilot countries through the participation of the relevant stakeholders in the project workshops, liaison and clustering activities (WP6).

Pivotal to the CIRCUIT holistic approach are the 1) co-creation methodology involving all relevant stakeholders in the process of gathering evidence and 2) the establishment of stakeholders' collaborative frameworks involving multidisciplinary profiles (scientific, policy making, practitioners, citizens, and the whole supply-value chain). The partners profiles involved in the different pilots are highly representative of the supply-value chain and will involve the most relevant stakeholders in their respective regions and with the required profiles tailored to the expected results and impacts.

2.5. EXPECTED IMPACT

The European Council has set the goal for the EU to cut its greenhouse gas emissions by at least 55% by 2030, compared to 1990, and become climate neutral by 2050. Emissions from the transportation sector represent around 25% of the EU's total greenhouse gas emissions, and these emissions have increased over recent years. The CIRCUIT project will provide several solutions that contribute to the targeted reduction of 90% in transport-related greenhouse gas emissions by 2050.

Table 2 Expected impacts

Expected Scientific impact
CIRCUIT will promote scientific excellence, support the creation and diffusion of high-quality new knowledge, strength human capital in R&I and contribute to full engagement of Union's talent pool in actions supported under the Programme by means of:

Key Impact Pathway 1 – Creating High Quality New Knowledge

Impact 1: New holistic framework with digital solutions (CIRCUIT objectives O1, O2, O3)			
Results	**Outcomes**	**Impact**	**Target Groups (TGs)**
New holistic approach for transport infrastructure management implemented by IMs.	Approaches adopted in the 5 pilot projects	Implementation by project stakeholder IMs followed by roll-out across other sectoral IMs in EU	RA, IM, IND[1]
Development of digital platforms with integrated digital tools	Approaches adopted in the 5 Pilot regions for circular management and digital transition	Knowledge transfer and incorporation in 5 different EU Regions	RA, IM, IND[1]
4 peer reviewed articles on the digital platform (WP2)	FWCI[2] > 1.3 per article	Adoption of dynamic data-driven approaches in future research	SC, IM, RA[1]

[1]RA = Regional Authorities, IM = Infrastructure Managers, SC = Scientific Community, IND = Industry

[2]FWCI = Field Weighted Citation Impact

Key Impact Pathway 2 – Strengthening human capital in R&I

Impact 2: Increasing the skills and capabilities of next generation Scientists and Researchers in transport infrastructure related disciplines. (related to CIRCUIT objectives O2, O3, O4)			
Results	**Outcomes**	**Impact**	**TGs**
5 new MSc & 2 new PhD completed	Highly skilled MSc staff available for direct employment. Aim for 50% of PhD to industry and 50% to academia. Facilitated through Innovative PhD training programs at hosts with secondments to IND.	In addition to the advanced problem solving skills provided, the structured training programs followed by researchers encourage innovation and entrepreneurship.	SC, IND

Key Impact Pathway 3 – Fostering diffusion of knowledge and Open Science

Impact 3: Making CIRCUIT results openly available (Across all project objectives)			
Results	**Outcomes**	**Impact**	**TGs**
At least 6 scientific journal publications and 6 conference papers presented in open access form. All publications available on OpenAire platform.	FWCI > 1.3 per article	FWCI > 1.4 per article	SC, IND

Expected Societal impact

CIRCUIT will address EU policy priorities & global challenges through R&I, deliver benefits & impact via R&I missions and support the uptake of innovative solutions in industry, notably in SMEs by means of:

CIRCUIT will focus not only on societal mitigation targets of reaching climate neutral, smart and resilient transport infrastructure it will also ensure a high-level of safety for its users. Resilience should be built in the transport systems to prevent, mitigate and recover from disruptions. Research and innovation outputs from CIRCUIT will underpin the three safety pillars: technologies, regulations and human factors. Europe needs to manage the transformation of supply-based transport into safe, resilient and sustainable transport and demand-driven, smart mobility services for passengers and goods. The CIRCUIT consortium recognises this need throughout our significant experience in the field. Below is a snapshot of how the HE Societal Key Impact Pathways will be addressed.

Key Impact Pathway 4 – Addressing EU policy priorities & global challenges through R&I

Impact 4: Lowering transport infrastructure environmental impacts and shifting towards circular management through digitalization (CIRCUIT objectives O1, O2, O3, O4)			
Results	**Outcomes**	**Impact**	**TG**
Digital product passports (DPPs) aligned with current Construction Products Regulation, Ecodesign for Sustainable Products Regulation	Digital tracing of materials, components and elements Increased transparency throughout the entire construction value chain 100% reutilisation of construction materials within and across transport modes;	Knowledge transfer and incorporation in 5 different EU Regions. DPPs adopted by contractors and construction materials producers, at least 3 in each partner country	IND, IM
Novel governance and procurement	Integrated circular economy principles into transport	The integration of GPP and innovative procurement for	RA, IM

models for a wider green and innovative public procurement	infrastructure management; Decrease of emissions and carbon footprint of all actions on transport infrastructure by 20%	> 5 regional authorities / infrastructure managers	
Guideline and standardization documents (WP4)	Increased implementation of GPP for 30% of tenders	The integration of CE principles into 5 RM and IM	SC, IM, RA

Key Impact Pathway 5 – Delivering benefits & impact via R&I missions

Impact 5: Demonstrating in an operational environment the CIRCUIT technologies and solutions for circular, smart, resilient and sustainable transport infrastructure (CIRCUIT objective O5, O6)			
Results	**Outcomes**	**Impact**	**TG**
Catalogue of digital tools and technologies for SRS transport infrastructure transition	Demonstration of proven solutions and innovative technologies at five (5) pilots across Europe	Uptake of similar solutions in more than ten (10) other regions and cities. Already confirmed 3: The Flemish Region and the cities of Karlovac and Velika Gorica.	Policy makers, RA, IM
Quantification / ranking of solutions	Demonstration of ranking methodology in four pilot projects across Europe	Ranking methodology utilized for effective in more than four other regions	RA, IM

Key Impact Pathway 6 – Strengthening the uptake of R&I in society

Impact 6: Transferring scientific knowledge to citizens through their involvement in the Circularity Hubs and in the CIRCUIT co-creation process. (CIRCUIT Objective O7)			
Results	**Outcomes**	**Impact**	**TG**
Involvement of citizens in co-creation activities & workshops	Increase of citizen representatives in stakeholder collaborative frameworks. Increased trust in circular economy & policy recommendations	Increased involvement of civil associations in dynamic decision process	Citizens & civil response

Expected Economic / Technological impact

The European Union Europe 2020 Strategy on Innovation aims to deliver growth that is smart, sustainable and inclusive. Europe's future ability to sustain economic growth, retain and create jobs will depend on innovation. CIRCUIT will foster all forms of innovation, facilitate technological development, demonstration and knowledge transfer, create more and better jobs and leverage investments in R&I.

Specifically, CIRCUIT will go beyond the state-of-the-art in the following areas; performance-based design models, manufacturing techniques, modular construction, maintenance and decommissioning interventions and optimized energy use.

CIRCUIT will develop and integrate a number of digital and technological solutions into the existing practices. To increase public authorities' ability to shift towards circular management of transport infrastructure, tools and models will be provided in the GPP and innovative procurement procedures. This will, in turn, lower the environmental impacts and overall life cycle costs. Based on the CIRCUIT pilot projects with their data integrated into the open-source digital platform, the impacts of the proposed

technologies will be known. Further, our assessments of the direct and indirect economic consequences of the measure to the chosen asset on the network. We will pioneer the development of **transparent socio-economic tools for more robust and science-based decision making**. As we learn how multiple transport modes have affected or could affect an area, we will use this to avoid consequences in other areas. The potential economic and technological impact of this work will there for continue for years beyond project completion Below is a snapshot of how the Horizon Europe Economic / Technological Key Impact Pathways will be addressed by CIRCUIT.

Key Impact Pathway 7 – Generating innovation-based growth

Impact 7: Fostering innovative companies building on the demonstration of the open source digital platform and technologies to implement circular transport infrastructure management (CIRCUIT objective O6, O7)			
Results	**Outcomes**	**Impact**	**TG**
Open source digital platform to foster Smart Resilient and Sustainable Transport infrastructure in 5 pilots	5 new applications based in the frame of HEU, Digital Europe or Innovation Fund programs	1 new start-up/spin off companies created leveraging on the open-source digital platform and innovative technologies	Construction and IT companies, Industry
Digital platform and Circularity analytics and Supply chain matchmaking tools	Deployment of the performance based design and circular economy principles will result in reduction of life cycle costs by 30% in pilot projects	Implementation of Circularity analytics and Supply chain matchmaking tools will result in 30% decrease of the maintenance backlog in 3 European countries particularly problematic (Spain, Italy, Croatia) due to the optimized maintenance planning and reuse of existing structures in the next 5 years after the project	RA, IM

Key Impact Pathway 8 – Creating more and better jobs

Impact 8: Fostering business growth through exploitation of CIRCUIT vulnerability assessment (O2)			
Results	**Outcomes**	**Impact**	**TG**
Offering of new commercial services by CIRCUIT SMEs	8 new staff members hired	2 new staff members annually for each SME organisation	SMEs

Key Impact Pathway 9 – Leveraging investments in R&I

Impact 9: Contributing to uptake of technologies to integrate holistic approach to transport (O1, O2, O3, O4)			
Results	**Outcomes**	**Impact**	**TG**
8+ organizations participating in the development and validation of the CIRCUIT Digital Tools and Technologies	6 new organizations in the CIRCUIT ecosystem	5 new organizations yearly joining the CIRCUIT ecosystem for integration in new applications	Simulation companies, Industry

3 PROJECT FEATURES AND WORK PLAN

3.1 GRANT AGREEMENT

The Grant Agreement (GA) for CIRCUIT has been signed by all partners and the European Commission. It is accessible in the EU Portal Funding & Tender Opportunities.

The GA is composed of the following reference documents:

Table 3: Grant Agreement overview

Page No.	Chapters	Description
Page 4	Terms & Conditions	Official EU rules, rights, and obligations under the project
Page 73	Annex 1	Description of the Action (DoA) PART A contains the work plan (description of the work packages, deliverables, milestones, etc.) PART B is the text of the proposal (detailed description of how the consortium will complete the work plan)
Page 169	Annex 2	Estimated budget for the action
Page 173	Annex 3	Accession Forms for beneficiaries
Page 191	Annex 4	Model for the financial statements
Page 192	Annex 5	Specific rules

3.2 WORKPACKAGES & THEIR PLANNING

CIRCUIT consists of 7 closely interrelated WPs, as shown in the Pert chart below. More specific interrelations are provided on WP level in Chapter 6 of the document.

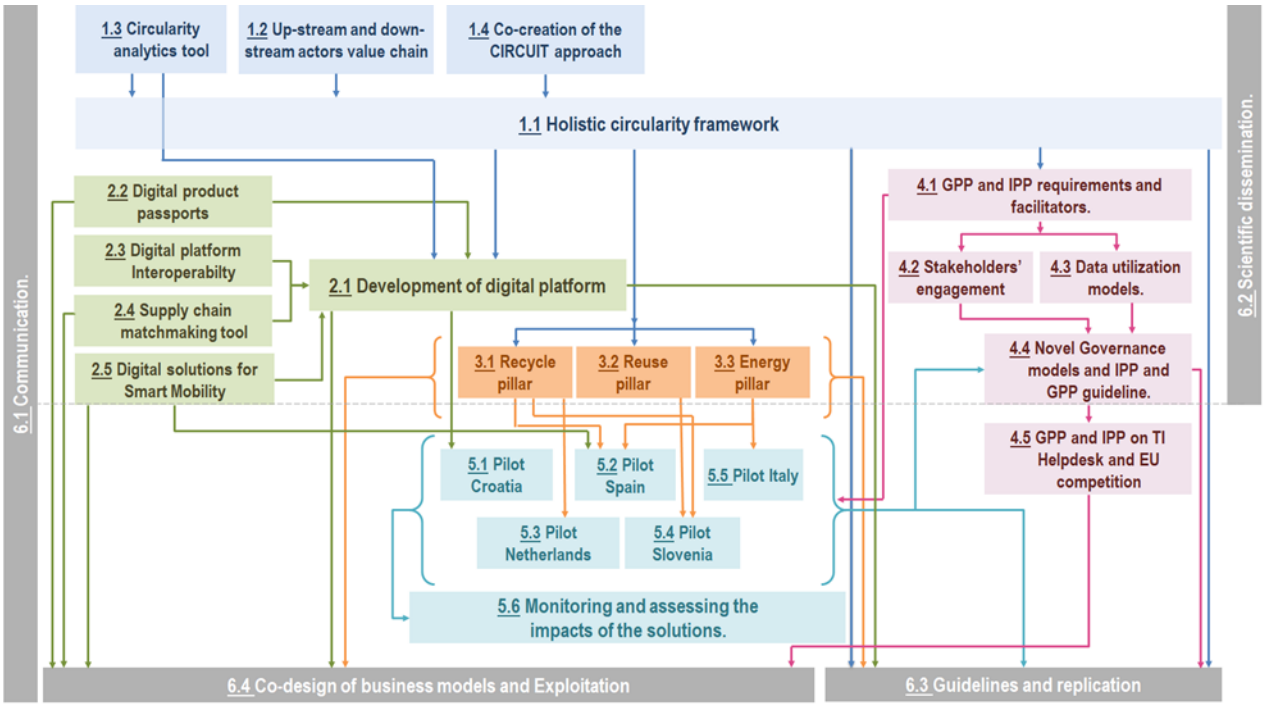

Figure 3: CIRCUIT Pert chart.

The Work Packages of CIRCUIT and Work Package leaders are listed below. Start and end month for each are defined in the Gantt Chart following.

Table 4: CIRCUIT Work Packages (WPs) and WP leaders.

WP No	WP title	Lead beneficiary	Lead physical person	Person-months
WP1	Holistic Approach Setting up & Co-creation	IP	Irina Stipanowic	32.00
WP2	Digital Platform & Solutions for Smart Mobility	DTT	Rahul Tomar	72.70
WP3	Innovative Technologies Validation	FEHRL	Adewole Adesiyun	204.48
WP4	Green & Innovative Procurement Models	ERF	Christophe Nicodeme	69.73
WP5	Implementation & Scale-up	ANAS	Patrizia Bellucci	163.51
WP6	Guidelines, Replication, Dissemination & Exploitation	RC	Esti Sanvicente	60.52
WP7	Coordination, Management & Ethics	FEHRL	Thierry Goger	43.93

The workplan timing is shown below. More concrete timing is provided on WP level in Chapter 6 of the document.

WPs and Tasks		WP/T-L	Month			Year 1												Year 2												Year 3												Year 4											
			Start	End	Dura.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
WP1.	**Holistic approach setting up & co-creation**	**IP**	1	18	**18**																																																		
Task 1.1	Holistic CIRCUIT framework	IP	1	10	**10**																																																		
Task 1.2	Up-stream and down-stream actors value chain	ERF	3	12	**10**																																																	
Task 1.3	Circularity analytics tool	IP	3	18	**16**																																																	
WP2.	**Digital platform & solutions for smart mobility**	**DTT**	6	46	**41**																																																	
Task 2.1	Development of digital platform	DTT	6	24	**19**																																																	
Task 2.2	Digital product passports	IECA	13	36	**24**																																																	
Task 2.3	Digital platform interoperability	DTT	18	46	**29**																																																	
Task 2.4	Supply chain matchmaking tool	DTT	18	46	**29**																																																	
Task 2.5	Digital solutions for smart mobility	UC	18	36	**19**																																																	
WP3.	**Innovative technologies validation**	**FEHRL**	1	36	**36**																																																	
Task 3.1	Recycle pillar	UC	1	36	**36**																																																	
Task 3.2	Reuse pillar	ZAG	1	30	**30**																																																	
Task 3.3	Energy pillar	ANAS	1	30	**30**																																																
WP4.	**Green & innovative procurement models**	**ERF**	1	48	**48**																																																
Task 4.1	G&IPP requirements	ERF	1	18	**18**																																																	
Task 4.2	Stakeholders' engagement in pilots	RC	13	24	**12**																																																	
Task 4.3	Data utilization models	IP	22	30	**9**																																																
Task 4.4	Novel governance models and G&IPP guidelines	ERF	24	36	**13**																																																
Task 4.5	G&IPP helpdesk and EU competition	FEHRL	36	48	**13**																																																
WP5.	**Implementation & scale-up**	**ANAS**	12	48	**37**																																															
Task 5.1	Croatia	HAC	18	48	**31**																																															
Task 5.2	Spain	MITMA	12	48	**37**																																															
Task 5.3	Netherlands	WSHD	12	48	**37**																																															
Task 5.4	Slovenia	CRNA	31	48	**18**																																															
Task 5.5	Italy	ANAS	24	48	**25**																																															
Task 5.6	Monitoring and assessing the impacts	IP	36	48	**13**																																																
WP6.	**Guidelines, replication, dissemination & exploitation**	**RC**	1	48	**48**																																																
Task 6.1	Communication	RC	1	48	**48**																																															
Task 6.2	Scientific dissemination	FEHRL	1	48	**48**																																															
Task 6.3	Guidelines and replication	ERF	24	48	**25**																																															
Task 6.4	Co-design of buisiness models and exploitation	RC	10	48	**39**																																															
WP7.	**Coordination, management and ethics**	**FEHRL**	1	48	**48**																																															
Task 7.1	Project administrative management	FEHRL	1	48	**48**																																															
Task 7.2	Scientific-technical coordination, quality & risk management	IP	1	48	**48**																																															
Task 7.3	Data management	FEHRL	1	48	**48**																																														
Task 7.4	Ethics	FEHRL	1	48	**48**																																														

Figure 4: CIRCUIT Gantt scheme.

4 CONSORTIUM GOVERNANCE

4.1 CIRCUIT GOVERNANCE SCHEME

As mentioned before, CIRCUIT project encompasses **20 partners** and **7 interdependent Work Packages (WPs).** Hence, it is important to establish a governance and management structure that can meet the challenges of a successful project implementation. It is designed in such a way to achieve the following goals:

- Lean structures and procedures for agile and cost-effective project management.
- Balanced distribution of activities & responsibilities among all partners.
- Efficient vertical and horizontal information flow, especially between Work Packages.
- Proactive conflict resolution mechanisms.
- Thorough assessment of potential risks involved.
- Optimal assignment of experienced personnel to the scientific, technical, and managerial tasks.

The project governance structure (Figure 7) is defined as to allow reliable overall coordination, efficient communication, clear decision procedures, workflow giving rise to Deliverables meeting time and quality requirements, all performed in accordance to the European Commission Grant Agreement (GA) and the project Consortium Agreement (CA).

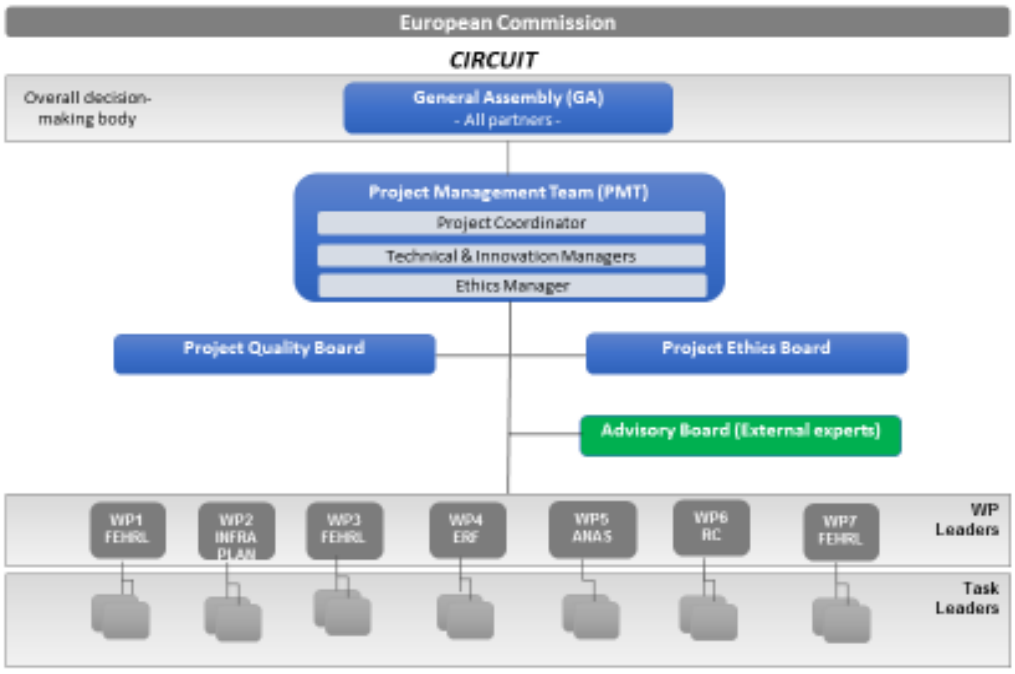

Figure 5: CIRCUIT Project Management structure.

4.2 THE CONSORTIUM

CIRCUIT consists of a multi-stakeholder Consortium of 19 beneficiaries coming from 8 European countries (Belgium, Croatia, France, Germany, Italy, Netherlands, Slovenia, Spain, United Kingdom) and one Associated Partner (Uberbinder) from the United Kingdom, 35% of them are industry and SMEs, 20% of them are research and academia entities, 30% are public bodies while 15% of them are associations. The project Consortium beneficiaries and their type are provided in the table below.

Table 5: The Consortium.

Partner no.	Short name	Name	Country	Type
1	FEHRL (Coordinator)	FORUM DES LABORATOIRES NATIONAUX EUROPEENS DE RECHERCHE ROUTIERE FEHRLAISBL	BELGIUM	Association
2	INFRA PLAN	INFRA PLAN KONZALTNIG JDOO ZA USLUGE	CROATIA	SME
3	INGEO BV	INGEO BV	NETHERLANDS	SME
4	ANAS	ANAS SPA	ITALY	Public Body
5	ZAG	ZAVOD ZA GRADBENISTVO SLOVENIJE	SLOVENIA	Research Organisation
6	ERF	EUROPEAN UNION ROAD FEDERATION	BELGIUM	Association
7	ACCIONA	ACCIONA CONSTRUCCION SA	SPAIN	Large Enterprise
8	IECA	INSTITUTO ESPAÑOL DEL CEMENTO Y SUS APLICACIONES	SPAIN	Research Organisation
9	BL	BETON - LUCKO DOO ZA GRADITELJSTVO PROIZVODNJU TRANSPORT I TRGOVINU	CROATIA	SME
10	CRNA	OBCINA CRNA NA KOROSKEM	SLOVENIA	Public Body
11	RC	RIGHT-CLICK	FRANCE	Association
12	UC	UNIVERSIDAD DE CANTABRIA	SPAIN	University
13	DTT	DIGITALTWIN TECHNOLOGY GMBH	GERMANY	SME
14	UNIZAG GF	SVEUCILISTE U ZAGREBU GRADEVINSKI FAKULTET	CROATIA	University
15	MITMA	MINISTERIO DE TRANSPORTES MOVILIDAD Y AGENDA URBANA	SPAIN	Public Body
16	NGVT	INGEVITY HOLDINGS SRL	BELGIUM	Public Body
17	ALGORAB	ALGORAB	ITALY	SME
18	HAC	HRVATSKE AUTOCESTE D.O.O.	CROATIA	Public Body
19	WSHD	WATERSCHAP HOLLANDSE DELTA	NETHERLANDS	Public Body

Partner no.	Short name	Name	Country	Type
20	UBERBINDER	UBERBINFER LIMITED	UNITED KINGDOM	SME

4.3 CONSORTIUM BODIES

4.3.1 The General Assembly (GA)

The **General Assembly (GA)** in the Consortium is the ultimate and top-level decision body where each project beneficiary is represented by one person (and a proxy). The GA has the overall responsibility for the direction of the project and has the power to agree upon its proposals for the allocation of the project's budget in accordance with the EC Grant Agreement; actions affecting defaulting partners; participation of new partners in the project, by entering into the EC contract and the Consortium Agreement; changes to technical specifications in Annex 1 of the Grant Agreement and exchange of activities between partners. Recommendations for amendments to the work plan, major technical, financial and resource allocation decisions along with periodic and final reports will be submitted to the GA for ratification, including without limitation, decisions regarding technical and business direction of the project, amendments to the DoA and effort allocation, specific contractual issues with the EC, policies for promotion and exploitation of results and financial planning and control and other administrative arrangements.

The main GA duties are:

- Define and maintain overall project objectives, targets, general directions, implementation plans.
- Evaluate the progress of the project & approves progress reports and milestone.
- Elaborate actions needed to be taken in case of deviation.
- Approve changes to Consortium Agreement and contracts. Decide on new consortium partners.
- Handle defaulting parties (if required).
- Agree on (re-)allocation of budget.
- Act on conflict resolution (highest level).
- Maintain procedures for knowledge management.
- Establish quality procedures.
- Review risks.
- Develop dissemination and exploitation plans.
- Coordinate and participate in external relations (press, standardization, etc.);

- Coordinate and participate in operational matters, including reporting and calls for meetings.

4.3.2 The Partner Executive Group (PEG)

The **Project Executive Group (PEG)** makes executive decisions on strategic issues and has a major impact on the overall outcomes and success of the partnership. Major decisions concerning overall technological, innovation and exploitation direction of the project are taken herein. Policies, standards, quality and IPR/knowledge management and publishing procedures will be approved by the PEG. It will also make recommendations for amendments of the EC GA towards ratification by the GA. Overall, the PEG is subject to the decisions made by the General Assembly.

The PEG consists of the following bodies:

- The **Project Management Team (PMT)** that will chair the Board and be responsible for the day-to-day project management and the follow-up of decisions and directions derived from the EC, the PEG and the GA. The PMT shall report to and be accountable to the GA. It consists of the
  - the **Project Coordinator** (Dr Thierry Goger (FEHRL)) who is the unique interface of the project to the EC,
  - the **Technical & Innovation Managers** (Ms Irina Stipanovic (INFRAPLAN) and Mr. Carlos Martin-Portugues Montoliu (ACCIONA)),
  - the **Ethics Manager** (Dr Adewole Adesiyun (FEHRL)).
- The **WP Leaders**, which are responsible for the overall monitoring and performance of the WPs.

4.3.3 The Project Quality Board (PQB)

The Project Quality Board is responsible for supervising the high quality and in-time implementation of the CIRCUIT workplan and its planned outcomes (milestones & deliverables). The QCB consists of the following members:

- the Technical & Innovation Managers (acting also as Quality and Risk Managers),
- the Project Coordinator (FEHRL),
- one internal expert (or more) assigned by each project beneficiary (to be defined in the Quality Manual of the project; D7.2).

4.3.4 The Project Ethics Board (PEB)

The Project Ethics Board (PEB), that will oversee implementing the ethics manual of the project will be developed in this activity and all the processes defined therein. Chaired by FEHRL, it will consist of at least one representative of each test site of the project. The ethics manual will cover the ethical requirements for running the test activities across the test sites and will identify the need for ethics approval by the corresponding national or

institutional committees. Also, it will ensure that GDPR guidelines are implemented. It will define the processes and provide templates for internal project ethical applications forms and informed consent forms in the cases that humans will be involved. Gender and equity issues will be monitored to guarantee equal (to the maximum extent) representations of genders, age groups, mobility limitations and socio-economic groups, to the extent applicable in the project planned activities. The PEB will continuously collect needed information and monitor the project work. If deviations are identified from the defined principles feedback will be given to the relevant partners for mandatory adjustments.

4.3.5 The Advisory Board (AB)

The AB will comprise of experts from public authorities, private companies, scientific community, policy makers etc.

They will be invited to attend workshops, demonstration events etc. Their main responsibilities will be as follows:

- To review the overall scientific, technological and demonstration strategy of the project and ascertain that the innovation concepts introduced and applied are valid, sustainable and replicable.
- To bring in their knowledge and experience to enable global outreach on the basis of best practices.
- To ensure that the project abides to existing standards and policies and will manage to end-up with a meaningful impact assessment and contribution to existing/emerging roadmaps and, to continuously assess the completed and on-going activities, proposing contingency and mitigation strategies whenever required.

In this context, the AB experts will also participate in the quality review of the key project outputs and be members of the PQB of the project.

5 KEY PROJECT MANAGEMENT PROCESSES

5.1 INTRODUCTION

The project management approach is based on management plans and techniques used successfully for other European projects coordinated by FEHRL. CIRCUIT project has a complex organisational structure including partners with complementary and interdisciplinary expertise. It requires an efficient management structure, which can handle the complexity and assure a smooth implementation and achievement of its ambitious goals. The aim of the management structure and procedures is to organize and manage the foreseen resources in such a way that the project is completed within the defined scope, quality, and time and cost constraints. The general purpose of the project management activities are financial, administrative, scientific and knowledge & innovation aspects, i.e. coordination of activities, analysis and design of objectives and events, planning the work according to the objectives, risk management, allocation and controlling of resources, assigning tasks, controlling project executions, tracking and reporting progress, analysing the results based on the facts achieved, forecasting future trends in the project, quality management, conflict resolution, identifying, managing & controlling changes, project closure, coordination of dissemination activities, management of intellectual property.

5.2 DECISION PROCESS AND CONFLICT RESOLUTION

The PEG will provide a forum for the discussion of major management issues and technical issues. Their decisions are binding for the project and will be based on recommendations from the PMT. The PEG will decide on the work plan and will prepare proposals for the European Commission.

All reports, including the Progress Reports and the Deliverables will be discussed and approved before being sent to the Commission.

The procedures for decision-making within the PEG follow a majority vote, with the Project Coordinator having the casting vote. Each entity participating in the General Assembly has one vote. It can also amend PEG's decisions with a 2/3 majority.

The General Assembly serves as an overall monitoring board and holds a decision-making role mainly when a serious disagreement occurs in the PEG.

Day-to-day decisions at the technical level will be taken by the PMT.

For any conflict or dispute that arises in the work of one or more partners, first, the partner or partners involved will try to immediately deal with the contingency. In case this is not achieved, the steps listed below will be followed in their respective order:

- Involvement of the WP leader (if applicable) to resolve the issue.
- Involvement of the Technical & Innovation Manager.
- Involvement of the Project Coordinator.

- Notification to the Project Executive Group.
- If a resolution is not achieved after all the above steps are taken, the issue will be brought to the attention of the EC.

5.3 TASK AND RESOURCE MANAGEMENT

To manage and document the project's results in the most efficient way, activity execution and management will be organised in a distributed way, following the project structure defined in the DoA, by the leaders of task management at each level as seen below:

- 1st level: Task
- 2nd level: Work Package (WP)
- 3rd level: Project Management Team (PMT)
- 4th level: Project Executive Group (PEG)
- 5th level: General Assembly (GA)

Progress, task execution, use of resources and risk management involved in the preparation of each Deliverable is followed by Task, and WP. Each Partner involved in each Task will be required to report to the Task leader on progress and achievement of targeted outcomes in which they are involved according to the work programme and of the DoA. These targeted outcomes shall include, but not be limited to, the following:

- Deliverable and Task objectives for the period.
- Work progress towards objectives over the time covered (including meetings and teleconferences).
- Internal Control Points/Milestones/Deliverables achieved in the period.
- Explanation of the gaps and their impact on other tasks.
- Reasons for failing to achieve critical objectives and/or not being on schedule, and impact on other tasks as well as on available resources and planning.
- Level of Key Achievement Indicators and foreseen Innovation fulfilment.
- Corrective actions planned or taken.

Work Package leaders will oversee the Task' progress and use of resources and report the advancement to the Technical and Innovation Managers. The Technical and Innovation Managers will liaise with the coordinator and bring to his attention the progress, risks and issues that need to be managed at that Project Management Team level. Key strategic and critical issues will also be brought to the attention of the Project Executive Group. Finally, management of Consortium level issues is done at the level of the General Assembly.

5.4 PROCESS FOR INITIATION / PLANNING OF WPS AND TASKS

- Technical and Innovation Manager requests WP leaders to initiate their WPs.
- WP leaders request Task leaders to initiate tasks.
- Task leaders come back with working document/detailed plans.

5.5 PROCESS FOR WPS AND TASKS PERFORMANCE

- Each partner responsible for performing part of a task prepares an internal report with the results obtained as soon as the task finishes. This internal report is sent to WP partners.
- WP partners send comments, if any, on this report within 5 days. The author revises the report and submits the final one to the WP leader with copy to all partners.
- If one or more activities result into a Deliverable, the Deliverable main author synthesizes the tasks internal reports into the expected Deliverable.
- The Deliverable main author submits the Deliverable for peer review with a notification to the Quality Manager, the respective WP leader, and the Technical & Innovation Managers.
- The Quality Manager follows the process as it will be defined in D7.2 (Project Quality Assurance, Ethics Manual and Risk Assessment Plan).
- The Deliverable Author sends the Deliverable for submission to the Coordinator, after conforming to the Peer Review process outcomes, with notification to the Quality Manager, the respective WP leader and the Technical & Innovation Managers.
- The Coordinator submits the Deliverable to the European Commission, with notification to the Author, the Quality Manager and the Technical & Innovation Managers.
- As soon as all Deliverables and their official/unofficial updates in a WP are submitted to the European Commission through the Coordinator (after having been peer reviewed), the WP is considered closed.

5.6 COMMUNICATION TOOLS AND MECHANISMS

In order to avoid an excessive use of emails that would result in a potential loss of information, especially in such a big Consortium, and having in parallel the need to keep the whole Consortium well informed and always up to date of the project progress, the project communication mechanisms will reflect the structure of the project, and be targeted as much as possible to as much as possible dedicated group of members in each case.

To obtain maximum flexibility, transparency, and awareness, all the documents in the project shall be transmitted and published via **Microsoft Teams**. In addition, and on

complementary basis, direct transmission of information to the partners will be used where appropriate via email.

The objectives and advantages of such a tool are namely:

- Targeted team communication.
- Centralised meeting information: agenda, minutes, etc.
- Document repository.
- Multi-platform / multi-device access.
- Flexible and customizable

5.7 PROJECT MEETINGS

To ensure a rapid and efficient launch of the project tasks, dedicated management tools and procedures, fitting all specific management requirements will be proposed from the start of the project. These tools will be placed under the responsibility of the Project Executive Group, the Project Management Team, the Work Package Leaders, and the Task Leaders. As mentioned in the previous section, Microsoft TEAMS is the tool to be used for meeting management and record keeping.

To ensure the project maintains rhythms and a team dynamic, the project will be oriented around team meetings on several layers, as listed in the table below. Overall, the following process will be followed for any type of meeting.

- Before each scheduled meeting (of any type), the initiator prepares a draft agenda and sends it to the expected participants for revision and finalisation.
- During the meeting, the initiator/chair of the meeting (of any type) is responsible for keeping minutes. Minutes are sent within 10 calendar days after the meeting end and comments from participants are accepted within 15 calendar days.
- The meeting initiator/chair sends the final revised meeting minutes to the whole team concerned in each case within another 2 calendar days.

In specific, the Coordinator announces the General Assembly meetings at least 45 calendar days in advance, except for extraordinary cases in which meetings may be called at short notice.

The anticipated meetings flow in the project upon the various layers is as follows. Depending on the case, they may either physical or virtual.

Table 6: Meetings frequency, goal, and participants per consortium body

Consortium body	Frequency	Participants
General Assembly (GA)	At least twice a year	At least one representative of each beneficiary
Project Management Team (PMT)	Monthly	The Coordinator, the Technical & Innovation Managers and the Ethics Manager

Consortium body	Frequency	Participants
Project Executive Group (PEG)	At least quarterly	• Project Management Team which consists of the Coordinator, the Technical & Innovation Managers and the Ethics Manager • Task leaders
Work Packages	Meetings will be convened as many times required and upon decision and request by the WP leader and whenever possible and for physical meetings, in conjunction with other physical meetings to save resources.	Work Packages partners

5.8 REPORTING PROCESSES

5.8.1 Internal reports

Twice during the project duration (M8 and M27), the Project Coordinator (FEHRL) will coordinate the production of an Internal Report (financial and technical) in collaboration with INFRAPLAN and ACCIONA based on a template that will follow the guidelines provided by the PO and will follow the same principles – though in a lesser extent - as the formal progress reports. The template will be made available before each Internal Report is due, as it may be subject to small changes from one internal reporting period to the other depending also the comments and requests of the PO.

The provisional – upon PO confirmation - content of the template is as follows:

- Summary on progress and highlights
- Progress towards the planned objectives
- Deviations from Annex 1 of the GA
- Statement on the use of resources
- Critical implementation risks and mitigation actions
- Dissemination activities, scientific publications, and intellectual property rights

All partners will send their completed templates back to the Project Coordinator who will review them. Once approved, they will be collated into a comprehensive Internal Report.

5.8.2 Periodic reports

There are three official reporting periods in CIRCUIT. The official reporting periods will end with the submission of a formal periodic report to the European Commission. The different components of the periodic reports need to be submitted at once (single submission system), and within 60 days since the end of the reporting period.

The reporting periods are:

- RP1: from month 1 to month 18
- RP2: from month 19 to month 36
- RP3: from month 37 to month 48

A periodic report is composed of two main reports:

- Technical report
- Financial report

In the last Periodic Report, there will be an additional section on the overview of results, conclusions of the Action and the socio-economic impact of the Action.

5.8.3 Amendments

Though deviations vs Annex 1– technical and financial – will be reported in the periodic reports, a specific process will be administered on a yearly basis in the project respectively. The goal will be to reflect all requests for deviations, communicate to the PO so that he responds to which of them adhere to official amendments or not.

The process will be triggered and organized centrally by FEHRL through the TEAMS, via the following table once a year (unless an extraordinary urgent/blocking case arises). Consolidation and communication to the EC will be held by the FEHRL.

Prior to any consolidation and communication to the EC, the PMT in first place and in turn the PEG will review the beneficiaries request and may accept or not the request. If accepted, will move forward to the next phase which is the inclusion in the consolidated table for the EC.

Table 7: Indicative table for deviation/amendment requests.

Request ID	Request description	Initial state	Justification	Relevant Task/ WP	Initiator beneficiary	Affected beneficiaries	Expected impact

5.8.4 Corrective and preventive actions

The formal description of the procedure is given below.

1. The PMT identifies need for corrective actions (i.e. could be originated also from a beneficiary/PEG request).
2. The Coordinator notifies the PMT, the PEG (if not the initiator) and the respective WP and Task leader (s). The relevant request is documented in the appropriate form of **Annex 1**.

3. The WP leader discusses the issue with the respective Task leader(s) and beneficiary and comes up with the proposed solution. The proposal on corrective action is also using **Annex 1** form.
4. The solution is communicated to the PMT and is forwarded to the PEG via the Coordinator.
5. The PEG decides on the matter. The decision shall be documented according to the template of **Annex 2**. The Coordinator sends this to all involved parties and checks that the actions decided are implemented. If the corrective action adheres to an amendment, the process described in the previous section is followed.

6 INCEPTION REPORT

This Chapter presents the Inception Report of the project, meaning the elaborate description of the approach to be followed across each Task of the workplan and according to the current vision of the Consortium. It should be seen as complementary to the GA content. Although this may be revisited in near future, as it is quite early in the project, it will stand, in its current and revised versions, as the reference document for the work to be held in CIRCUIT towards fulfilling the goals and delivering the outcomes it has committed to.

6.1 WORK PACKAGE 1 – HOLISTIC APPROACH SETTING UP & CO-CREATION – INFRA PLAN [M1-M18]

6.1.1 WP Objectives

- Co-creation of the CIRCUIT holistic framework for circular, smart, resilient, and sustainable transport infrastructure management,
- Definition of Key Performance Indicators for Resilience, Circularity, Economy, Sustainability, etc. and the contribution to the digital transformation and innovative and green procurement.
- Setting up the scope, indicators, supply/value chain roles and the requirements and functionalities of the associated digital platform.
- Development of Circularity Analytics Tool (CAT) for estimating the environmental impacts of design, maintain and end-of-life alternatives for transport infrastructure materials and components.

6.1.2 WP overall methodology

Partners involved in WP1 (IP, UC, DTT, ACC, ERF, BL, IECA), will cooperate closely to achieve the objectives of WP1 and to provide important inputs for all other WPs. WP1 has important goal to link the industry and academic partners, which will give important inputs for the development of KPI holistic CIRCUIT framework. The work is divided into three tasks, starting from setting up the baseline using literature and surveys on circularity KPIs and existing frameworks, over collecting data about the actors needs across the whole value chain, and finally developing circularity analytics tool which will allow the users to analyse different decision-making scenarios and determine their impacts.

All the partners involved in WP1 will ensure a continuous collaboration and development of all necessary inputs for the development of KER 1 The CIRCUIT open source digital platform.

6.1.3 Methodology on Task level

6.1.1.1 Task 1.1: Holistic CIRCUIT framework – IP [M1-M10]

This task will firstly establish the baseline for the CIRCUIT holistic framework development for circular, smart, resilient and sustainable transport infrastructure. This will include following steps (in the M01-M06):

- overview of the construction materials and products which will be used in pilot projects.
- collection of data about the current certification approaches in Pilot project and consortium partner countries.
- collection of KPIs which are used for the assessment of technology, environment and costs.
- literature review on existing methodologies for resilience, economy, and circularity impact assessment, using KPIs.

6.1.1.2 CIRCUIT framework will be developed using quantifiable KPI metrics in the 2nd period of the Task 1.1 (M06-M10). This framework will link performance based design, construction, maintenance, operation and decommissioning of the transport infrastructure by providing following: i) a set of indicators and metrics for product (concrete, asphalt, equipment, etc.) and system (bridge, road, tunnel, etc.) level, ii) quantitative and holistic category-based KPI metrics, iii) requirements for data visualization and analysis of KPIs in digital platform (WP2). The applicability and the capabilities of the developed holistic circularity framework will be demonstrated through pilot projects in WP5.Task 1.2: Up-stream and down-stream actors value chain – ERF [M3-M12]

This task will firstly identify major barriers for the use of circular management and GPP for transport infrastructure by screening up-stream and down-stream actors needs and requirements. The following steps are already under development (M3-M9):

- Identification of key stakeholders related to pilot projects in Croatia, Slovenia, Spain, Italy and the Netherlands
- an online survey and interviews aimed to collect the data from up-stream and down-stream actors in the value chain about their needs, obstacles and barriers for the implementation of GPPs
- Screening of the regulatory framework and existing standards in EU countries
- in-depth literature review

Based on the literature review, survey and interviews the barriers will be identified and categorized according to their nature, (regulatory, technical, social or economic). Based

on the identified barriers, a detailed analysis of needs and requirements for the whole value chain will be provided (M9-M12).

6.1.1.3 Task 1.3: Circularity Analytics Tool – IP [M3-M18]

This task develops a circularity analytics tool (CAT), for the assessment of the environmental impacts of design, maintenance and end-of-life alternatives for transport infrastructure. The tool will be integrated into BIM models and linked to the CIRCUIT digital platform (WP2) to quantify waste impacts throughout the entire lifecycle. To make it software-independent, the tool will be based on the IFC standard. The following steps are going to be performed:

i) The tool requirements are defined including, the associated calculation models and the required input parameters(DTT, IP). The IFC file will be obtained directly from DPP developed in task Task2.2. (DTT). (M3 – M6)

ii) The next step is the development of a circularity analytics tool with a graphical interface to allow users to customize the analyses they want to perform. This will allow the environmental impact assessment of the construction scenario considered including the lifecycle costs (IP). (M6-M12)

iii) By running different life cycle management scenarios (IP, UC), and computing their associated metrics (LCC and LCA KPIs identified in T1.1), it will be possible to perform circularity assessments of design solutions. (M12-M15)

iv) The final step is updating the API developed before to allow sending the KPI calculation results back to the BIM model and to the digital platform. (M15-M18)

Using this quantitative tool, stakeholders will be able to assess their decision-making alternatives, track their transition towards circular economy, conduct temporal analysis, and benchmark their performance against their peers and industry's standards.

6.1.4 Interrelations to other WPs and Activities

Input:

- WP1 is first working pacakge, from M1, and mostly providing inputs for other WPs
- Interrelated work with WP2 and WP4.

Output:

- CIRCUIT holistic framework (D1.1) is input for WP2 Digital Platform
- Quantification methods for KPIs (D1.1) are inputs for WP3 Innovative Technologies, WP4 Data utilization models, and for WP5 for all pilot projects

D1.2 Up-stream and down-stream supply-chain actors needs are input for WP4 GPP modelsD1.3 Circularity analytics tool is input for WP Digital platform and for WP5 Pilot projects

6.1.5 Critical Risks

Table 8: Relevant critical risks and currently identified mitigation measures.

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	Lack of availability engagement within the expert group may affect the baseline assessment and inputs for holistic approach development.	Mix of expertise in the consortium and Advisory Board, as well in the association networks (FEHRL, ERF, IECA) will ensure high level input. Although very unlikely to be required, replacement expertise will be obtained from within road stakeholders, agencies and industry.
2	Lack of data as an input for building up models and demonstrators in the tools	Engagement of road and motorway owners (ANAS, MITMA, HAC), and industry partners involved in pilot projects as well as several research organizations that have already developed collaborations with the owners, will ensure access and collection of input of data. Partners already possess lots of data.
3	Lack of availability engagement within the expert group may affect the baseline assessment and inputs for holistic approach development	Mix of expertise in the consortium and Advisory Board, as well in the association networks (FEHRL, ERF, IECA) will ensure high level input. Although very unlikely to be required, replacement expertise will be obtained from within road stakeholders, agencies and industry.

6.1.6 Expected outcomes

Table 9: WP Deliverables.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D1.1	Report on CIRCUIT holistic framework with quantifiable KPIs for circular, smart, resilient and sustainable transport infrastructure.	IP	R	PU	10	Report on CIRCUIT holistic framework with quantifiable KPIs for circular, smart, resilient and sustainable transport infrastructure.
D1.2	Up-stream and down-stream supply-chain actors needs	IECA	R	PU	12	Report on identified barriers for GPP and IP uptake, regulatory framework in EU countries and

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						existing standards, and analysis of needs and requirements for the whole value chain.
D1.3	Circularity analytics tool	IP	R	PU	18	Tool for the assessment of the environmental impacts of design, maintenance and end-of-life alternatives for transport infrastructure circularity, demonstrated on number of products and systems.

Table 10: WP key Milestones (as of G.A.).

No	Milestone Name	Lead Beneficiary	Means of Verification	Due Date (Month)
MS1	Holistic Circularity Framework	IP	Holistic framework defined and D1.1 approved by SC	10

6.2 WORK PACKAGE 2 – DIGITAL PLATFORM & SOLUTIONS FOR SMART MOBILITY – DTT [M6-M46]

6.2.1 WP Objective(s)

- Creation of an open-source digital platform for the whole supply/value chain (incl. Digital Product Passport and supply-chain matchmaking tool) to facilitate the uptake of CIRCUIT principles and link with the selected engineering, environmental and economic tools.
- Create a CIRCUIT Digital platform capable of interacting with multiple digital ecosystems within the industry and in this project, we will be demonstrating the interoperable and interaction work with Autodesk, Trimble, and ISTRAM ecosystem.

- The design and development of solutions for the design, adaptation and management phases of transport infrastructure to mitigate congestion and minimize accidents, incidents and fatalities.

6.2.2 WP overall methodology

Partners involved in WP2 (DTT, IP, ACC, IECA, BL, UZ, HAC, MITMA, UC) will collaborate closely to achieve the objectives of WP2 and provide essential inputs for other WPs. WP2 serves as a pivotal point, creating a digital platform and smart mobility solutions that will connect various aspects of the CIRCUIT project. The work is divided into several tasks, starting from the development of the digital platform, digital product passports, interoperability, supply-chain matchmaking tools, and digital solutions for smart mobility. This collaboration will ensure the effective integration and utilization of digital technologies within the project's scope.

6.2.3 Methodology on Task level

6.2.1.1 Task 2.1: Development of digital platform – DTT [M6-M24]

This task aims to establish the CIRCUIT digital platform for infrastructure Life Cycle Assessment (LCA). Instead of building the platform from scratch, existing digital twin capabilities will be enhanced for alignment with CIRCUIT goals. The methodology includes:

- Establishing a Common Data Environment (CDE) that links waste, SRM, SCE, byproducts, and biomaterials datasets.
- Implementing a linked database concept to enhance data accessibility.
- Setting up an open-source graph database and utilizing SPARQL language for efficient data querying.
- Incorporating blockchain technology for secure data transactions.

6.2.1.2 Task 2.2: Digital product passports – IECA [M13-M36]

This task will develop digital material passport for sustainable construction projects using BIM / digital twin and enables the shift to a circular and low carbon infrastructure sector by selecting most appropriate products and materials (low carbon, high amount of recycling components and high technical performance) and by setting up effective recovery and reuse of components, products or materials in infrastructure requires of an easy identification and that the right information is easily accessible. This identification and information are also crucial for choosing materials, products and components that later can be re-used. CIRCUIT digital product passports (DPPs) aims to: increase the value or keep the value of materials, products and components over time, create incentives for suppliers to produce healthy, sustainable and circular materials/building products, make it easier for developers, managers and renovators to choose healthy, sustainable and circular building materials. European Commission is planning to introduce a DPPs in

the coming months that would serve as an inventory of all materials, components and raw materials used in a product or building, along with information on their location. CIRCUIT DPPs will support the development and implementation on the demonstration sites. The digital product passport under consideration by the CIRCUIT relies heavily on the digital infrastructure and five years of experience of Madaster, the "material register". CIRCUIT will let this DPPs open source for the use within the ecosystem. This digital passport shall be integrated with digital twin platform of DTT for the proper visualization together with 3D model of infrastructure.

6.2.1.3 Task 2.3: Digital platform interoperability – DTT [M18-M46]

This task will deal in the development of interface for the communication and exchanging information in between existing digital ecosystems and CIRCUIT digital platform based on the building information exchange standards. Further we will explore alternative data standards for future of construction or as we say Construction 4.0 Partner DTT has developed the LCA ontology called "Platology" under the H2020 project ASHVIN that will be considered within CIRCUIT for data exchange. Seamless data exchange between field data capture technologies and collaboration technologies should be performed based on the search for the interoperability between them. Linked data concept shall be used to store data in digital platform for the very sole purpose of interoperability make easier to ecosystem. For the interface JSON format shall be considered via RestAPI software.

6.2.1.4 Task 2.4: Supply chain matchmaking tool – DTT [M18-M46]

This task will develop a digital matchmaking method, which matches the availability of valuable materials in the built environment (existing transport infrastructure) with the possibilities for their recovery, including the digital technologies developed in Tasks 1.3, 2.1, 2.2 and 2.3. The methodology involves:

- In a first step a method for matchmaking the existing infrastructure stock with future projects, ensuring the supply and demand requirements, will be developed by using data from blockchain-based DPP platform (T2.2), which enables identification and localization of the materials and elements, validation of the quantity and quality estimates and finally connecting them to new projects.
- In a next step, the method will be transferred into a tool and tested in collaboration with designers, highway managers/owners, whose catalogue of assets contains large number of different types of assets (e.g., bridges, tunnels, pavements) in different stages of life cycle. In order to develop medium and long-term strategic planning to be in line with Circular Action Plan requirements, different scenarios will be illustrated and used for validation purposes.

6.2.1.5 Task 2.5: Digital solutions for smart mobility – UC [M18-M36]

Subtask 2.5.1: Application for Real-time Management of Smart Mobility Systems

The following applications will be developed as demonstrative examples of real-time decision-making tools. Specifically:

- Management of traffic situations derived from recurrent congestion, possible incidents in lanes and/or emergency/safety situations (making use of data collected in real time from the infrastructure itself and/or from the vehicles and with traffic prediction models).
- Management of loading/unloading zones in urban areas (using devices deployed in the area of action); and environmental management (low emission zones and/or management of pollution episodes) through the mapping of air quality by means of a network of low-cost sensors, calibrated together with the traffic and mobility microsimulator

The scenarios in which these demonstrable scenarios will be discussed with the Joint Research Centre experts to consider their inputs for the final application proposes.

Subtask 2.5.2: Simulator for Evaluating Transport Infrastructure Design in Mixed-Driving Scenarios

The following applications will be developed as demonstrative examples of real-time decision-making tools. Specifically:

A driving simulator will be developed to evaluate infrastructure design variables in mixed driving situations (autonomous and non-autonomous vehicles). For this purpose, a traffic microsimulation model, in which different simulation scenarios will be programmed with APIs, will be combined with a driving simulator. Thanks to this simulator, the collaborators with the experiment are presented in an immersive way with the situation reproduced in the microsimulation, returning the user's response (interaction with the vehicle controls) to the microsimulation. This will finally allow the use of a risk assessment model, which measures the danger with different indicators based on the trajectories of the vehicles, without the need for crashes. This will allow conclusions to be drawn for the final design of new infrastructure or adaptation of existing infrastructure as more autonomous vehicles are integrated, to subsequently link this simulator to infrastructure design and management tools, enriching the digital platform and assessing the impacts of design alternatives prior to construction.

6.2.4 Interrelations to other WPs and Activities

Input:

- WP2 plays a central role in developing the CIRCUIT digital platform that will be used in various other WPs.
- WP2 will be deploying the outcomes of WP1 into developing the digital solutions.
- Interconnected work with WP1 and WP5.

Output:

- The CIRCUIT digital platform developed in WP2 will serve as a critical input for WP3 and WP5.
- D2.3 Supply Match-making tool will be an input for T3.2.
- Digital product passports (DPPs) D2.2 will provide inputs for WP5 pilot projects.

6.2.5 Critical Risks

Table 11: Relevant critical risks and currently identified mitigation measures.

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	Lack of data as an input for building up models and demonstrators in the tools	Engagement of road and motorway owners (ANAS, MITMA, HAC), and industry partners involved in pilot projects as well as several research organizations that have already developed collaborations with the owners, will ensure access and collection of input of data. Partners already possess lots of data.
2	Poor understanding of the digital technology and its intended use	Industry partners involved in the project are direct users of the technology which is developed and upgraded. Further dissemination will demonstration workshops which will act as an face-to-face and online teaching aid to help the initial development of the digital tunnel twin and its application and usage in the processes.

6.2.6 Expected outcomes

Table 12: WP Deliverables.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D2.1	Digital Platform	DTT	D	PU	24	Demonstration of the open-source digital platform, with integrated information from different products and processes.
D2.4	Real-time traffic management on smart	UC	R	PU	24	A report including a literature review of the existing

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
	mobility systems					infrastructure, devices, and new trends in traffic management strategies, an analysis of real applications already implemented and related projects and the description of the pilot application of the proposal: infrastructure, deployed devices and implemented strategies.
D2.2	Digital product passport	IECA/IP	R	PU	36	Report with requirements for DPP for construction products, and related existing regulatory framework.
D2.5	Transport infrastructure assessment based on the integration of traffic and driving simulators	UC	R	PU	36	This report includes the state of the art analysis of traffic and driving simulators comparing different simulation hardware commercial solutions and the description and structure of the integration of the proposed open source

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						simulators: CARLA for human integration and SUMO for traffic modelling.
D2.3	Supply – chain matchmaking tool	DTT	R	PU	40	Report on digital matchmaking method, which uses DPP and matches the availability of valuable materials and elements in the existing transport infrastructure with the needs in the new projects.

Table 13: WP key Milestones (as of G.A.).

No	Milestone Name	Lead Beneficiary	Means of Verification	Due Date (Month)
MS3	Open source digital platform	DTT	Digital platform approved by SC and ready for validation	24

6.3 WORK PACKAGE 3 – INNOVATIVE TECHNOLOGIES VALIDATION - FEHRL [M1-M36]

6.3.1 WP Objectives

The main objective of WP3 is the development, assessment and validation of the most suitable technologies for the recycle, reuse and energy CIRCUIT Strategic Pillars. Specifically, WP3 will address:

- The development of new solutions for the preparation of asphalt and concrete mixtures and for subgrade stabilization with low carbon footprint, by using secondary materials achieving similar performance than that of their conventional alternatives.
- The engineering validation of structural components implementing reuse and material minimisation principles through the use of secondary elements and

materials, design for disassembly and adaptability and parametric and/or generative design.
- The design and development of solutions for the reduction of emissions through more efficient energy management on transport infrastructure operations.

6.3.2 WP overall methodology

Partners involved in this WP will collaborate closely to achieve objectives defined in WP3, which is divided in three tasks associated to each one of the strategic CIRCUIT pillars (recycle, reuse and energy). In these tasks different solutions will be demonstrated at a controlled environment before their implementation in a real scenario in WP5. It requires first the identification of the requirements of the solution, second the design and characterization of the solutions to validate that they meet the expected properties (for example through laboratory tests) and third the selection of the best solutions to be adopted for their implementation in WP5.

6.3.3 Methodology on Task level

6.3.1.1 Task 3.1: Recycle Pillar – UC [M1-M36]

Subtask 3.1.1. Advanced materials to maximise the use of RA for the design of new asphalt mixtures.
Three technologies will be developed in this subtask. The steps to follow for these developments are summarized below.

Use of sulfur based low-carbon organic polymer binder engineered from industrial and agricultural byproducts in two separate formulations for use with 20%/50%/70% of RA as follows:

1. As a standalone sulfur based low carbon organic polymer binder product
2. As a hybrid binder product mixed with bitumen to create an entry level product

Steps to create and use sulfur based low carbon organic polymer binder product (UB)

1. Define mixture specifications in relation to required RA content.
2. Define expectations on resulting mixture specification for the Horizon CIRCUIT trial.
3. Consideration of application approach with constructor.
4. Development of an application strategy including plant and machinery specifications and time from plant to site with constructor.
5. Agreement on parameters for formula development relating to construction – delivery to plant, viscosity, pumping speeds, distance to site etc.
6. Consider approach to formula adjustments to the UB base binder formula to achieve optimum specification for Horizon CIRCUIT trial using CMA approach.
7. Development of formulation for 100% CMA UB trial.
8. Development of formulation for Hybrid CMA trial at 20%UB/50% UB addition.

9. Test laboratory formulations for DMA/GPC to establish correct viscoelasticity and phase angle results.
10. Assess results with laboratory and engineering partners
11. If results are acceptable proceed to step 9. If there is further development required return to steps 6,7,8.
12. Proceed to bench manufacture of 2 – 4Kg sample of each formulation for mix design testing.
13. Gather preferred aggregate material and RA material for mix testing from contractor to ensure close match to test material to be deployed.
14. Undertake design and characterisation of asphalt mixtures with 20/50/70% RA content with UB formula for CMA.
15. Undertake design and characterisation of asphalt mixtures with 20/50/70% RA content with UB Hybrid formula for CMA.
16. Assess results leading to decision to repeat steps,6,7,8 to adjust formula and/or repeat steps 11/12 to adjust composition.
17. Repeat until optimum mixture is obtained for trial.
18. Develop scale up plan with binder manufacturer to create a pilot sample of 10 tonnes per 150m of road for each of UB and UB Hybrid mixtures.
19. Manufacturing test sample to be trialled through steps 11/12.
20. Assessment of test results.
21. Manufacturing of pilot sample subject to success at step 16/17.
22. Consideration of application approach with constructor.
23. Adaptation of constructor strategy with 'live' samples to test viability prior to trial.
24. Trial application of specified formulas.

Steps to be completed before the GA meeting (October 2023): 1-3
Steps to be completed by the end of 2023: 1-8 (first round)
Coordinator: Jonathan Davis

Use of biobinders from crude tall oil and investigation of asphalt production mixtures at a reduced temperature.

1. Define mixture specifications in relation to required RA content
2. Gather materials (bitumen, aggregates and RA) and selection of the most suitable additives to work at reduced temperatures (warm and half-warm mix asphalt).
3. Characterization of the reference binder (conventional penetration grade bitumen without pitch tall oil).
4. Test laboratory formulations with bitumen/pitch tall oil (PTO) blends.
5. Characterization of the binder formulations prepared (fundamental tests and DSR on aged and unaged binder formulations).
6. Definition of the most promising binder formulations based on the assessment of the results in step 5.

7. Design and characterisation of reference asphalt mixes (without PTO). These include the development of hot mix asphalt (HMA), warm mix asphalt (WMA) and half-warm mix asphalt (HWMA).
8. Design and characterisation of asphalt mixtures (HMA, WMA and HWMA) with up to 50% RA content with the most promising bitumen/PTO formulations (see step 6).
9. Assessment of the results and repetition of steps 4-5 and 8, if needed, until a mixture with acceptable properties is obtained.
10. Definition of the optimum asphalt mix for the Circular Road Simulator.

Steps to be completed before the GA meeting (October 2023): 1, 2 & preliminary testing part of step 3.
Steps to be completed by the end of 2023: 3, 4 & 5 (first binder formulations)
Coordinator: Raque Casado (ACC) & Julien Buisson (NGVT)

Use of a novel highly polymer modified bitumen (HPMB)

1. Define mixture specifications.
2. Collection of materials (HPMB, RA with PMB, aggregates, conventional PMB).
3. Characterization of materials (HPMB, RA with PMB, aggregates, conventional bitumen).
4. Mix and characterization (aged/unaged) of bitumen (conventional and HPMB) incorporating 50% old bitumen from RA
5. Design and characterization of asphalt mixtures with PMB.
6. Design and characterization of asphalt mixtures with 50% of RA (with PMB) and conventional bitumen.
7. Design and characterization of asphalt mixtures with 50% of RA (no PMB) and conventional bitumen.
8. Design and characterization of asphalt mixtures with 50% of RA (PMB) and HPMB
9. Design and characterization of asphalt mixtures with 50% of RA (no PMB) and HPMB
10. Adjust composition of HPMB if needed
11. Repeat steps 3, 7, 8 and 9 until an optimum mixture is obtained.
12. Fabrication of large slabs for the Circular Road Simulator
13. Evaluate and compare mechanical performance of the three technologies (sulfur based low carbon organic polymer binder, biobinders and HPMB) at the road simulator.

Steps to be completed before the GA meeting (October 2023): 1 & 2.
Steps to be completed by the end of 2023: 3 & 5.
Coordinator: Irune Indacoechea, UC

Subtask 3.1.2. Secondary Raw Materials for subgrade stabilisation
A set of optimized solutions will be developed to stabilize a range of soils with poor characteristics (loose fill soils and soft subgrade soils) by utilizing and optimized content of the industrial by-products.
The following steps are planned:

1.1. Screening of available by-products in the Netherlands & throughout the Europe
1.2. Analysis of the previous works of soil stabilization using by-products

2.1. Establishment of the soil sampling programme
2.2. Obtaining the samples of soils with range of properties
2.3. By-product acquisition (a range of by-products)

3.1. Establishment of the mixture testing programme
3.2. Transport of samples and by products to UZ laboratory
3.3. Laboratory test on mixtures
3.4. Data processing and interpretation

4.1. Numerical simulations for impact of improved soil on critical infrastructure
4.2. LCA simulations for improved soil
4.3. Algorithm for the optimized designed mixtures for different soil types

Steps to be completed before the GA meeting (October 2023): 1.1
Steps to be completed by the end of 2023: 1.1, 1.2, 2.1
Coordinator: Meho Saša Kovačević / Mario Bačić, UZ

Subtask 3.1.3. Concrete for prefabricated slabs and for 3DCP safety wall incorporating recycled materials

Prefabricated slabs

1. Define the concrete specifications;
2. Shortlist concrete components (cement, aggregate, admixtures, suitable recycled materials);
3. Develop initial mix design;
4. Laboratory scale trial mix and assessment of properties for the initial mix design;
5. Based on properties of the initial mix modify and finetune the mix design;
6. Subsequent laboratory scale trial mixes and assessment of properties until optimized mix design is established;
7. Full scale trial mix on the batching plant and assessment of properties;
8. Finetuning of mix design and process until optimized concrete fulfilling specifications is reliably produced;
9. Fabricate concrete slabs for small-scale superstructure prototype testing;
10. Acquire Slovenian Technical Approval;

Steps to be completed before the GA meeting (october 2023): 1 and 2.
Steps to be completed by the end of 2023: 1, 2 and 3.
Coordinator: Sandra Skarić Palić, IP

3DCP safety wall

1. Define the concrete specifications;
2. Shortlist concrete components (cement, aggregate, admixtures, suitable recycled materials);
3. Develop initial mix design;
4. Laboratory scale trial mix and assessment of properties for the initial mix design;
5. Based on properties of the initial mix modify and finetune the mix design;
6. Subsequent laboratory scale trial mixes and assessment of properties until optimized mix design is established;
7. Develop the initial design of the safety wall (through the Innovation Partnership with the bridge consultancy);
8. Secure sufficient quantities of concrete components;
9. Develop the work programme (G-code) for the initial design of the safety wall;
10. Print safety wall segments for the proof-of-concept laboratory test;
11. Execute the proof-of-concept laboratory test on the safety wall segments;
12. Analyse proof-of-concept test results;
13. Refine the design of safety wall based on the analysis of the proof-of-concept test results (through the Innovation Partnership with the bridge consultancy);
14. Develop the work programme (G-code) for the refined design of the safety wall.

Steps to be completed before the GA meeting (october 2023): 1 and 2.
Steps to be completed by the end of 2023: 1, 2 and 3.
Coordinator: Lucija Hanžič, ZAG

6.3.1.2 Task 3.2: Reuse Pillar – ZAG [M1-M30]

Subtask 3.2.1. GRS abutments with reutilized infill
Through the Innovation Partnership Consultancy the secondary reused material will be selected and tested in manner to provide proper design of bridge GRS abutments. It will be done in following steps:

1. Select the site for the bridge construction;
2. Initiate the Innovation Partnership;
3. Acquire topographic survey data from bridge site;
4. Acquire the Geotechnical report from the bridge site (input from CRNA needed);
5. Estimate the required infill quantity (through the Innovation Partnership with the bridge consultancy);
6. Screen and shortlist infill options (sufficient quantity available from local demolition projects). Use the supply matchmaking tool to support this action;
7. Conduct basic laboratory tests on shortlisted infills;
8. Select the secondary material to be used for GRS backfill. (input from CRNA based on Innovation Partnership with Consultant and Contractor is needed);
9. Stockpile the selected infill at a secure location (on collaboration with CRNA based on Innovation Partnership Contractor;

10. Conduct elaborate laboratory tests on geosynthetic-backfill interaction;
11. Design the GRS abutments (through the Innovation Partnership with the bridge consultancy);
12. Set-up a small-scale prototype GRS abutments in the laboratory and test for load-bearing capacity;
13. Analyse laboratory test results on small-scale prototype (through the Innovation Partnership with the bridge consultancy);
14. Use the small-scale prototype analysis to improve and finalize the full-scale design of GRS abutments (through the Innovation Partnership with the bridge consultancy).

Subtask 3.2.2. Modular bridge superstructure with reclaimed girders

The following goals are designed to streamline the completion of this subtask. We aim to work collaboratively with the Bridge Designer, leveraging our Innovation Partnership Consultancy when this will be possible. To ensure we are making informed decisions at each step, we will not finalize any plans until we receive approval from the Consultancy and confirm the capabilities of local construction companies to implement the chosen solutions:

1. Requirement analysis (identify targeted bridge structure, expected load, span ..)
2. Prepare specifications for reclaimed girders
3. Screen and shortlist reclaimed girders. Use the supply matchmaking tool to support this action
4. Develop a conceptual modular superstructure design
5. Select most suitable girders from the shortlist and find optimum storage facility/area to store the selected girders for a case-study at a secure location
6. Develop superstructure design including the design of the prefabricated slabs according to DfA and DfD principles, and modularization strategy (consideration of transport, installation methods, on-site assembly through the Innovation Partnership with the bridge consultancy
7. Design, fabricate and built the prototype of the superstructure for the testing in the laboratory;
8. Test and Analyse the results of prototype testing
9. Refine the superstructure design based on analysis of the prototype testing

Steps to be completed/started before the GA meeting (October 2023): 1,2,3
Steps to be completed by the end of 2023:1,2,3,4
Coordinator: Andrej Anžlin/Maja Kreslin, ZAG

6.3.1.3 Task 3.3 Energy Pillar – ANAS [M1-M30]

Subtask 3.3.1 Design of the Full Adaptive Lighting System

The Full Adaptive Installation Lighting System (FAI) will be designed, and the technical specifications of the devices and civil works needed to implement the system will be defined. The design of the FAI system requires:

- Collating ambient data (traffic, weather conditions, outdoor lighting conditions for at least six months to gather all the information needed to define the regulation rules.
- Defining the regulation rules.
- Development of the algorithms to manage the FAI system.
- Testing the algorithm in a simulated environment.
- Development of the control system, where unavailable.
- Identification of the sensors type, and position needed to regulate the light intensity.
- Design of sensors connections to the electric power grid and the control system.
- Design of the civil work, where needed.

Subtask 3.3.2 Introduction of energy generators for lighting poles

The renewable energy generators for the lighting poles will be designed. The design phase involves the following steps:

- An accurate study of climatic and environmental characteristics of the sites (wind, sunshine, shadows).
- Investigation of the bureaucratic steps necessary to connect the power generators to the electric power grid. In case of denial from the Energy Manager, identification of alternative solutions to store the produced energy.
- Defining the connection process (grid interface) to make the plant fully operative for the implementation and experimental phase (WP5).
- Design of the lighting poles with hybrid generators from a structural and electrical perspective.
- Development of a hybrid lighting pole prototype.
- Recurring testing and upgrade of the hybrid lighting pole prototype.
- Preparation of the technical specifications for the procurement of the hybrid lighting poles.
- Design of civil works to be provided for the installation of the hybrid lighting poles.

Subtask 3.3.3. Design of the remote control for tunnel ventilation systems

The design of the remote control of the ventilation system involves the following steps:

- To gather information on the existing tunnels in Italy and Spain to adequately customize and optimise the fan control system.
- Collating data on key parameters such as on real time alarms, vibrations, fan-speed, front and back bearing temperature, static pressure and air flow.
- Development of a web platform to allow remote control of the system, monitor the energy consumption and provide the necessary access to ANAS and MITMA control room (integration with their actual asset management system).
- Testing the control system in a simulated environment.
- Preparation of the technical specifications for the implementation of the solution in WP5, for both the Italian and Spanish pilots.

- Real environment trials in one of the tubes of the tunnels proposed for the pilot demonstration activities in WP5, both in Italy and Spain

6.3.4 Interrelations to other WPs and Activities

Input:

Subtask 3.1.1 will need input from Task 1.1 in which KPI metrics will be defined. These KPIs will support the decision to select the two most promising advanced materials from the three investigated within subtask 3.1.1 for their implementation in WP5.
Subtasks 3.2.1 and 3.2.2 require input from task 2.4 where the supply matchmaking tool is developed. The tool is to be used to locate the reclaimed girders for bridge superstructure and GRS infill.
Subtasks 3.1.3, 3.2.1 and 3.2.2 require input from task 4.1 where the Innovation Partnership will be established with a bridge consultancy firm via a public procurement. The bridge consultancy firm will lead the design of the bridge including the structural elements for the listed subtasks.
Subtask 3.2.2 requires subtask 3.1.3 to develop the concrete mix in time to fabricate the slabs required for small-scale prototype testing.

Output:

All the subtasks associated to WP3 will provide input for WP5, in which materials developed at laboratory scale in WP3 will be implemented in a real scale scenario. Thus, subtask 3.1.1 will provide input for task 5.2, subtask 3.1.2 will provide input for task 5.3, subtasks 3.1.3, 3.2.1 and 3.2.2 provide input for task 5.4. and task 3.3 will provide input for task 5.2 and 5.5.

6.3.5 Critical Risks

Table 14: Relevant critical risks and currently identified mitigation measures.

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	Subtask 3.1.1. New binders developed do not meet the requirements as expected. Severity: High Likelihood: low	This risk is reduced through the involvement of highly experienced researchers, up-to date in the project's domain and with a huge know-how on a specific technology. In addition, some of the materials are commercially available, so they are designed for this purpose.
2	Subtask 3.1.1. Results of CRS facility are not significant Severity: Medium Likelihood: medium	No significant differences in the results of the CRS tests among the technologies. Other criteria will be considered as large scale technical, economic and environmental feasibility.
3	3DCP safety wall: Printability issues with mix formulations utilizing secondary materials. Severity: Medium Likelihood: Medium	Start material characterization and selection early. If all else fails, use a printable mix without secondary materials.
4	3DCP safety wall: Negative results in the proof-of-concept tests. Severity: Medium Likelihood: Medium	Conduct simulations and small-scale tests during the design stage.
5	Acquisition of reclaimed the girders and infill: The supply matchmaking tool not developed on time to support the acquisition of reclaimed girders and infill. Severity: High Likelihood: High	Initiate a search for reclaimed girders and infill without support of the supply matchmaking tool. Use personal connections with the industry to locate suitable reclaimed elements and materials.
6	Reclaimed girders: No girders found on the market (the market with secondary components is not yet established) Severity: High Likelihood: High	ZAG is collecting bridge components for research purposes and some of these could be reutilised.

6.3.6 Expected outcomes

Table 15: WP Deliverables.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D3.2	Report on the innovative reuse solutions	ZAG	R	CO	30	This report will summarize the GRS abutment and superstructure design and outcomes of laboratory prototype testing.
D3.3	Report on the developed solutions in the Energy Pillar	ANAS	R	CO	30	This report describes the different solutions designed for the Italian and Spanish sites.
D3.1	Report on the innovative solutions developed for the recycling pillar	UC	R	CO	36	This deliverable will report the different solutions demonstrated at a controlled environment for the development of new asphalt mixtures, concrete and material for subgrade stabilisation reducing the environmental impact by placing emphasis on recycling technologies, use of secondary materials and biobinders.

Table 16: WP key Milestones (as of G.A.).

No	Milestone Name	Lead Beneficiary	Means of Verification	Due Date (Month)
MS3	Innovative technologies validated at laboratory scale	ACC	Technologies ready for scaling up and validation in operative environment	10

6.4 WORK PACKAGE 4 – GREEN & INNOVATIVE PROCUREMENT MODELS – ERF [M1-M48]

6.4.1 WP Objectives

- Identify, propose and demonstrate modifications in (i) actual engineering and procurement processes and practices and (ii) facilitators, novel governance and procurement models for a wider GPP and Innovative procurement deployment in transport infrastructures.
- Support the deployment and replication across EU of GPP and innovative procurement through effective training, adaption measures and recommendations and by creating a Helpdesk and EU competition on GPP and Innovation procurement.

6.4.2 WP overall methodology

Partners involved in WP4 will cooperate closely with the project pilots to link the development of the guidelines on Innovative GPP to the actual state of the art in the pilot countries (Croatia, Italy, Netherlands, Slovenia and Spain). The stakeholders' engagement will thus be crucial for the whole length of the project (see point 6.4.3.2) in order to deliver the outcomes of this work package in an effective way. In the first part of the project, the stakeholders will be required to answer a survey realised by the partners about the state of the art on the application of Innovative GPP in the five countries, at national, regional and local level. The survey will be aimed at investigating if the Innovative GPP is applied coherently with the EU Commission recommendation and if it's integrated in the overall national management system and in broader circular economy policies. Furthermore, the main barriers to the deployment of Innovative GPP will be investigated, as well as the techniques of stakeholders' involvement at pilot level and ideas to enhance the Innovative GPP in the future. Afterwards, the pilots will be actively involved in the first project meeting to share the state of the art in their countries and ideas on Innovative GPP with the whole consortium.

All the partners involved in WP4 will ensure a continuous coordination with the pilots and the stakeholders involved at national level for the whole duration of the project.

6.4.3 Methodology on Task level

6.4.1.1 Task 4.1: GPP and Innovation procurement requirements and facilitators – ERF [M1-M18]

Procurement of bridge consultancy services for pilot 4 through Innovation Partnership procedure:

- Prepare project brief for bridge consultancy services;
- Identify and contact possible tenderers to inform them of the upcoming call;
- Prepare call documentation according to Slovenian national legislation;
- Public procurement – Innovation Partnership, Stage 1: Publish the call via the public procurement portal. Economic operators to submit request to participate with credentials (experience in bridge design and in R&D, full time employment of charted structural engineers);
- Review the submitted expressions of interest and invite selected economic operators to stage 2;
- Public procurement – Innovation Partnership, Stage 2: Competitive procedure with negotiations;
- Selection of tenderer and contracting;
- Reviewing the targets of the innovation partnership.

6.4.1.2 Task 4.2: Stakeholders' engagement in pilots – RC [M13-M24]

Task 4.2 aims to understand the decision-making processes within the value chain of the five CIRCUIT pilot demonstrations. It seeks to define the main user profiles of the CIRCUIT platform and materials, identify elements that enable or limit stakeholders' engagement and governance, and ultimately enhance stakeholder collaboration and successful implementation of GPP and innovative procurement practices.

In close collaboration with Task 6.1, Task 4.2 will follow the following methodology:

- Conduct a comprehensive understanding and mapping of stakeholders involved in each CIRCUIT pilot. This includes suppliers, manufacturers, distributors, contractors, subcontractors, service providers, and end-users. This step is crucial to identify and analyze the actors with interests and influence in the project's success.
- Identify effective governance models that can support GPP and innovative procurement practices, the roles and responsibilities of key stakeholders within the supply/value chain.
- Co-create with pilot owners visual diagrams of the supply/value chain for each pilot demonstration with the pilot owners, analyzing interactions and relationships

among stakeholders within the supply/value chain to identify bottlenecks and inefficiencies.
- Analyze the value creation process within the supply chain, identifying critical value-adding activities.
- Propose recommendations for optimizing procurement processes to promote sustainability and innovation.

The research methodology will involve a collaborative survey in conjunction with Task 4.1, as well as structured interviews and open discussions.

6.4.1.3 Task 4.3 Data utilization models – IP [M22-M30]

Task 4.3 has the objective to improve the utilization of GPP in pilot projects, by providing an overview of available models and database which can be used as a support in GPP preparation. Upon detailed analysis of data and information gathered, a dedicated team will work on the identification of the main failures that prevent the market uptake of new, smart, more resilient and greener technologies solutions to be included in tendering processes. Considering the different profiles involved in the project, a further analysis of the regulatory framework, economic return to investment or lack if financial capacity in concrete areas will be elements to further develop the assessment of results. Results will facilitate the recommendations for the implementation of data and models in every pilot project within CIRCUIT.

6.4.1.4 Task 4.4 Novel Governance models and Innovation and GPP guideline – ERF [M24-M36]

The guideline for the deployment of Innovative GPP will be based on the outcomes of the previous activities. The guideline will be one of the main outcomes of the work package 4 and aims at improving the Innovative and GPP practices in the pilots' countries and possibly at a further integration at European level. The project will conduct an analysis of the supply/value chain in the relevant field, identifying specific considerations and recommendations for each stage of the chain. Besides the deployment of the guideline, specific actions are envisaged in order to practically implement their principles in the pilot countries, eventually leading to the establishment of best practice potentially replicable in other contexts.

6.4.1.5 Task 4.5 GPP and Innovative procurement on transport infrastructures Helpdesk and EU competition – FEHRL [M36-M48]

In order to support the deployment at EU level of both GPP and Innovative procurement aligned with the CIRCUIT principles, two strategies will be followed:

- Innovation and GPP Helpdesk

The CIRCUIT project will build a Helpdesk that will address the needs of public administration at national, regional or local level and of the whole associated supply/value chain. The Helpdesk will include all the training and capacity building

materials developed in the project (i.e. webinars, workshops, short videos, infographics) and will structure them in a user-friendly manner to provide most value for users. The Helpdesk will promote GPP, IP and the benefits of using the CIRCUIT platform and of aligning the procurement process with the project principles. The Helpdesk will be tested during the project and its economic sustainability will be studied to ensure it will last after the project end.

The CIRCUIT Project will use the pilots to co-design the Helpdesk with stakeholders and future users to ensure it addresses real needs of current public authorities.

- Innovative and GPP International Competition

The project will organise a European GPP and Innovative procurement competition that aims to give visibility to EU frontrunners and to generate awareness on green public procurement. CIRCUIT will develop a methodology to assess the innovativeness and greeningness of the public procurement processes at different levels: municipalities, regions and/or national level. By giving visibility at EU level, the competition aims at incentivizing public authorities to boost these processes and facilitate replication across Europe. Participants (public authorities at national/regional/municipality level) will be asked to fill a template and present their candidature that will be evaluated by a jury (Advisory board and members of the consortium). The final event of the project will include the reveal of the winners and an official ceremony.

6.4.4 Interrelations to other WPs and Activities

WP4 will closely collaborate with WP6 regarding stakeholder understanding and mapping, as well as the development of the engagement strategy and activities.

Input:

- WP1 is providing input for WP4 with the KPIs identified in the Holistic circularity framework WP5 and all pilot projects will provide input for the guidelines (T4.4) and helpdesk (T4.5)

Output:

Task 4.1 provides essential input for subtasks 3.1.3, 3.2.1 and 3.2.2 and task 5.4. The whole work package will also provide material for the task 6.3 and the wp6 in general.

- Task 4.4. will provide inputs for WP6, especially for Co-design of business models (T6.4) and Guidelines and replication (T6.3)
- Task 4.3 Data utilization models will provide information for WP5 Pilot projects and for WP2 Digital platform

6.4.5 Critical Risks

Table 17: Relevant critical risks and currently identified mitigation measures

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	Lack of involvement regarding the questionnaire Level of severity: Medium Level of likelihood: Low	Involvement of ERF and FERHL in various working groups and organizations at European and international level will ensure good level of participation in the surveys. In addition, the consortium includes public bodies from five member states offering an important contribution from transport authorities
2	Quality of the responses from public bodies Level of severity: Medium Level of likelihood: Low	Public bodies involved in the consortium are committed to provide quality data and information towards a modernisation of their national GPP methodologies in line with EU climate neutrality objectives.
3	Innovation partnership for pilot 4: No tenders received in GPP/IPP call for the innovation partnership. Severity: High Likelihood: Medium	Local firms will be alerted before the call is published to ensure that at least one tender is submitted. If no tenders are submitted negotiated procedure without prior publication according to article 46 of ZJN-3* will be activated. * The *Official Gazette of the Republic of Slovenia*, XXV (91), 2015.

6.4.6 Expected outcomes

Table 18: WP Deliverables.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D4.1	Manual for a successful deployment of GPP in CIRCUIT pilots	ERF	R	PU	16	The document will describe results of data collected and analysed at EU level while establishing a set of recommendations (methodology, indicators, requirements) for public bodies regarding the preparation of GPPs in every pilot in Croatia, Italy, The

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						Netherlands, Slovenia and Spain.
D4.2	Novel Governance models, Innovation and GPP guideline	ERF	R	PU	36	The document will include specific governance models and recommendations for public authorities and private sector to improve current tendering processes while considering EU policy priorities on climate neutrality and innovation
D4.3	Organisation of the CIRCUIT helpdesk and European Innovation and GPP competition	FEHRL	R	PU	48	This deliverable will set up the criteria and key aspects of the Helpdesk and EU competition designed to incentivize public authorities and facilitate replication.

Table 19: WP key Milestones (as of G.A.).

No	Milestone Name	Lead Beneficiary	Means of Verification	Due Date (Month)
MS2	GPP and Innovation procurement requirements and facilitators defined	ERF?	Requirements and principles for GPP and IP aligned with CIRCUIT discussed and agreed with Pilot owners	18

6.5 WORK PACKAGE 5 – IMPLEMENTATION & SCALE-UP – ANAS [M12-M48]

6.5.1 WP Objectives

- To demonstrate in an operational environment the innovative technologies developed, assessed and validated in WP2 and WP3.
- To demonstrate the potential of the CIRCUIT innovative technologies and managing tools to limit the overall emissions from construction, maintenance, operation and decommissioning of the infrastructures and increase their resilience.
- To validate the novel governance strategies proposed in WP4 together with the relevant authorities.

6.5.2 WP overall methodology

The methodology used mainly depends on the type of demonstration foreseen in the pilot sites. In general, where a physical implementation is planned, the methodology involves three main steps:

- The procurement of the works to be done, following the prescription given in the design phase.
- The construction phase, involving also the acquisition of the necessary permits to implement the solution.
- The calibration and testing phase.

Where the implementation of physical demonstrators is not required, the methodology provides for the acquisition of data and samples, their processing and the preparation of models capable of estimating the effects produced by the proposed solutions, both in technical (effectiveness) and economic terms.

The performance of all pilot projects will be monitored, before, during and after their implementation, to determine the proposed CIRCUIT KPIs related to resilience, economy, environment and circularity defined in WP1.6.5.3 Methodology on Task level

6.5.1.1 Task 5.1: Croatia – HAC [M18-M48]

In this Pilot, the digitalization pillar will be demonstrated and validated. This will include the implementation of the Digital platform and interoperability with the engineering tools and existing Asset Management platform. The following tasks are going to be performed:

- Selection of the section on Croatian Motorways, which contains a number of engineering structures (bridges and tunnels) and road section for the demonstration of CIRCUIT tools.

- Collection of existing data about the assets (drawings, BIM models, historical records, etc.)
- Planning of scanning of the objects and inspections using UAV with different sensors
- Development of digital twin models for the selected assets.
- Implementation of circularity KPIs (assessment of recyclability, reusability and end-of-life value of the existing asset) into digital twin models.
- Development of different life cycle scenarios (e.g. reuse, replace, recycle etc.)
- Demonstration of the implementation of circularity KPIs in GPP and development of guideline document for transition from traditional longitudinal design, build and maintenance planning to circular management by using supply-demand matchmaking tool. One design project will be selected, and traditional design tools and data will be extracted and exchanged with the models and the CIRCUIT digital platform, in order to update these projects with the CIRCUIT principles, which means linking the new project with the existing assets and demonstrating the implementation of circular management principles.
- Preparation of the report "Demo 1: Report on Pilot 1 in Croatia and validation of the digitalization solutions" (D5.1)

6.5.1.2 Task 5.2: Spain – MITMA [M12-M48]

In this task, three strategic pillars (Recycling, Energy and Digitalisation) will be demonstrated at a pilot scale in the region of Cantabria in the north of Spain. The technologies will be implemented according to the following considerations:

- Two best new asphalt mixtures based on advanced materials and reclaimed asphalt (Recycling pillar) from task 3.1 will be selected, scaled up and implemented in a real test environment. The pilot site will be located at N-623 road, on a road stretch 546 m long between 2 roundabouts, with one lane for each running direction. The new pavement layer will have a thickness of 5 cm, giving it a total amount of 655 t of asphalt approximately. This experimental site will be built upon an already planned project in the area, with the support of the road maintenance service. The following tasks are planned:
    - Launch a public tender for resurfacing the road section with selected innovative materials (including materials and works) and including the upscaling of the two selected innovative materials from task 3.1.1 at a local plant [MITMA].
    - Scaling up of selected experimental mixtures (2) in the local asphalt plant [CONTRACTOR, UC, ACC, NGVT, UB].
    - Quality control (laboratory testing) of produced batches [UC].
    - Implementation by the contractor of the two experimental mixtures on selected location: production at the asphalt plant, transportation, laying and compaction [CONTRACTOR, UC, ACC, NGVT, UB].
    - Short-term performance tests (in-situ and laboratory)

- The integration of the innovations on adaptive lighting and ventilation systems related to Subtask 3.3.1 and 3.3.3 respectively will be done in the current Ministry's asset management system (Energy Pillar), specifically Hoz Tunnel (A8 highway). the following steps are foreseen:
    - The implementation of the adaptive lighting system will be supported by the road maintenance service. It's not necessary to ask for any kind of permission or external collaboration as the road is already owned by MITMA.
    - The first steps for the integration of the innovations proposed for the lighting and ventilation systems in the Hoz tunnel will be undertaken by ACCIONA, MITMA and ALGORAB and include the following:
        - Assessment of the Ministry legacy systems for the future integration of the solutions proposed
        - Evaluation of available installations, connectivity, and electrical fittings
        - Requirements for the CIRCUIT solutions proposed to facilitate the deployment in the Hoz tunnels and facilitate further replication in future procurement processes/public tenders
    - Launch a public tender, based on WP4 GPP procedure, for the design and installation of the adaptive lighting control system (T box controllers, control system, lighting system design, safety and testing) [MITMA].
    - Launch a public tender, based on WP4 GPP procedure, for the design and installation of the ventilation control system [MITMA].
    - To monitor the energy consumption before and after the implementation phase to check the effectiveness and efficiency of the solutions (Task 5.6) [MITMA, ACC, ALGORAB, IP].
- Validation of digital solutions for smart mobility. Deploy a smart dynamic traffic management system in a road section located along the A-8 motorway in Cantabria. The pilot case will include a detection and alert system for vehicles running in opposite direction, including dynamic signalling on lanes and ramps to alert road users of the potential danger, so they can actively try to avoid any accident. The system will be also provided with traffic monitoring and real-time information capabilities based on a network macroscopic diagram. The following steps are planned:
    - Interviews with traffic safety experts on the ways to communicate severe traffic incidents to road users.
    - Analysis of the available infrastructure and definition of sensor location.
    - Purchase and installation of visual systems, drivers and consumables.
    - Data collection and models calibration.
    - Implementation and validation of the real-time decision-making tool developed in subtask 2.5.1

6.5.1.3 Task 5.3: Netherlands – WSHD [M12-M48]

This task develops solutions for using recycled materials to increase the strength and stiffness of soft soils. A suite of solutions will be developed for typical soil types and construction problems (embankments, quay walls, etc.). To do so, the following steps will be performed:

- The first step is to obtain soil samples from the Netherlands demonstration site. This is planned to take place in September 2023. A detailed plan of how and where to obtain samples will be developed by WHSD, UZ and INGEO.
- UZ and InGEO will visit the test site to supervise soil sampling and undertake some geotechnical and geophysical investigations. These will include in-situ strength tests, MASW geophysical tests to measure the in-situ small-strain stiffness of the different soil layers and classification tests.
- The soil samples will be transported to the UZ laboratory. A range of recycled materials will be mixed with the soil samples. Strength and stiffness properties of the soils will be determined over time. The tests will be performed in direct shear and triaxial testing equipment available in the geotechnical laboratory at UZ.
- The properties of the tested soils will be used as input in finite element model, FEM analyses performed by INGEO. The FE analyses will allow the impact of the improvement of the soil properties on the overall performance of the flood defence to be quantified.
- IP will then quantify the life cycle cost of various remediation measures and compare these to KPI's for the performance.
- The group will also engage with other stakeholders in the transport sector to investigate additional applications.
- Finally, the report related to deliverable D5.3 will be prepared.

6.5.1.4 Task 5.4: Slovenia – CRNA [M31-M48]

This task includes the off-site fabrication of 3DCP safety wall segments (ZAG) and prefabricated slabs (BL), followed by the on-site construction of the GRS abutments and modular superstructure (reclaimed girders + prefabricated slabs) and the installation of the 3DCP safety wall. The implementation of the proposed solutions is achieved by the following steps:

- Develop the bridge documentation according to the Slovenian construction act (GZ-1, *Official Gazette of the Republic of Slovenia*, XXXI (199), 2021) through the Innovation Partnership with the bridge consultancy. Documentation includes refined design for GRS abutments, superstructure and safety wall (CRNA, ZAG);
- Acquire the construction permit (CRNA);
- Select the construction contractor using the GPP (CRNA);
- Set-up the construction site (CRNA);
- Construct the GRS abutments utilizing the infill selected in T3.2.1 (CRNA, ZAG);
- Fabricate the slabs developed in T3.1.3 and T3.2.2 and deliver them to construction site (BL);

- Deliver reclaimed girders selected and refurbished in T3.2.2 to construction site (ZAG);
- Construct the superstructure with the reclaimed girders and prefabricated slabs (CRNA, ZAG);
- Fabricate the 3D printed safety wall segments developed in T3.1.3 and deliver them to the construction site (ZAG);
- Construct the safety wall with 3D printed segments (CRNA, ZAG);
- Develop the protocol for the serviceability load test (ZAG, CRNA);
- Conduct the serviceability load test and analyse the results (ZAG, CRNA);
- Perform the supervision of construction works in collaboration with the bridge consultancy firm (CRNA, ZAG);
- Produce the as-built plans (through the Innovation Partnership with the bridge consultancy) (CRNA, ZAG).
- Prepare the report related to D5.4 "Demo 4: Slovenian pilot report: Bistra Creek bridge construction" (ZAG, CRNA, BL)

Steps to be completed before the GA meeting (october 2023): none.
Steps to be completed by the end of 2023: none.
Coordinator: Lucija Hanžič, ZAG

6.5.1.5 Task 5.5: Italy – ANAS [M24-M48]

In this task, the different solutions foreseen in the Energy pillar for the Italian pilot sites, i.e. the FAI Lighting system, the adaptive ventilation system and the hybrid lighting poles, will be implemented. The FAI system will be extensively applied to all sites:

- The Selva Candida Tunnel, located in Rome, along the A90 Motorway, part of the TEN-T core road network, from km 6+015 to km 6+990. The tunnel is 1.040 m long with three lanes for each running direction and average monthly energy consumption of 155 MWh. The tunnel will be also equipped with the adaptive ventilation system.
- The A91 Motorway outdoor lighting plant, part of the TEN-T comprehensive road network, located in Rome, from km 1.100 to km 18.436. The motorway is 17.363 km long with two/three lanes for each running direction and average monthly energy consumption of 52,5 MWh.
- The SS 4 "Salaria" - A90 Motorway (Rome) junction. Here the FAI system will be applied to 13 hybrid lighting poles with a total energy generation of about 7 MWh/year.

Task 5.5 is directly linked with WP3 and follows the design phase of the adaptive lighting systems and hybrid lighting poles. The lighting systems installed in the Selva Candida Tunnel and the A91 motorway are already equipped with devices controlling the luminaires individually and remotely. Therefore, they can be piloted using the current remote-control system with a few additional sensors to implement the FAI algorithms defined in the design phase (WP3).
The implementation of the proposed solutions will require the following steps:

- To achieve the necessary authorizations to guarantee compliance with the regulations in force and safety conditions [ANAS].

- To procure the construction service (WP4) by applying the GPP procedure based on the EU Public Procurement Criteria for the installation of hybrid generators and the connection of the ventilation plant to the fan control system [ANAS].
- To install the sensors needed to provide the inputs to the FAI systems [ALGORAB].
- To implement the developed algorithms (WP3) for controlling the lighting and ventilation systems [ALGORAB, ACC].
- To install the hybrid lighting poles and provide their connection to the electric power grid [CONTRACTOR, ANAS].
- To test and calibrate the different solutions before making them operative in real traffic conditions [ANAS, ALGORAB, ACC].
- To monitor the energy consumption before and after the implementation phase to check the effectiveness and efficiency of the solutions (Task 5.6) [ANAS, ALGORAB, ACC, IP].
- To prepare the as-built plans and the final report (Deliverable D5.5) [ALGORAB, ANAS, ACC].

6.5.1.6 Task 5.6: Monitoring and assessing the impacts of the implemented solutions – IP [M36-M48]

In this task, the performance of all pilot projects will be monitored with the aim to determine the proposed CIRCUIT KPIs related to resilience, economy, environment and circularity defined in WP1, along with the integration of developed pillar solutions. The task will be performed as follows:

- Collection of data from all pilot projects for KPIs from WP1 through an online system in order to collect data systematically and along the whole WP.
- Analysis of data related to expected impacts (e.g. reduction of life cycle cost, decrease of the emissions and carbon footprint of the whole life cycle of transport infrastructure, utilisation of construction materials within or across transport modes, etc.).
- Validation of Circularity KPIs with the Pilot project owners with specific expertise in GPP and regulations.
- Finally, the impacts for different stakeholders will be quantified, after implementing the developed KERs in different pilot projects across Europe and diverse types of transport infrastructure at different life cycle stages.
- Development of deliverable D5.6 "Impact assessment report"

6.5.4 Interrelations to other WPs and Activities **Input:**

All previous WPs (WP1, WP2, WP3, WP4) are providing inputs for Pilot projects.

Task 5.4 requires input from subtasks 3.1.3, 3.2.1 and 3.2.2 and task 4.1.

Output:

Validation of the innovations / KERs and impact assessment. Outputs are used in WP6, Guidelines, Replication, Dissemination & Exploitation6.5.5 Critical Risks

Table 20: Relevant critical risks and currently identified mitigation measures.

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	Innovation partnership for pilot 4 (task 4.1): No tenders received in GPP/IPP call for innovation partnership, resulting in delay in bridge design and acquisition of construction permits. Severity: High Likelihood: High	See Table 17.
2	Pilot 4: Poor quality of GRS abutments. Severity: Medium Likelihood: Medium	ZAG will conduct laboratory tests on reclaimed infill material and will provide quality control personnel on-site during construction work to ensure adequate compaction.
3	Pilot 4: Prefabricated slabs – Slovenian Technical Approval not awarded on time. Severity: High Likelihood: Medium	Start the process early.
4	Pilot 4: 3DCP safety wall may not have sufficient structural integrity Severity: High Likelihood: High	Ensure thorough design and planning, considering the compatibility of the 3D printed components with the existing conventional design. Collaborate with structural engineers and construction experts to develop a plan that seamlessly integrates both techniques (finding hybrid solution).

6.5.6 Expected outcomes

Table 21: WP Deliverables.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D5.1	Demo 1: Report on Pilot 1 in Croatia and validation of the digitalization solutions	IP	R	PU	M48	Report describing the implementation of the Digital platform for different types of assets on one section, managed and owned by Croatian Motorways.
D5.2	Demo 2: Up-scaling and implementation report	MITMA	R	PU	M48	This deliverable will include the outcomes and conclusions,

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						including technical problems detected, possible solutions and best practices, from the up-scaling and implementation of the innovative mixtures
D5.3	Demo 3: As-built plans and test report	INGEO	R	PU	M48	This deliverable will describe the implemented solutions applied to soft soil enhancement under roads and flood defences, the methodology applied for the final testing and calibration phase, and the results achieved. In addition, consideration will be given to application in other modes, e.g. strengthening quay walls and railways.
D5.4	Demo 4: Slovenian pilot report: Bistra Creek bridge construction	ZAG	R	PU	M48	Report documenting the bridge construction and load test, summarizing the load test results and providing a comprehensive analysis of the results.
D5.5	Demo 5: As-built plans and final tests report	ANAS	R	PU	M48	This deliverable will describe the implemented

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						solutions, the methodology applied for the final testing and calibration phase, and the results achieved.
D5.6	Impact assessment report	IP	R	PU	M48	This deliverable will report an estimate of the impacts related to the application of KERs to different pilot projects and transport infrastructures across Europe at diverse life cycle stages.

Table 22: WP key Milestones (as of G.A.).

No	Milestone Name	Lead Beneficiary	Means of Verification	Due Date (Month)
MS5	Innovative technologies and digital platform validated in the 5 CIRCUIT pilots	ANAS	Technologies and platform ready for monitoring and assessing impacts.	M42

6.6 WORK PACKAGE 6 - GUIDELINES, REPLICATION, DISSEMINATION & EXPLOITATION – RIGHT-CLICK [M1-M48]

6.6.1 WP Objectives

The primary objective of this project is to make a positive impact on market and regulatory frameworks while maximizing the visibility of project outcomes. To achieve this

goal, this WP was designed to coordinate various activities coordinated activities related to communication, dissemination, exploitation, replicability and social engagement.

All CIRCUIT partners will actively participate in this WP.

The key objectives include:

- Developing an effective dissemination and communication strategy, along with the creation of relevant materials, to ensure widespread awareness and understanding of the project's outputs.
- Implementing targeted dissemination and communication activities to reach the intended audiences and stakeholders, ensuring the effective transmission of project findings and outcomes.
- Defining guidelines for public authorities and a replication strategy to facilitate the uptake of project outputs by relevant stakeholders (CIRCUIT guidelines).
- Developing an exploitation strategy and business plan will be developed to capitalize on the main results of the project.

6.6.2 WP overall methodology

The consortium leading this project will actively engage with interested parties and stakeholders involved in the supply value chain of infrastructures, including authorities, end-users, and external organizations. By sharing knowledge and collaborating with relevant initiatives, clusters, and organizations, the consortium aims to enhance the project's impact. The coordinated approach adopted by the consortium will ensure successful market replication and commercial exploitation of the project's outputs.

6.6.3 Methodology on Task level

6.6.1.1 Task 6.1: Communication – RC [M1-M48]

Initially, a thorough Communication and Dissemination Strategy and Action Plan (CDP) will be formulated at the beginning of the project. Furthermore, this strategy will undergo annual updates to ensure its efficacy and evaluate the impacts of the implemented actions.

The primary step involves establishing the project's strategy, which encompasses a detailed plan for all communication activities. This plan includes defining overarching objectives, specified target audiences, key messages, and a comprehensive description of actions and initiatives. In addition, Key Performance Indicators (KPIs) will be set to facilitate regular monitoring and evaluation of the project's progress.

To enhance project visibility among public authorities, materials and tools will be customized for different target audiences.

Communication efforts will include the creation of a logo and brand identity, development of a website, production of brochures and posters, creation of introductory and final results videos, coordination of publications in collaboration with FERHL, biannual

newsletters, management of social media channels, participation in conferences, congresses, and political events.

To ensure broad participation and awareness, all communication and dissemination activities will be coordinated, targeting institutional stakeholders, private sectors, and research and innovation bodies.

- Multilingual campaigns will be implemented to promote zero-emission transport infrastructure. Emphasizing the positive impacts of CIRCUIT will be central to these campaigns, which may include success stories, factsheets, infographics, videos, and interviews.
- Workshops and training sessions will be also organised to facilitate knowledge sharing, exchange best practices, and gather insights from industry representatives and public authorities. These events will be conducted in hybrid and in-person formats.
- A Climate Fresk workshop will be organised in each pilot in collaboration with universities in the local community, to generate awareness on the impact of the construction sector in climate change.
- A dedicated section on the project website will be created to showcase these campaigns, and strategic partnerships with influencers and media outlets will be leveraged to maximize their reach and impact.
- A final conference will be organized to showcase CIRCUIT results and engage key stakeholders.

6.6.1.2 Task 6.2: Scientific Dissemination – FEHRL [M1-M48]

The objective of this task is to effectively disseminate the results and advancements achieved in the CIRCUIT project to its stakeholders, with a particular focus on infrastructure managers, construction companies, ports, research communities, associations/networks, and policymakers. The following activities will be undertaken to achieve this goal:

1. Identification of relevant events and coordination of the consortium's participation: This involves identifying conferences, fairs, forums, and other platforms where the consortium can submit papers, present findings, and disseminate project results. The aim is to actively engage with the target audience and share the progress made in CIRCUIT.

2. Coordination of publications: The task includes coordinating the publication of project findings in various outlets such as specialized press, magazines, open-access journals, and online repositories like Zenodo and Open Science Repository. Additionally, partner repositories will be utilized to archive and provide access to these publications.

3. Creation and distribution of a yearly electronic newsletter: A newsletter will be drafted and distributed annually to keep stakeholders informed about the project's progress.

4. Wide distribution of deliverables: To actively engage with stakeholders all along the value chain, at least 4 user-friendly briefing papers summarising important deliverables will be produced (linked to awareness campaign).

5. Open Day in each pilot: All engaged stakeholders will be invited to the Open Day in pilots where results, demos, and project information will be shared and presented (linked to press releases).

6.6.1.3 Task 6.3: Guidelines and replication – ERF [M24-M48]

This task aims at developing the final guidelines for public authorities and private sector seeking to modernize public procurement processes (and an intermediate version of such guidelines on M36). In order to achieve such objective, the task leader will collect data and information resulting from the wp4 activities, such as the workshops organized at key moments of the project. In this way, the guidelines will include practical examples and successful experiences deployed in different stage of the infrastructure lifecycle (design, construction, operation and manteinance) and at different level (national, regional, local).

6.6.1.4 Task 6.4: Co-design of business models and Exploitation – RC [M10-M48]

This task aims at the development of the exploitation strategies and marketability for the different Key Exploitable Results in CIRCUIT. For the commercial results RC will undertake an analysis of the individual business models of the different stakeholders involved and will facilitate workshops to co-design individual BM and global circular organisational models for each of the pilots. RC, together with all the CIRCUIT partners, will identify the main KERs and map the IPR linked to the KERs with a 1st Exploitation workshop (M15), and organize a 2nd Exploitation workshop to define the final exploitation and IPR strategy linked to the main KERs (M40).

6.6.4 Interrelations to other WPs and Activities

WP6 will establish close collaboration with all other WPs in the project. Its primary objective is to maximize the visibility and impact of project outputs, making it interconnected with all WPs. However, it shares a specific link with WP4, as it will build upon the stakeholder engagement activities conducted in that WP and utilize the guidelines produced. By leveraging the stakeholder engagement and guidelines from WP4, WP6 aims to enhance the dissemination and utilization of project outcomes, ensuring broader reach and increased impact. This collaborative approach between WPs will facilitate a comprehensive and cohesive project implementation, leading to effective dissemination and utilization of project outputs.

6.6.5 Critical Risks

Table 23: Relevant critical risks and currently identified mitigation measures.

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	COVID-19 outbreak prevents stakeholders' activities	Given the uncertainty and other major global disturbances caused by the pandemic, the consortium is committed to finding suitable methodological alternatives. These alternatives aim to ensure that participatory and D&C activities are not completely halted, allowing the project to continue generating results.
2	Low stakeholders' engagement	Each responsible partner brings substantial experience in the construction sector along with an extensive network within the field. To ensure effective stakeholder engagement, the project will employ robust recruitment methods. In cases where local recruitment poses challenges, the partners will collaborate to provide assistance and advice, ensuring that sufficient stakeholders are engaged. The collective expertise and support from the partner network will overcome any initial recruitment difficulties, ensuring the project's success in stakeholder involvement.
3	Capacity building activities	User research conducted in WP4 will serve as the foundation for developing training materials that are specifically tailored to meet the needs of the users. These materials will be created in various formats, such as live sessions, videos, workshops, and other relevant materials, ensuring that they are adaptable to different audiences and their specific requirements. By customizing the content and utilizing diverse formats, the project aims to provide effective and engaging training experiences that effectively cater to the unique needs of various user groups.

6.6.6 Expected outcomes

Table 24: WP Deliverables.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D6.1	Communication strategy, monitoring and materials	RC	R	CO	48	The report will provide a comprehensive overview of the CIRCUIT communication strategy implemented throughout the project, detailing the materials used across various activities. Additionally, it will outline the impact achieved through the different communication actions undertaken. By documenting the communication strategy and materials, as well as assessing the resulting impact, the report will offer valuable insights into the effectiveness of the project's communication efforts. It will serve as a valuable resource for understanding the project's communication approach and the outcomes achieved in terms of reaching and engaging the target audience.

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D6.2	CIRCUIT Dissemination & Exploitation Plan	FEHRL	R	CO	4	Report including a draft dissemination and exploitation strategy of the project and the planned actions to be implemented per partner.
D6.3	CIRCUIT Final Dissemination & Exploitation Plan	FERHL	R	CO	48	The report will encompass a draft dissemination and exploitation strategy for the project, outlining the planned actions to be implemented by each partner. It will provide an overview of the intended approaches and channels for disseminating project outcomes and exploiting project results. The report will offer insights into the specific activities and initiatives that each partner will undertake to maximize the visibility and impact of the project. By outlining the dissemination and exploitation strategy, the report will serve as a roadmap for

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						effectively sharing project findings and ensuring the project's long-term sustainability and utilization.
D6.4	CIRCUIT Guidelines and replication strategy	ERF	R	CO	48	The report will compile the guidelines and best practices acquired throughout the project, intending to transfer this knowledge to various target audiences. It will serve as a valuable resource, providing a comprehensive collection of the insights and lessons learned. Additionally, the report will outline the replication strategy for the different project results, detailing how these outcomes can be successfully applied and implemented in other contexts. By consolidating the guidelines, best practices, and replication strategy, the report will facilitate the dissemination

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						and utilization of project findings, promoting the widespread adoption of successful approaches and fostering long-term impact beyond the project's duration.

Table 25: WP key Milestones (as of G.A.).

No	Milestone Name	Lead Beneficiary	Means of Verification	Due Date (Month)
MS6	CIRCUIT exploitation strategy set up	ERF	The business models and exploitation strategies will be formulated following the organization of the second exploitation workshop.	42

6.7 WORK PACKAGE 7 – COORDINATION, MANAGEMENT & ETHICS - FEHRL [M1-M48]

6.7.1 WP Objectives

- To ensure effective coordination and implementation of the project applying thoroughly defined project governance principles and mechanisms and in line with the guidelines from the EC, the aim, objectives, ambition and workplan described in the Grant Agreement (GA) and the articles unanimously agreed in the upcoming Consortium Agreement.
- To collaborate with an external Advisory Board, that will assist with and empower the project coordination and path towards excellence and innovation.

- To organise and sustain international concertation and twinning activities during the project that will enable widening of the project position, visibility, scope and activities.
- To ensure compliance with the requirements set out in the project ethics documentation.

6.7.2 WP overall methodology

The management and coordination of the project is divided into the administrative and the technical management and this makes up Task 7.1 and Task 7.2 of the WP. The general purpose of the project management activities are financial, administrative, scientific and knowledge & innovation aspects, i.e. coordination of activities, analysis and design of objectives and events, planning the work according to the objectives, risk management, allocation and controlling of resources, assigning tasks, controlling project executions, tracking and reporting progress, analysing the results based on the facts achieved, forecasting future trends in the project, quality management, conflict resolution, identifying, managing & controlling changes, project closure, coordination of dissemination activities, management of intellectual property.

To ensure an efficient and timely implementation of the planned activities of CIRCUIT multidisciplinary team, we have defined and agreed in certain communication mechanisms and procedures, which will enhance the management and coordination of the project (described in section 5.6). The project management of the project relies strongly on the project governance, the consortium and the consortium bodies, as described in Chapter 4, and ensures that the challenges of a successful project implementation will be met.

The administrative project management aims at:

- coordinating the joint efforts of the Consortium during the execution of the project;
- ensuring the smooth progress of the work plan and the fulfilment, of the consortium's contractual obligations, resolving any emerging conflicts;
- providing the necessary liaisons between the consortium and the EC;
- setting up an adequate coordination structure to ensure and establish communication between partners and EC, project monitoring, procedures, and interaction for the overall administrative, financial, legal, and technical management of the Action for the entire project period;
- ensuring the correct administration of the entire project and the achievement of the project objectives within budget, quality, and time schedule;
- assuring the reporting in due time towards the EC and the submission of the requests for the EU payment.

All partners are engaged in the administrative project management.

The technical project management aims at providing quality, consistency, harmonisation, and convergence of the technical activities and results of the project, by constant monitoring of the progress of individual WPs according to the schedule set and

described in the Grant Agreement. Operating complementary to Task 7.1 and Task 7.3, Task 7.3 describes the planned effort in liaising and collaborating with other initiatives both within and outside Europe while Task 7.4 organises and supervises all ethical activities of the project. All activities clustered under this WP aim to be cross-cutting and operating daily throughout the project.

6.7.3 Methodology on Task level

6.7.1.1 *Task 7.1: Project administrative management – FEHRL [M1-M48]*

Project coordination activities will be adapted to the needs of the project as it evolves, but will encompass the following as a minimum:

- To maintain continuous communication with the EC. In order to facilitate the communication between the project and the European Commission, a unique point of contact is nominated. This point of contact is the Project Coordinator Dr Thierry Goger (FEHRL).
- To process financial accounting and budget reporting with.
- To establish and maintain in terms of content a web-based shared information space for the exchange of the Partners that will also accommodate the previously mentioned financial accounting and budget reporting.
- To create and supervise the project Help Desk that will provide continuous support to the Partners and will operated on a daily basis with the support of INFRAPLAN and ACCIONA (Task 7.2). The Help Desk will monitor the status of the partners and support on demand any project management and administrative request in order to anticipate critical issues and mitigate any type of risk related to the management of the project's partners.
- To administrate decision-making and conflict resolution in the Consortium.
- To administrate requests by Consortium members and the Commission. Though deviations vs Annex 1 – technical and financial – will be reported in the periodic reports, a specific process will be administered on a yearly basis in the project respectively. The goal will be to reflect all requests for deviations, communicate to the PO so that he responds which of them adhere to official amendments or not.
- To monitor compliance with the GA and the CA, in collaboration with INFRAPLAN and ACCIONA (Task 7.2). The monitoring of the progress of individual WPs will be done based on the processes defined by the governance of the project.
- To chair and coordinate the project General Assembly (GA), the Project Management Team (PMT) and the Project Executive Group (PCG). The Coordinator organises and chairs all the management meetings, namely the General Assembly meetings, the PMT meetings and the PEG meetings. At WP level, meetings are organised and chaired by WP leaders; at Task level the meetings are organised and chaired by the Task leader. Still, all meetings' organisation is acknowledged to the PMT.

- To establish and manage the continuous interaction within the project with the Advisory Board.
- To organise Project Reviews in synergy with INFRAPLAN and ACCIONA (Task 7.2). The coordinator is in charge of organising the formal project reviews with the European Commission, according to the schedule defined by the Grant Agreement, as well as any extraordinary informal project reviews occurring in addition in the course of the project.

The project governance that is going to be administrated in this task and its bodies description has been described in Chapter 4. FEHRL is the task leader, being the Coordinator of the project, assuming all relevant contractual responsibilities, with the collaboration and support by all Consortium Partners that will be contributing to the project progress reports and follow all administrative processes of the project.

6.7.1.2 Task 7.2: Scientific-Technical coordination, quality & risk management – ACCIONA [M1-M48]

ACCIONA will lead this task, together with INFRA Plan acting, in a tied-up manner, as Technical, Innovation, Quality and Risk Manager, represented by Irina Stipanovic (INFRAPLAN) and Carlos Martin-Portugues Montoliu (ACCIONA). They will collaborate with all Partners on a daily basis, and, following the governance scheme will exchange in a more systematic manner with Task and WP leaders, along with rest members of the PMT.

The key tasks assumed under those roles are namely:

- Advice on the technical path that should be followed across all activities, propose solutions and control the project through a continuous and robust risk assessment and mitigation strategy. This will be performed through communication with all Consortium partners on a daily basis and using all available means (mails, physical meetings, virtual meetings, dedicated workshops). Across the project and in order to leverage the organization of the technical work, in addition to the WP teams as they are formed and reflected in the project workplan, cross-cutting task forces will be created from the early beginning of the project. An inherent part of technical management is to provide solutions to technical-wise challenges and problems reported, provide the path to be followed for all technical activities orienting and supporting the WP and Task leaders, but also each Partner on individual level; and this keeping an eye to outside world ensuring connection and interaction with it as well as pursuing innovation throughout the full duration of the project.
- Ensure that project activities are according to schedule and in line with the project objectives defined but also to the broader priorities. A key tool to that will be the quality manual and the processes that will be defined therein (see point 5 below).
- Monitor all emerging innovation in the field to adapt project plans (i.e. perform Innovation Management). Along with the anticipated technical management of the project, one key task is the progress of the project beyond the formal

commitment or, at least, the maximum possible value brought up in the emerging outcomes, in the context and workplan foreseen. In specific, there will be a constant monitoring of the innovation of the methodologies followed across all aspects (design and conceptual; development; deployment; evaluation; impact assessment) and their potential to deliver promising outcomes. The collaboration with the Advisory Board is deemed important in this respect.

- Supervise, organize and compile the key project technical reports, publications and key project events in collaboration with all Partners and, following the governance scheme of the project. This consists an executional task that however reflects on the progress noticed in the project. It includes the technical progress reports anticipated from the Commission, any amendments related to technical content that may occur (in collaboration with FEHRL), but, also, other internal cross-cutting reports that will be produced in the project. With regard to the amendments in specific, a specific process will be established in collaboration with FEHRL, to serve as a protocoled tool for all partners opting for a deviation vs the original contract (see section 5.8.3). Part of the process will be the step of approval (or not or upon conditions) from the PMT side of requests reaching them, prior to the formal acknowledgment to the EC. Apart from that, big, cross-cutting, demonstrations and other important, technical wise events and central or key to the project publications are going to be organized/designed and supervised by INFRA PLAN and ACCIONA. Last but not least, project reviews are going to be organized by INFRA PLAN and ACCIONA. in synergy with FERHL and all the Consortium partners.
- Establish, supervise and actively participate in the Project Quality Board (PQB); The PQB will be responsible for supervising the high quality and in-time implementation of the project workplan and its planned outcomes (milestones & deliverables). It consists of the following members: the Quality Managers (INFRA PLAN and ACCIONA), the Coordinator (FEHRL), one internal expert assigned by each Partner and one expert originating from the AB of the project that will be different per outcome and depending the required expertise to be defined in the Quality Manual of the project (D1.2). The PQB will highlight and tackle deviations in terms of intended outcomes quality, timing and resources spent for, whereas will peer review, upon a specific protocol to be defined in the Quality Manual (D7.2), all project Deliverables. Overall, the Quality Manual itself (D7.2) will identify all the responsibilities with respect to quality in the project and in relatio to the respective entities involved to ensure that all Deliverables and other tangible outcomes comply with the contract.
- Conduct in an iterative manner the Risk Assessment of the project in an iterative manner. INFRA PLAN and ACCIONA will perform an annual formal FMEA (Failure Modes and Effects Analysis) based project risk assessment tackling with all types of risks, which will allow early identification of shortcomings in the project course and their mitigation. For every risk identified, the risk severity, occurrence

probability, detectability and recoverability will be ranked by the project GA to allow the calculation of the overall risk level per each and attract the required attention in the time period following. Starting point will be the risks identified in GA section 3.1.11 (provided here again on WP level in the following sections) that will be continuously revisited. All types of risks will be assumed, namely project governance; technical; operational; legal/regulatory, etc. The Risk Assessment methodology will be defined in D7.2. The process will be enabled through an aligned Risk Registry that will be developed at the very beginning of the project. The cross-cutting to the project risk assessment will be conducted on an annual basis and will be reported internally in the project (and when applicable, will feed the respective risks section in the participant portal). Risk Assessment reports will be shared with all and proactive or mitigation strategies will be applied, when needed, and re-evaluated later. In specific, the Extended Failure Mode and Effects Analysis (eFMEA) methodology will be used, adding other types or risks on top of the typical technical ones (as it is the case in the conventional approach). The risks to be recognized can be also either horizontal to the project or test site specific ones.

The eFMEA based risk assessment process is designed in such as way so as to:

- Identify potential failure modes for a product or process.
- Assess the risk associated with those failure modes and prioritize issues for corrective action.
- Identify and carry out corrective actions to address the most serious concerns.

The key steps of the methodology are as follows:

Step 1: Initial risk area identification (type of risks) –in collaboration with all partners

Step 2: Risk definition and classification

Step 3: Risk rating (Severity[S], Occurrence Probability[O], Detectability [D], Recoverability [R])

Step 4: Calculation of Overall Risk Number

Step 5: Overall Risks calculated classification in Severity Levels

Step 6: Proposal of mitigation strategies (especially for the most severe risks identified)

Table 26: Risk Numbers and Severity Levels in eFMEA

Overall Risk Number	Severity Level	Mitigation Possibility
513-1000	I-Extremely severe	Very High
217-512	II-Severe	High

65-216	III-Moderate	Medium
9-64	IV-Slight	Low
1-8	V-Insignificant	Improbable

The overall risk number is estimated via the following formula:

$$\text{Risk Number} = S * O * \left\lceil \frac{D+R}{2} \right\rceil \quad (1)$$

The risk assessment is a cross-cutting task in terms input and output both across all project activities. As such, and despite the fact that it will be coordinated by INFRA PLAN and ACCIONA, it will utilise feedback by almost all Partners. The consultation of Advisory Board members, especially with what concerns the identification of the most appropriate mitigation actions, will be also sought.

6.7.1.3 Task 7.3: Data management – FEHRL [M1-M48]

A concrete Data Management Plan (first issued on M6, to be updated on M18, M36 and M48) will elaborate on the FAIR principles, in compliance with the EC guidelines on data management in Horizon Europe, whilst the need for issuing Data Privacy Impact Assessment(s) (DPIA) at the test sites will be analysed. The DMP will detail the data that will be collected and generated, how data need to be handled, classified, and stored to comply with data protection regulations and good practice, and which data can be shared or need to be protected/restricted. The DMP will evolve during the lifetime of the project and will continuously be reviewed at the Project General Assembly meetings. The DMP will include all information about the processes needed for collecting and processing personal data (including information about data collection, storage, protection, retention and destruction and confirmation that these processes comply with national and EU legislation). The data minimisation principle will be cross-cutting, whereas anonymisation/pseudonymisation techniques will be applied to subjective data that will be collected in the test activities.

6.7.1.4 Task 7.4: Ethics – FEHRL [M1-M48]

Ethics issues monitoring via the Project Ethics Board (PEB)

The initial activity for effective implementation of ethics is the establishment of the Project Ethics Board (PEB) by M3, that will oversee implementing the ethics manual of the project that will be developed in this task and all the processes defined therein. Chaired by FEHRL, it will consist of one representative of each test site of the project; all of them being assigned with the task to oversee the compliance of their activities with the determined

ethics principles. For this task, the reference point will be the guidance document by the European Commission 'Roles and Functions of Ethics Advisors/Ethics Advisory Boards in EC-funded Projects' which details the appointment, the nature, and the functions of such group. The membership in the ethics board will be conditional upon relevant expertise in law, data protection/privacy and research ethics and substantive experience in the assessment of ethics issues in the specific topic area of the project, i.e., smart mobility, smart cities, and automation. The PEB will critically assess the technological applications under consideration and will proactively participate in the discussions, in written or oral. It will constantly oversee the application of the ethics manual, as explained below, where working practices should be formally agreed and clarified from the outset of the establishment of the PEB. The PEB, in principle, must maintain an overview of operations throughout a project, helping with preparation in terms of thinking ahead about possible problems and how they can be addressed. Any sense of static, 'tick-box' approvals must be avoided. The PEB should be seen as a resource for advice and guidance when ethical dilemmas arise during a project. Independence and freedom of any conflict of interests are requirements for the participation in the PEB. The PEB will coordinate its activities through monthly meetings, in which updates on the consortium activities will be discussed.

Issue of the ethics manual, update when necessary & application in the project

The main and first task of the PEB, guided by FEHRL will be the preparation of the ethics manual. This manual will cover the ethical requirements for running the test (and other user related) activities across the test sites (i.e. any co-creation activities that will emerge) and will identify the need for ethics approval by the corresponding national or institutional committees. Through this, additionally, it will be ensured that GDPR guidelines are implemented in the agreed processes of the project and involved partners are getting familiarized with the process of data protection impact assessment (DPIA) to be conducted in WP3. One the one hand, the DPIA is a comprehensive exercise for the controller of personal data to demonstrate accountability. On the other hand, the ethics manual will define the processes and provide templates for internal project ethical applications forms and informed consent forms when humans will be involved (e.g., field and driving simulation studies of WP4). Apart from the established practices, the guidance document for this activity will be the European Commission guidelines 'Identifying serious and complex ethics issues in EU-funded research'. The principles with which the research activities should, among others, respect: the principle of proportionality; the right to privacy; the right to the protection of personal data; the right to physical and mental integrity of all persons; the right to equality and non-discrimination; high levels of protection of the environment and human health. Moreover, the ethics manual will take into consideration concrete solutions and recommendations with regards to artificial intelligence, smart city applications and automated mobility. To that direction, the ethics manual will integrate findings from the analysis of the proposal for an AI act as well as policy developments in the area of ethics for AI (e.g., the report of the high-level expert group on AI). To ensure compliance with the principles set in the Ethics Manual of the project, an ethics controlling process will be conducted before each evaluation round in the project.

Ensuring respect to gender and equity issues

Gender and equity issues will be monitored to guarantee equal (to the maximum extent) representations of genders, age groups, mobility limitations and socio-economic groups, to the extent applicable in the project planned activities. The safeguarding of the right to non-discrimination will be materialized through continuous monitoring of research groups and their gender representation in the project. Specific templates will be used, when necessary, inspired from the work of Horizon Europe Guidance on Gender Equality Plans (European Commission, Directorate-General for Research and Innovation, Horizon Europe guidance on gender equality plans, Publications Office of the European Union, 2021). The Gender Equality Plan will concern, among others, the publications, the dedicated resources, the data collection and monitoring, as well as the training of personnel. It should consider how the gender dimension will be incorporated in the contents of research or educational activities and outputs of the organisation. Content-wise, the plan will pay particular attention to the work-life balance and organizational culture as well as the gender balance in leadership and decision-making, among others.

6.7.4 Interrelations to other WPs and Activities

WP7 being the project coordination and management will work hand in hand with all the other WPs in the project in monitoring of the administrative and technical aspects of the project as well as the ethics and external collaborations.

6.7.5 Critical Risks

Table 27: Relevant critical risks and currently identified mitigation measures.

No	Risk Description - Level of severity – Level of likelihood	Proposed mitigation measure
1	Defaulting/withdrawing partners or missing expertise of a specific sector, leading to biased/ incomplete outcomes - High - Low	Consortium encompasses multiple entities with similar expertise (both SMEs and Research/Academia), allowing in case of a defaulting party, the shift of responsibility and resources to other entities for addressing the same objectives.
2	Deliverables do not achieve the expected quality or are not delivered in time - High - Medium	Through the iterative quality procedure regarding Deliverables preparation and submission and the establishment of the Quality Board that will be managed by the Technical Manager, such occurrences (if any), will be mitigated to lead to the most high quality possible outcomes

6.7.6 Expected outcomes

Table 28: WP Deliverables

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
D7.1	Project inception report	FEHRL	R	PU	M2	The deliverable will include a) detailed project management plan including detailed task scheduling, allocation of responsibilities among Partners, Deliverables and Milestones planning, interdependencies among tasks and full definition of governance scheme layers with tasks and roles assigned to each, b) Inception report detailing the specific methodology and expected outcomes for each planned project task. Related tasks: Task 7.1
D7.2	Project Quality Assurance, Ethics Manual and Risk Assessment Plan	FEHRL	R	PU	M3	The deliverable will include the a) Quality Management Plan of the project, b) Ethics manual of the project, the informed consent/assent forms, encompassing information regarding the data processing, as well as information sheets (in language and terms intelligible to the participants) as well as information related to GDPR governing principles of the project and c) the Risk Assessment

No	Deliverable Name	Lead Beneficiary	Type	Dissemination Level	Due Date (Month)	Short description
						Plan of the project. Related tasks: Tasks 7.2, 7.4
D7.3	Data Management Plan	FEHRL	R	PU	M6	First issue of the project DMP, including data protection policy. Related task: Task 7.3
D7.4	Data Management Plan 1st rev	FEHRL	R	PU	M18	First revision of the DMP, including data protection policy. Related task: Task 7.3
D7.5	Data Management Plan 2nd rev	FEHRL	R	PU	M36	Second revision of the DMP, including data protection policy. Related task: Task 7.3
D7.6	Data Management Plan 3rd rev	FEHRL	R	PU	M48	Third revision of the DMP, including data protection policy. Related task: Task 7.3

7 CONCLUSIONS

The current document stands for *D7.1: Project Inception Report* and encompasses the project short presentation as well as the Inception Report of the project, which provides the detailed approach to be followed in each task of the workplan, in the way it is currently seen by the Consortium; being subject to continuous revisions and enrichments. Some of the topics mentioned in this deliverable e.g., project ethics, Advisory Board, as well as project templates e.g. peer review report, meeting agenda templates etc. will be fully elaborated in *D7.2 - Project Quality Assurance, Ethics Manual and Risk Assessment Plan*.

8 ANNEX 1: REQUEST FOR CORRECTIVE ACTION

WP:	**Task:**
Requesting Beneficiary:	
Number of request:	

No	Issue	Reasoning	Proposal for remedy	Deadline for remedy implementation

9 ANNEX 2: DECISION ON CORRECTIVE ACTION REQUEST

CORRECTIVE ACTION DECISION Number: Title: Date:
SECTION 1: Description of issue Relevant WP / Task: .....
SECTION 2: Reasoning / Cause
SECTION 3: Immediate corrective action to be taken To be implemented by ..... Date .....
SECTION 4: Follow Up Action and Effectiveness Monitor List of Changes to be made: 1. 2. 3. 4. 5. 6. The Corrective/Preventive Action has been completed and has/has not effectively cured the problem. Further action has been requested on Corrective Action Request No.....