HEIDI Y1 exploitation, sustainability, and standardisation activities

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Version	Date	Name/Organisation	Description
0.1	2023-06-09	TREE	Table of content
1.0	2023-06-15	TREE, All partners	First draft – contributions from partners coming from workshop teleconference.
1.1	2023-08-08	TREE	Draft version for revision by Internal Reviewers.
1.2	2023-08-24	TREE	Reviewers' comments addressed.
2.0	2023-08-29	TREE, VIF	Final version for internal quality check and submission.

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1. Executive Summary

The HEIDI project aims to address the exploitation and sustainability of the project assets since the beginning, providing a plan and road map towards this goal, as presented in deliverable D8.3. The HEIDI consortium is committed to producing results that will be sustainable after the project's completion in August 2025, ensuring high quality and innovative outcomes to enrich the exploitation potential of HEIDI. To this end, emphasis is and will be placed on managing Intellectual Property Rights (IPRs) and mapping out the expected project assets, uses, and benefits to different target groups.

The present deliverable describes year one (Y1) of HEIDI's exploitation and sustainability work carried out under the framework of Task 8.2, led by TREE, towards exploitation and sustainability of the project's results after the end of the grant. This includes a summary of the exploitation plan presented in deliverable 8.3 in M6. The deliverable also aims to provide a first description of the HEIDI business strategy and sustainability activities as envisioned by consortium partners after one year of HEIDI activities.

The structure of the main sections of the deliverable is the following:

Section 3 presents the general HEIDI exploitation overview and plan, including the identified project assets, the analysis of the potential exploitation models that could be followed and the identification of main stakeholders that may be interested in the exploitation of the project results.

Section 4 describes the business strategy including the market analysis (i.e., size and growth, target market segmentation, customer analysis, competitive landscape, technological advancements, SWOT analysis, and regulatory landscape). This section also presents the business model canvas.

Section 5 presents the potential sustainability activities that will be carried out at the end of the project to ensure the sustainability of HEIDI results and outcomes.

The plan and strategy described in the present report will be regularly updated and detailed in-depth in following reports (D8.8 - HEIDI Y2 exploitation, sustainability, and standardisation activities (M24); and D8.9 - HEIDI Y3 exploitation, sustainability, and standardisation activities (M36)).

Keywords: exploitation, sustainability, strategy, plan, impact, market analysis, canvas model, key exploitable results.

2. Objectives

The primary objective of deliverable 8.7 is to report about the year one (Y1) exploitation and sustainability activities of HEIDI outcomes. As part of WP8, this objective complements HEIDI's main objectives 1 and 4 related to the development and demonstration of fluid, cooperative Human Machine Interface (HMI) solutions and the elaboration of recommendations for regulation, standardisation, and development of adaptive internal and external HMIs, respectively.

To reach this objective, we have implemented an initial strategy and methodology by investigating the different exploitation models that could be followed, identifying the main stakeholders, establishing a preliminary strategy regarding the joint and individual exploitation plans, and providing a strategy to analyse the main HEIDI's assets and their relationship with background IP, foreground IP, and partners exploitation interests (see annex 1 of D8.3). Furthermore, we have performed a first approach to market analysis, including the size and growth, segmentation customers, competitive landscape (including technological advancements, SWOT analysis and Porter's five forces analysis.) and a preliminary identification of the regulatory landscape applicable for HEIDI outcomes. All this information is summarised in a business model canvas. Finally, we have identified potential sustainability activities to be performed after project conclusion.

The current document is the Y1 report of HEIDI's exploitation activities and sustainability plan and will be regularly updated under WP8. Furthermore, inputs of recommendations for standardisation will be collected from Task 5.4 and will be used to promote HEIDI on relevant standardisation workgroups. This information will be detailed in the next version of the current deliverable for Y2 and Y3 (D8.8 & D8.9).

3. HEIDI exploitation overview

3.1 HEIDI identified assets

As stated in the Grant Agreement (GA), HEIDI's expected assets can be summarised as follows:

- 3 unique HMI solutions (internal, external, cooperative HMI)
- 5+ technical innovation modules
- 1 unique multi-user simulation environment for effective validation of HMI solutions
- 3 catalogues targeting standardisation, ethical guidelines, and human-centred methodology.

Table 3-1 provides an overview and description of HEIDI's Key Exploitable Results (KERs), identified at this stage of the project. HEIDI KERs are owned by the beneficiary who generates them. 'KERs' means *any tangible or intangible output of the action (data, knowledge, information, whatever its form or nature, whether it can be protected or not) that is generated in the action, as well as any rights attached to it, including IPRs*.

The leading partner of the action is the main partner that leads to the KER. If there is no clear leading partner of the action, the asset is considered as a joint result. In case of a shared KER, partners have to identify who are the other owners of the result, and which was their contribution to this result. Other KERs could arise and be added to the ones listed in this deliverable during the execution of project activities. This list will be update, if necessary, in future exploitation and sustainability reports.

Table 3-1: HEIDI identified assets

Key Exploitable Result (KER)	Short Description	Partners	WP
Osmotic Layer	Application Programming Interface (API) for the transmission of information via a wireless connection between the vehicle and the outside world.	BMW, NISYS	WP4
Fluid internal HMI (iHMI)	Concept for adaptive vehicle interface based on driver's state monitoring	BMW, NISYS, VIF	WP2
Fluid external HMI (eHMI)	An external HMI which can react adaptively to the different road users and will communicate to many groups (or only specifically one person out of a group) and may present more information.	MAR, RUAS, UAH	WP3
Integrated cooperative HMI with situation assessment, resolution, and decision module	Software system providing recommendation of optimal coordinated behaviour for driver and outside participants via iHMI and eHMI	VTI, RUAS, HRIEU, VIF	WP4
Situation resolution and tracking module	Algorithm that continuously evaluates behaviour of driver and outside participants, compares it to a recommended best joint behaviour and communicates deviations and criticality of deviations	HRIEU	WP4
Sensing & behavioural predictive models for ego-driver	Algorithms that detect driver's distraction and predict driver's intentions	VIF, UAH	WP2
Sensing & behavioural predictive models for pedestrians	Recognition of adult pedestrians and children pedestrians; recognition of pedestrian behavioural features and prediction of most likely future behaviours	RUAS, UAH	WP3
Unique multi-user simulation with driver and pedestrians (co-simulation)	Networked driving and pedestrian simulators of multi-user experiments	VTI, RUAS, HRIEU	WP5

Standardisation, ethical guidelines, and human-centred methodology	Catalogues targeting standardisation, ethical guidelines, and human-centred methodology coming from project activities, evaluation and produced know-how.	ALL	WP5

3.2 Exploitation models

The HEIDI consortium consists of 9 partners coming from industrial and scientific background with highly relevant and complementary know-how which is needed for the successful completion of the project. Specifically, the consortium includes:

- Industry partners with BMW, MAR, NISYS and TREE, which cover a broad range of the value chain (OEM, Tier-1 & SME).
- Research partners RUAS, UAH, HRI-EU, VTI, and VIF, with extensive know-how and experience in sensing vulnerable road users, cooperative decision modules, driving and pedestrian simulators, human-centred development of HMI solutions, internal sensing, and human-in-the-loop simulators.

The two proposed exploitation models will be discussed in depth with project partners as part of the activities of Task 8.2. Nevertheless, an initial approach is presented in D8.3 sections 4.2 and 4.3 to provide and initial overview of HEIDI's joint and individual plan towards exploitation and sustainability of project assets.

3.3 Exploitation stakeholders

The HEIDI consortium identifies the following stakeholders' categories that may be interested in the exploitation of the project results:

Table 3-2: HEIDI Exploitation stakeholders

Target group	Description	Time frame	Channel
A – Business stakeholders	Automobile operators and other stakeholders who might use or receive benefits from HEIDI assets (e.g., significant increase in safety).	Last 12 months of the project	Website, digital press notes in specialised websites, workshops, B2B, etc.
B – IT technology providers; Industry associations and clusters	OEMs in partner network: As beneficiaries of HEIDI HMI solutions and guidelines regarding ethics and human-centred methodology. Raising awareness of the challenges in the field of technical/modelling and HMI; present the results; raise interest towards the project itself but also towards the developed technologies, build support.	Project life	Website, digital press notes, workshops, newsletters, exhibitions, etc.
C – Policy makers and Standardisation Organisations	Adopting the standardisation guidelines developed in the HEIDI project (e.g., like EuroNCAP and IEEE)	Last 12 months of the project	Uptake of standardisation guidelines resulting in improved legislation and standardisation, especially for external HMIs. Adaptation of ethical and human-centred guidelines by the broader community.
D – Scientific Community	Promoting the scientific developments of HEIDI in	From M6 until the end of the project	Academic conferences, scientific journals, exhibitions,

	compliance with the Findable, Accessible Interoperable, and Reusable (FAIR) principle and the open science practices. Scientific publications and further evolving the state of the art.		social media, newsletter, final event, community work.
E – Related R&D projects and Networks	Involving or establishing networks to disseminate public project findings, and exchange knowledge.	Project life	HEIDI website, social media, workshops, exhibitions, international conferences, newsletter, final event.
F – End users (Road users)	Drivers and other road users, as main users of these technologies. Promotion of the HEIDI project to raise awareness and build support.	Project life (through dissemination and communication activities)	HEIDI website, social media, workshops, exhibitions, international conferences, newsletter, final event.

Dissemination and communication activities are viewed by the consortium as tightly linked to any planned exploitation activity as they would help in preparing the ground for HEIDI being introduced into the market and create curiosity and expectation among its potential stakeholders. The overall goal of HEIDI dissemination and communication activities, linked to the exploitation and sustainability approach, is to raise awareness among the public and specific target groups regarding the results, guidelines, generated knowledge and benefits of project outcomes. Detailed information about the dissemination actions performed during the project is provided in D8.2 – Dissemination and Communication plan and in its future updates within deliverables D8.4 to D8.6.

3.4 Exploitation & Sustainability plan

The HEIDI exploitation and IPR management strategy is based on setting a common understanding concerning the background, foreground, ownership (including joint ownership), access and usage rights, dissemination, and exploitation during and after the project development, of HEIDI assets. For this purpose, we have divided the strategy to be followed in three main phases:

- Grand Agreement (GA) & Consortium Agreement (CA) stage
- Project Implementation stage
- Post-project stage

Figure 3–1 summarises the planned activities under each phase. Detailed information is provided in the following sub-sections. More details are described in deliverable D8.3.

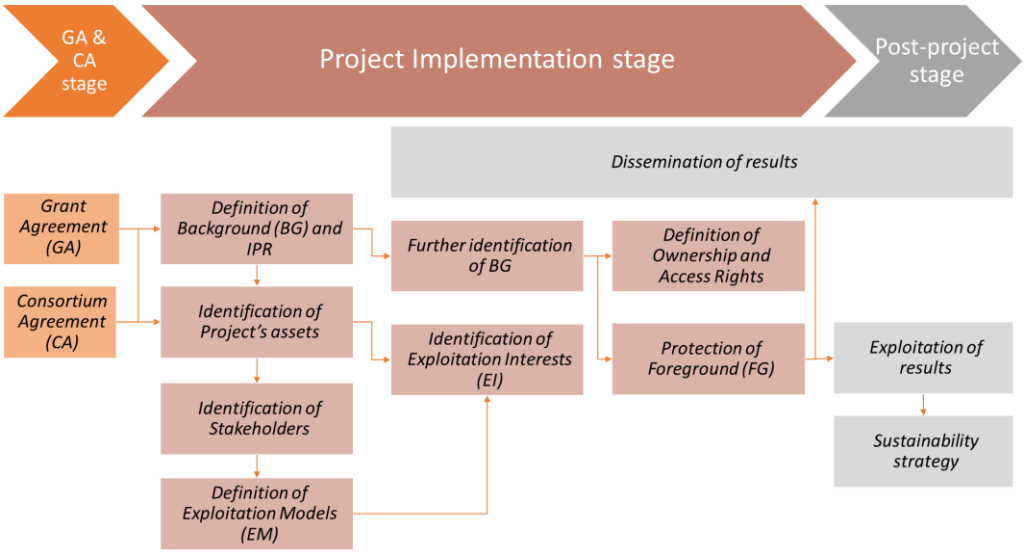

Figure 3–1: HEIDI strategy for exploitation and IPR management

3.5 Joint exploitation and sustainability plan

The joint exploitation and sustainability strategy foreseen by the HEIDI consortium aims to innovate through science by:

- providing differential know-how and technology.
- supporting standardisation and current legal requirements (e.g., ECE regulation).
- evaluating the feasibility of latest advancements in the area through the research & business expertise and networks from research and business partners.
- investigate the possibility and opportunities for synergies with other organisations to jointly promote related developments as integrated product or marketing efforts via exhibitions, market initiatives to address new alliances, etc.

In the course of HEIDI, also workshops and webinars will be organised. The partners aim to ensure the sustainability of the HEIDI results also after the project end, which is why they also plan to continue the workshop/webinar series after the project ends.

HEIDI will offer the basis for potential spin-offs exploiting the infrastructure offering new service models in new ecosystems. The cognitive systems lab (part of RUAS facilities) is as well involved in know-how transfer activities (Steinbeis Transfer-Centre for Human-centred Artificial Intelligence) working closely together with industry, guaranteeing the transfer of know-how raised through HEIDI. Partners will transfer, improve and disseminate the newly developed products and the generation of further knowledge will help to cater the customer needs and gain more market access and share. After the project evaluation phase, HEIDI will prepare guidelines for standardisation bodies in order to contribute with new knowledge coming from HEIDI mainly related with human-centred designs of HMI solutions for driving scenarios.

3.6 Individual exploitation and sustainability plans

The exploitation strategy is expected to support, facilitate, and guide individual and joint exploitation of results, with an approach that is both coherent and compatible with internal strategies of each project consortium partner. Nevertheless, all the partners participating in HEIDI have different plans for exploiting individually the outcomes of the project.

The individual exploitation plans refer to a situation in which a company or research centre exploits the HEIDI solution either in house or commercialises it independently, without relying on the resources or support of other partners. Importantly, the individual exploitation plans have to be undertaken within the framework agreed on between the consortium partners in the CA.

The following table summarises the exploitation interests of the participant partners:

Table 3-3: HEIDI partners' individual exploitation plan

Partner	Individual exploitation plan
RUAS (Research)	The results of HEIDI will directly feed into lectures and build the basis for novel workshops at annual conferences. Students from Human-centred-computing master course, but also others, will be involved in HEIDI at an early stage of their curriculum, and thus, HEIDI will attract potential PhD candidates. RUAS is a very strong partner for entrepreneurship programmes. HEIDI will offer the basis for potential spin-offs exploiting the infrastructure offering new service models in new eco-systems. The cognitive systems lab is as well involved in know-how transfer activities (Steinbeis Transfer-Center for Human-centred Artificial Intelligence) working closely together with industry, guaranteeing the transfer of know-how raised through HEIDI.
UAH (Research)	Results will feed into scientific publications and demonstrable prototypes. This will strengthen UAH's position to attract high quality PhD students and to provide advanced research services to the automotive industry. Among the expected research results to be attained in HEIDI, are the following: advanced road users' behaviour prediction system for anticipating pedestrian crossing actions, vehicles lane changes, and ego-driver behaviour; perception system for recognising the level of attention of pedestrians; recognition of pedestrians walking on crutches or walkers and pedestrians on wheelchairs; recognition of adult pedestrians and children pedestrians.
VIF (Research)	The focus is on scientific dissemination in peer-reviewed journals and international conferences to further strengthen the impact created in the scientific community. Cooperations with industry partners are being discussed and planned to increase bi-lateral transfer between industry needs and scientific solutions. The aim is to establish and strengthen further links to (industrial) partners.
VTI (Research)	VTI envisages three main exploitation channels for the project results achieved in HEIDI. Firstly, the activities undertaken in WP5 (coordinated by VTI) for the development of validation methods for HEIDI and similar systems will serve to provide guidance and recommendations to both regulators and standardisation bodies. Secondly, the developments carried out during the project at VTI (e.g., synchronisation of driving and pedestrian simulators, development of specific scenarios and test protocols for multi-user interaction analysis) will contribute to consolidating VTI's position as a leading research institute to address future interaction issues between VRUs and other vehicles. Finally, the results will be exploited by dissemination to the scientific and other industrial communities through publications in scientific journals and presentations at conferences, seminars and/or workshops.
TREE (SME)	TREE's research and business expertise will help to investigate the opportunity for synergies with other partners to jointly promote related developments as an integrated product, marketing efforts via exhibitions, specific marketing initiatives to address new customers and alliances by presenting the technology and possibilities of the whole system, and active participation in industrial seminars to communicate about exploitable results. HEIDI results bring differential know-how and technology

	to TREE business area and will favour alliances and network of contacts for future projects, commercialisation of products and services.
NISYS (SME)	NISYS plans to further extend their links to industry partners and establish new links to other partners outside of the HEIDI consortium. It will be possible to further develop existing products and work on new product developments. By cooperating with the HEIDI partners, NISYS plans to gain new knowledge and strengthen its market position by better understanding and meeting customer needs.
HRI-EU (Industry)	HRI-EU will evaluate the feasibility of HEIDI's advancements for potential future products, particularly focusing on European markets, and contribute the results to Honda R&D as well as the scientific community to demonstrate leadership in ADAS research.
MAR (Industry)	Gain knowledge, creating a prototype, research results will support standardisation and adaptation of legal requirements (ECE regulation), could lead to future products in vehicle lighting for safety improvement.
BMW (Industry)	BMW, representing a premium OEM, will assist in bringing the HEIDI results to the market. The collaboration with the HEIDI partners will support BMW in the creation of innovative and marketable solutions that are expected to be featured in one of their products in 2027, leading to the generation of IP and commercial exploitation. Thus, this will secure the sustainability of the HEIDI results and support not only the EU policies but also the creation of new standards in the automotive industry.

More information about the complete instrument designed to gather this information during the project implementation stage, is provided in deliverable 8.3 (subsections 4.1.2.1 – 4.1.2.4) delivered on M6. This instrument will be completed and updated as the project activities evolve.

4. Business strategy

4.1 Market Analysis

Market analysis is a crucial component of business strategy that involves assessing and understanding various aspects of a target market to make informed decisions. It helps organisations gain insights into customer behaviour, market trends, competition, and other factors that can impact their success. The market analysis is an ongoing process that should be conducted regularly to stay informed about changes in customer preferences, market dynamics, and competitive landscapes. It serves as the foundation for developing effective marketing strategies, identifying growth opportunities, and making data-driven business decisions [1].

Prior to exploring the HEIDI business model in detail, it is important to identify who the actual client is, the market size and growth, the market segmentation and the technological and regulatory landscape.

4.1.1 Market size and growth

For the HEIDI project the market size and growth related to the automotive industry are significant and expected to grow in the coming years at a CAGR (compound annual growth rate) of 8.2% in the 2021-2028 period. Global Automotive HMI market was valued at 9.490 billion euros in 2020 and is projected to reach 16.896 billion euros by 2028 [2]. Europe region contributed significantly to the market growth as it is home to many leading car manufacturers in countries like Germany, France, and Italy.

Some key factors that may contribute to this market expansion are the following:

1. *Increasing Demand for Connected and Intelligent Vehicles*: There is a growing demand for connected vehicles that offer advanced features and seamless integration with digital systems. Integrated HMI solutions play a crucial role in enabling connectivity, providing intuitive interfaces, and enhancing the overall user experience [3].
2. *Advancements in Sensor Technologies*: With the advancements in sensor technologies, including internal and external sensors, there is a greater ability to collect and analyse real-time data [4]. This allows for more accurate and comprehensive information to be presented through HMI systems, resulting in improved safety, convenience, and personalized experiences.
3. *Rising Focus on Driver Assistance and Safety*: Safety is a top priority in the automotive industry, and integrated HMI solutions are instrumental in providing driver assistance features. These solutions can leverage internal and external sensing to detect potential hazards, provide alerts, and assist in avoiding accidents, thereby enhancing overall road safety [5].
4. *Growing Adoption of Autonomous and Electric Vehicles*: The increasing adoption of autonomous and electric vehicles presents opportunities for integrated HMI solutions. These vehicles require advanced interfaces to ensure effective communication between the vehicle and the driver or passengers, creating a seamless experience and enhancing trust in autonomous capabilities [6].
5. *Emphasis on User Experience and Differentiation*: Automotive manufacturers are placing greater emphasis on enhancing user experience to differentiate their products. Integrated HMI solutions offer a competitive advantage by providing

adaptive interfaces, personalized settings, and intelligent features that cater to individual preferences and needs [7].

6. *Government Regulations and Industry Standards*: Governments and regulatory bodies are increasingly recognizing the importance of HMI systems in promoting road safety and are implementing regulations to ensure minimum standards. This creates a favourable environment for the adoption of integrated HMI solutions that comply with safety and usability standards [8].
7. *Emerging Markets and Technological Innovations*: The automotive industry is expanding globally, with emerging markets showing strong growth potential. Additionally, continuous technological innovations, such as augmented reality (AR), virtual reality (VR), and artificial intelligence (AI), are further driving the demand for integrated HMI solutions [9].

It is important to note that market size and growth potential can vary across regions and market segments. However, overall, the integrated HMI solutions market in the automotive industry is expected to witness substantial growth in the coming years due to the increasing focus on connectivity, safety, user experience, and advancements in technology.

4.1.2 Target market segmentation

The following is a first analysis of the HEIDI target market segmentation. The HEIDI market segments may be based on factors such as:

1. customer characteristics such as demographics, psychographics, behaviour, and needs;
2. Product type (i.e., voice control system, central displays, head-up displays, context awareness systems…);
3. vehicle type (i.e., passenger car, commercial car, and sub types such as electric car…) and
4. geography (i.e., EU, North America, Asia-Pacific, etc.).

that helps to identify specific target audiences for HEIDI's outcomes.

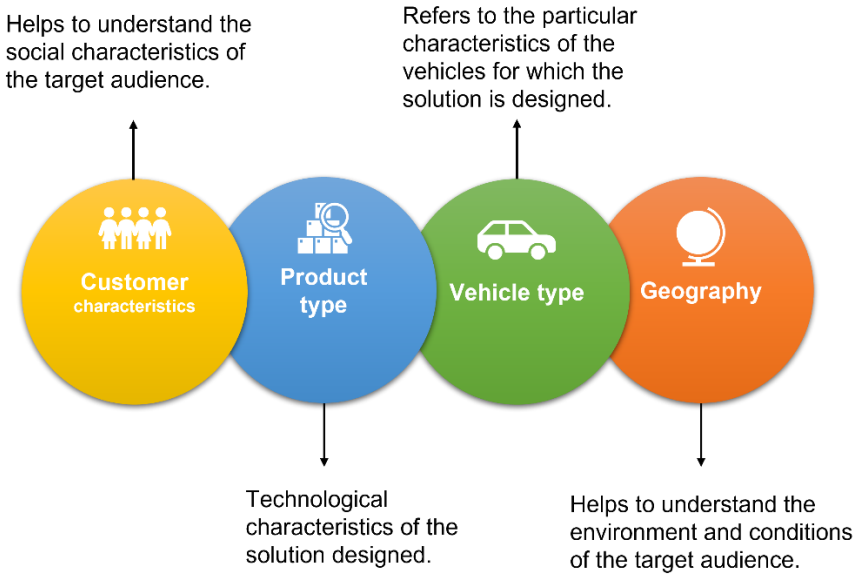

Figure 4–1: HEIDI target market segments

Part of the target market segmentation analysis is the profiling of each of the segments identified by creating the buyer persona. We have shaped some example profiles including demographic information, preferences, behaviours, pain points, needs, and challenges for each one of the segments identified for HEIDI project. The following figures show these profiles.

1. Demographic-Based Segmentation Profile:

   Urban Tech Enthusiasts are urban dwellers who embrace technology and prioritize innovative solutions that enhance their urban lifestyle. They are early adopters of new tech trends and are interested in seamless connectivity, convenience, and sustainability. This segment is attracted to vehicles that offer advanced HMI systems and smart features that align with their tech-savvy and environmentally conscious preferences.

Demographic-Based Segmentation Profile

Segment Name: Urban Tech Enthusiasts

DEMOGRAPHIC INFORMATION	
Age	25-40
Gender	Male & Female
Education	College with preference for STEM
Income	Middle to high income
Occupation	IT professionals, designers, engineers, urban planners
Geographic location	Urban and suburban areas with high-tech infrastructure
Family life cycle	Single professionals, young couples, and small families

Psychographic Characteristics:

Lifestyle: Tech-savvy, urban-oriented, socially conscious
Values: Sustainability, innovation, convenience, connectivity
Interests: Smart home technology, electric vehicles, urban mobility solutions
Activities: Early adopters of new gadgets, city events attendees

Behavioral Characteristics:

Purchase Behavior: Willing to invest in premium technology and smart features
Usage Behavior: Frequent travelers within urban areas, active participation in car-sharing services
Loyalty Behavior: Open to trying new brands that align with their values and preferences

Needs and Preferences:

- ***Seamless Connectivity***: Desire for integrated systems that connect with smartphones and smart home devices
- ***Innovative Features***: Attracted to augmented reality displays, voice-activated controls, and adaptive interfaces
- ***Sustainability***: Interest in electric or hybrid vehicles with eco-friendly features
- ***Urban Mobility Solutions:*** Seeking solutions for navigating congested urban areas

Challenges and Pain Points:

- ***Information Overload***: Concerns about potential distraction from excessive information displayed
- ***Price Sensitivity***: Balancing the desire for advanced technology with affordability
- ***Environmental Impact***: Seeking solutions that reduce their carbon footprint and contribute to sustainable living

Figure 4–2: HEIDI Demographic-based segmentation profile example

2. Product type-Based Segmentation Profile:

   Context Awareness HMI Users are drivers who prioritise a seamless and intuitive driving experience through advanced context-aware interfaces. They value HMI solutions that adapt to their surroundings and preferences, enhancing safety and convenience. This segment seeks vehicles equipped with context awareness HMI systems that leverage internal and external sensing to provide real-time information and assistance.

Product type-Based Segmentation Profile

Segment Name: Context Awareness HMI Users

DEMOGRAPHIC INFORMATION	
Age	30-55
Gender	Male & Female
Education	Varied, with an inclination toward technology understanding
Income	Middle to high income
Occupation	Professionals, managers, tech-savvy individuals
Geographic location	Urban and suburban areas with high-tech infrastructure
Family life cycle	Single professionals and small families

Psychographic Characteristics:

Lifestyle: Safety-conscious, tech-forward, early adopters of smart devices
Values: Convenience, safety, efficiency
Interests: data-driven insights, predictive assistance
Activities: Active users of smart devices, technology workshops, continuous learners

Behavioral Characteristics:

Purchase Behavior: Willing to invest in advanced context awareness technology for a safer and more convenient driving experience
Usage Behavior: Frequent drivers, open to autonomous driving features, value-added services
Loyalty Behavior: Likely to switch to vehicles that offer superior context awareness HMI systems

Needs and Preferences:

- ***Safety Enhancement***: Desire for real-time hazard alerts, predictive collision avoidance, and intelligent traffic information
- ***Personalization***: Preferring HMI interfaces that adapt to driving style, weather conditions, and traffic patterns
- ***Data-Driven Insights***: Valuing insights derived from contextual data

Challenges and Pain Points:

- ***Information Overload***: Concerns about overwhelming data and interface complexity
- ***Privacy***: Awareness of data collection and a desire for transparent data usage
- ***Technological Reliability***: Expectation of accurate context analysis and reliable performance

Figure 4–3: HEIDI Product type-based segmentation profile example

3. Vehicle Type-Based Segmentation Profile:

Safety-Conscious Families are individuals and families who prioritise the safety of their passengers, especially children, when choosing a passenger car. They seek vehicles that offer advanced safety features and technologies to protect their loved ones. This segment values HMI systems that provide intuitive access to safety information and alerts, enhancing their confidence and peace of mind on the road.

Vehicle Type-Based Segmentation

Segment Name: Safety-Conscious Families

DEMOGRAPHIC INFORMATION	
Age	30-50
Gender	Male & Female
Education	Diverse
Income	Middle to high income, willing to invest in safety-enhancing features
Occupation	Parents, caregivers, professionals with family responsibilities
Geographic location	Suburban and family-friendly neighborhoods
Family life cycle	Families

Psychographic Characteristics:

Lifestyle: Family-oriented, safety-conscious, responsible
Values: Security, dependability, protection
Interests: Family activities, parenting resources, safety workshops
Activities: Family trips, school commutes, weekend outings

Behavioral Characteristics:

Purchase Behavior: Prioritize passenger cars with top-tier safety ratings and advanced safety features
Usage Behavior: Daily commuters, regular family travel, prefer routes with less traffic risk
Loyalty Behavior: Likely to stay loyal to brands with a strong reputation for safety and reliability

Needs and Preferences:

- ***Advanced Safety Features:*** Desire for HMI systems that provide real-time alerts for lane departure, collision avoidance, pedestrian detection, and adaptive cruise control
- ***Emergency Assistance***: Preferring quick access to emergency services and automatic collision notification
- ***Clear Visibility***: Seek HMI displays that offer clear visibility of safety information without causing distraction

Challenges and Pain Points:

- ***Information Overload***: Concerns about potential distraction from excessive safety alerts and notifications
- ***Technology Familiarity***: Desire for user-friendly interfaces that are accessible to all family members
- ***Trust and Reliability***: High expectations for accurate safety alerts and assistance features

Figure 4–4: HEIDI Vehicle type-based segmentation profile example

4. Geographic-Based Segmentation – Europe:

   European Urban Trendsetters are tech-savvy and style-conscious consumers residing in various countries across Europe. They seek vehicles that offer cutting-edge HMI systems, seamless connectivity, and innovative features to match their modern and urban lifestyle. This segment values HMI solutions that provide a sophisticated blend of functionality and aesthetics.

Geographic-Based Segmentation

Segment Name: European Urban Trendsetters

DEMOGRAPHIC INFORMATION	
Age	25-40
Gender	Male & Female
Education	Higher education, with an interest in technology and car sector
Income	Middle to high income, willing to invest in premium technology
Occupation	IT professionals, designers, engineers, urban planners
Geographic location	Countries across Europe, with a focus on urban and metropolitan areas
Family life cycle	Creative professionals, digital nomads, urban entrepreneurs

Psychographic Characteristics:
Lifestyle: Urban, fashion-forward, digitally connected
Values: Innovation, aesthetics, urban sustainability
Interests: Design exhibitions, cultural events, technology
Activities: Urban exploration, networking, social media

Behavioral Characteristics:
Purchase Behavior: Prioritize vehicles with advanced infotainment systems, AR displays, and interactive interfaces
Usage Behavior: Frequent urban travelers, rely on navigation apps and digital tools
Loyalty Behavior: Likely to switch to brands that offer superior tech integration and urban adaptability

Needs and Preferences:
- ***Cutting-Edge Technology***: Desire for state-of-the-art HMI systems, voice-activated controls, and AR interfaces
- ***Seamless Connectivity***: Interest in integration with smartphones, smart home devices, and urban infrastructure
- ***Aesthetic Appeal***: Preferring sleek and minimalist HMI designs that complement modern vehicle interiors
- ***Urban Adaptability***: Seek real-time traffic updates, parking assistance, and urban mobility solutions

Challenges and Pain Points:
- ***Information Overload***: Concerns about potential distraction from advanced technology and excessive data
- ***Multilingual Interfaces***: Desire for user-friendly interfaces available in multiple languages
- ***Urban Navigation***: Need for accurate and updated navigation data in densely populated urban areas

Figure 4–5: HEIDI Geographic-based segmentation profile example

The passenger car sector is projected to take the lead in the automotive HMI market, primarily driven by rising consumer preferences for in-car functionalities encompassing advanced technologies and connectivity choices. Moreover, the anticipated features provided by OEMs are expected to further catalyse the expansion of the automotive HMI market in the forthcoming years [2].

A more in-depth analysis of each target market segment, including the targeting strategy will be provided in next versions of the deliverable (Y3 D8.9 report) after revising the final characteristics of the proposed HEIDI solution and all the advances during the second and third year of project activities regarding the design, development, integration and evaluation of HEIDI's assets.

4.1.3 Customer analysis

Understanding customers' preferences, purchasing behaviour, needs, and pain points provides valuable insights for product development, marketing strategies, and customer relationship management.

- *Automotive Manufacturers*: Target automotive OEMs that seek to enhance their vehicles with advanced HMI capabilities.
- *Transportation Authorities*: Transportation authorities interested in integrating intelligent HMI systems into their infrastructure.

- *Policy makers and Standardization Organisations*: Adopting the standardisation guidelines produced.
- *End users (Road users)*: Drivers and other road users, as main users of these technologies. As part of WP1 activities four use cases have been devised for incrementally testing the internal HMI (iHMI), in use case 1 (UC1), the external HMI (eHMI), in use case 2 (UC2), and the fluid HMI, in use case 3 (UC3). These use cases take into consideration users' needs and preferences and address different road user types and different numbers of road users (see D1.2 for more details).

4.1.4 Competitive landscape

Assessing direct and indirect competitors, their strengths, weaknesses, market positioning, pricing strategies, and offerings helps identify opportunities for differentiation and competitive advantages. In this section we present the key players (primary competitors) in the sector, and then we categorise them by product offering.

The competitive landscape of HMI solutions in the automotive industry consists of both traditional players and innovative companies. There are mainly five categories in which we can categorise the competitors: (i) the traditional automotive OEMs, well-established automakers that have a history of producing vehicles with integrated HMI systems; (ii) tier-1 suppliers, that provide HMI-related components and systems to automotive manufacturers; (iii) technology and software companies, that offer solutions for automotive HMIs; (iv) HMI specialists and innovators, specialised in advanced HMI solutions and those at the forefront of innovation; and (v) startups and new entrants, innovative startups that have entered the market with novel HMI solutions. Table 4-1 provides a summary of the key providers in each category by product offering.

Table 4-1: Competitive landscape by category

Category	*Companies*
Traditional Automotive OEMs	BMW Group (Germany) Daimler AG (Mercedes-Benz) (Germany) Volkswagen Group (Audi, Porsche) (Germany) Renault Group (France) Fiat Chrysler Automobiles (Italy) Volvo Cars (Sweden) Honda Motor Co., Ltd. (Japan) Ford Motor Company (US) Toyota Motor Corporation (Japan)
Tier-1 Suppliers	Continental AG (Germany) Robert Bosch GmbH (Germany) Valeo (France) Aptiv PLC (Ireland) Magna International Inc. (Austria) HARMAN International (a Samsung Company) (Germany) Denso Corporation (Spain)
Technology and Software Companies	Apple Inc. (Apple CarPlay) Google LLC (Android Auto) NVIDIA Corporation (with offices in Europe) Qualcomm Incorporated (with offices in Europe) Panasonic Corporation (with automotive technology divisions in Europe) Nuance Communications (US)
HMI Specialists and Innovators	Rightware (Finland) Visteon Corporation (United Kingdom) Elektrobit (EB) (Germany) WayRay (Switzerland) Cognex Corporation (Switzerland) Continental Engineering Services (Germany) Preh GmbH (Germany)

Startups and New Entrants	Canatu Ltd. (Finland) Eyesight Technologies (Israel) Brightway Vision (France) Eyeris Technologies, Inc. (Germany) Perceptive Automata (Germany) Cognata (Israel) Apex.AI (Germany)

The competitive landscape is dynamic, and new players and partnerships emerge as the industry evolves. It is important to conduct thorough research to stay updated on the latest market developments and identify the specific competitive landscape relevant to HEIDI target market segment and geographical location.

The differentiation factors, highlighting what sets each competitor apart, the market share and penetration (e.g., market share and geographic penetration) and the customer types of each competitor target, will be analysed during year 2 (Y2) activities of HEIDI's WP8 and will be presented in deliverable D8.8 (M24).

4.1.4.1 Technological advancements

Observing trends within the industry, staying attuned to technological progress, monitoring regulatory shifts, and understanding market dynamics aid in predicting changes and adjusting strategies correspondingly. The domains of internal and external sensing, HMI and intelligent transportation systems (ITS) are undergoing swift transformations. The following figure (Figure 4–6) present some of the recent breakthroughs in these domains:

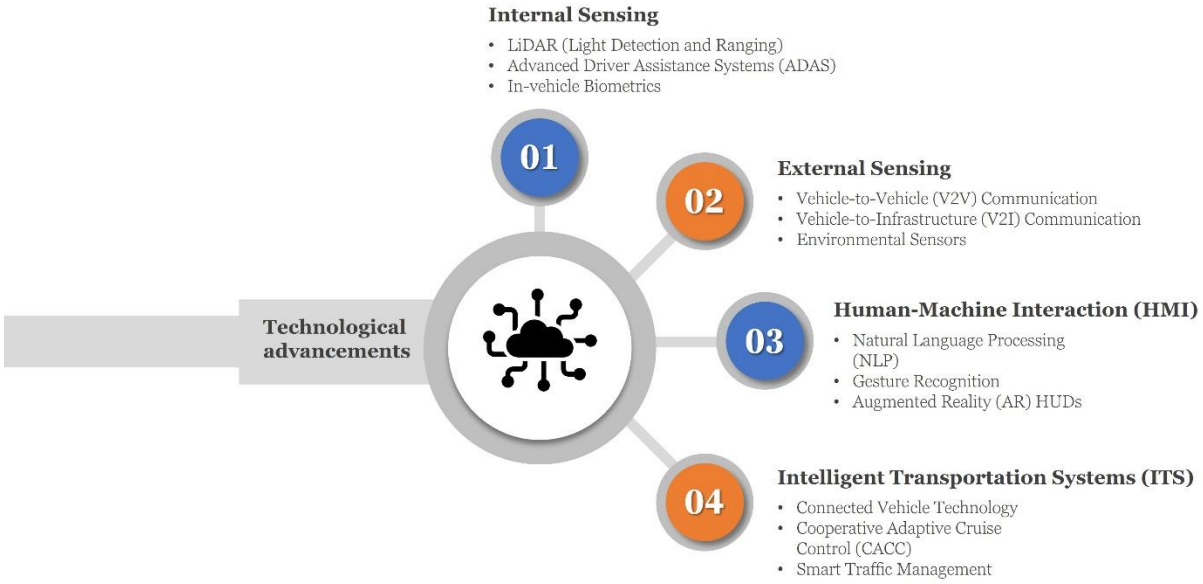

Figure 4–6: Recent technological breakthroughs in the domains of HMI and ITS

1. Internal Sensing:
    a. ***LiDAR (Light Detection and Ranging)*** technology uses laser beams to accurately measure distances and create detailed 3D maps of the surroundings [10]. It enables advanced object detection and precise localisation for autonomous vehicles.
    b. ***Advanced Driver Assistance Systems (ADAS)*** technologies, such as radar and cameras, are continuously improving to provide enhanced object

detection, lane-keeping assistance, adaptive cruise control, and automated emergency braking [11].

c. ***In-vehicle Biometrics sensors***, including facial recognition, fingerprint scanners, and heart rate monitors, are being integrated into vehicles to enhance security and personalise the driving experience [9].

2. External Sensing:
    a. ***Vehicle-to-Vehicle (V2V) Communication*** technology allows vehicles to communicate with each other, exchanging real-time data on location, speed, and other critical information. This enables cooperative collision avoidance and traffic optimisation [12].
    b. ***Vehicle-to-Infrastructure (V2I) Communication*** facilitates interaction between vehicles and the surrounding infrastructure, such as traffic lights and road signs, enabling improved traffic management and safety [13].
    c. ***Environmental Sensors***: advanced environmental sensors, such as weather sensors and air quality sensors, are being integrated into vehicles to provide real-time data for weather forecasting, road condition monitoring, and pollution detection [9].
3. Human-Machine Interfaces (HMI):
    a. ***Natural Language Processing (NLP)*** technology enables voice commands and natural language understanding, allowing drivers to interact with the vehicle's HMI system using voice control more seamlessly and intuitively [9].
    b. ***Gesture Recognition*** systems utilise cameras or depth sensors to detect and interpret hand movements, enabling drivers to control various functions without physical contact with the interface [9].
    c. ***Augmented Reality (AR) Head Up Displays (HUDs)*** overlay relevant information, such as navigation instructions or hazard warnings, onto the driver's view of the road, enhancing situational awareness and reducing distraction [14].
4. Intelligent Transportation Systems (ITS):
    a. ***Connected Vehicle Technology*** utilises wireless communication to exchange data between vehicles, infrastructure, and traffic management centres. This enables real-time traffic monitoring, optimised routing, and enhanced safety features [9].
    b. ***Cooperative Adaptive Cruise Control (CACC) systems*** enable vehicles to maintain safe distances from each other in a platoon, using vehicle-to-vehicle communication and sensor fusion. This technology improves traffic flow, reduces congestion, and enhances fuel efficiency [15].
    c. ***Smart Traffic Management systems*** leverage data from various sources, including vehicles, infrastructure sensors, and historical traffic patterns, to optimise signal timing, manage congestion, and improve overall traffic efficiency [16].

These are just a few examples of the latest technological advancements in internal and external sensing, HMI, and ITS. The continuous progress in these fields is shaping the future of transportation, making vehicles safer, more connected, and efficient.

4.1.4.2 SWOT Analysis

Assessing the strengths, weaknesses, opportunities, and threats (SWOT) specific to the market provides a comprehensive understanding of the external factors that can impact the success of the exploitation and sustainability of HEIDI's outcomes.

1. Strengths:
    a. ***Advanced Technology***: The integration of internal and external sensing technologies enables a more comprehensive and accurate understanding of the vehicle's environment, enhancing safety and user experience.
    b. ***Enhanced User Experience***: The adaptive HMI solutions provide personalised and intuitive interfaces, improving driver comfort, engagement, and satisfaction.
    c. ***Cooperative Functionality***: The ability to communicate and cooperate with other vehicles and road infrastructure facilitates intelligent decision-making, leading to improved traffic flow and safety.
    d. ***Competitive Advantage***: The innovative and holistic approach to HMI solutions sets the solution apart from traditional providers and positions it as a leader in the market.
    e. ***Safety Improvement***: The integration of adaptive features and real-time data helps detect potential hazards and assists drivers in making informed decisions, contributing to overall road safety.
2. Weaknesses:
    a. ***Adoption Challenges***: Introducing a new and advanced HMI solution may face resistance from customers who are accustomed to traditional interfaces or have concerns about the learning curve associated with new technology.
    b. ***Technological Dependencies***: The effectiveness of the adaptive HMI solutions heavily relies on the availability and reliability of internal and external sensing technologies. Any limitations or failures in these technologies could impact the system's performance.
    c. ***Cost Considerations***: The integration of advanced sensing technologies and the development of adaptive HMI solutions may result in higher costs, which could limit initial market penetration and require convincing customers of the long-term value.
    d. ***Limited use cases***: The evaluation of HEIDI solution will be tested in a limited number of use cases. These use cases are described in D1.2.
3. Opportunities:
    a. ***Growing Market Demand***: The increasing emphasis on connectivity, user experience, and safety in the automotive industry creates a favourable market environment for innovative HMI solutions.
    b. ***Partnerships and Collaborations***: Collaborating with automotive manufacturers, technology companies, and infrastructure providers can expand market reach and facilitate the integration of HMI solutions into vehicles and smart infrastructure.
    c. ***Regulation and Standards***: The evolving regulatory landscape focused on HMI systems and vehicle safety standards presents an opportunity to align the adaptive HMI solutions with emerging requirements and position the HEIDI project as a compliant and trustworthy regulation and standardisation provider.

4. Threats:
    a. ***Competitive Rivalry***: Established players and new entrants in the HMI market may also develop innovative solutions, leading to intense competition and price pressures.
    b. ***Technological Advancements***: Rapid advancements in HMI technologies and alternative approaches may pose a threat if competitors introduce more advanced or disruptive solutions.
    c. ***Data Privacy and Security***: The collection and processing of sensitive data related to internal and external sensing raise concerns about data privacy and cybersecurity. Addressing these concerns is crucial to maintain customer trust.

Figure 4–7 presents a summary of the SWOT analysis.

Figure 4–7: SWOT analysis of HEIDI's solution

4.1.4.3 Porter's Five Forces analysis

Porter's Five Forces Framework is an analytical approach used to assess a business's competitive landscape. It utilises principles from industrial organisation economics to identify five forces that shape the competitive strength and overall appeal (or lack thereof) of an industry in relation to its profitability [17].

Using Porter's Five Forces analysis, it is possible to identify the potential market threats coming from existing competitors, new entrants, and potential substitutes and the threats to HEIDI's profitability coming from suppliers and buyers. By analysing each of these potential threats it

is also possible to consider whether there are strategies to mitigate these threats and, if not, how it is possible to retarget the product so that these threats are minimised. Below we present the results of the first market forces analysis which could be updated, if necessary, during project execution and presented in next reports (D8.8 and D8.9).

a. Threat of New Entrants:

Low to Moderate: Developing a fluid, cooperative HMI system that holistically integrates internal and external sensing requires substantial technological expertise, research and development capabilities, and access to advanced sensor technologies. Established companies with expertise in HMI, automotive, and sensor industries may have an advantage. However, the threat of new entrants with innovative ideas and disruptive technologies remains possible.

b. Bargaining Power of Suppliers:

Moderate: The bargaining power of suppliers of internal and external sensing technologies and components may vary. Companies that offer unique, proprietary technologies and have limited competition may have higher bargaining power. However, the market for technologies is relatively diverse, allowing the provider to have multiple sourcing options and negotiate competitive deals.

c. Bargaining Power of Buyers (Customers):

High: The automotive industry is highly competitive, and buyers, such as automotive manufacturers and fleet operators, have multiple options for HMI solutions. Customers are price-sensitive and seek integrated solutions that deliver high value, user experience, and safety benefits. The provider must demonstrate clear differentiators and a compelling value proposition to address customer needs effectively.

d. Threat of Substitutes:

Moderate: While there may be alternative HMI solutions available in the market, such as traditional HMI interfaces and standalone driver assistance systems, a fluid, cooperative HMI that integrates internal and external sensing to create adaptive solutions offers unique benefits and enhanced safety. However, the threat of substitutes remains as technology advances and competitors introduce alternative solutions.

e. Competitive Rivalry:

High: The market for HMI solutions in the automotive industry is competitive, with established players and emerging startups offering various solutions. The development of innovative HMI technologies is continuously evolving, and competition drives companies to improve their offerings. Differentiation through seamless integration, cooperation capabilities, and real-time data analysis is essential to stand out and maintain a competitive edge.

A summary of the HEIDI's Poter's five forces analysis is presented in Figure 4–8.

Figure 4–8: Porter's Five Forces analysis for HEIDI solution

Overall, the HEIDI solution faces challenges from established players, technological advancements, and customer demands. However, there are opportunities for differentiation, strategic partnerships, and market positioning to overcome these forces and succeed in the competitive automotive HMI market.

4.1.5 Regulatory landscape

The regulatory landscape related to HMI systems and vehicle safety standards varies across different regions and countries. The following table presents a preliminary summary of the main key aspect to consider while taking into consideration the regulatory landscape in different countries / regions:

Table 4-2: Regulatory landscape for HEIDI assets in different countries/regions

Region / country	Regulations
United States	***National Highway Traffic Safety Administration (NHTSA)***[1]: The NHTSA sets and enforces vehicle safety standards in the United States. They have guidelines for driver distraction and in-vehicle electronic devices to ensure that HMI systems do not compromise driver safety.
	Federal Motor Vehicle Safety Standards (FMVSS)[2]: FMVSS regulations cover various safety aspects of vehicles, including crashworthiness, occupant protection, and vehicle equipment. Compliance with FMVSS standards is mandatory for vehicles sold in the U.S.
European Union	***United Nations Economic Commission for Europe (UNECE)***[3]***:*** The UNECE develops international

[1] https://www.nhtsa.gov/
[2] https://www.nhtsa.gov/laws-regulations
[3] https://unece.org/

	standards, regulations, and type approval procedures for vehicles, including safety and HMI-related aspects.
	European Union Vehicle Safety Standards[4]: The EU has established vehicle safety standards, including regulations on driver distraction, to ensure HMI systems do not impair driver attention and safety
Japan	***Ministry of Land, Infrastructure, Transport and Tourism (MLIT)***[5]: MLIT is responsible for vehicle safety standards in Japan. They have regulations related to driver distraction and HMI systems to maintain safety standards.
Other Countries	Different countries have their own regulatory bodies and standards for vehicle safety and HMI systems. For example, Canada has regulations established by Transport Canada, while China has guidelines set by the Ministry of Industry and Information Technology (MIIT).

In addition to these regional regulations, there are also global initiatives and collaborations focusing on vehicle safety and HMI systems, such as those led by the United Nations and its affiliated organizations. For example, the World Forum for Harmonization of Vehicle Regulations (WP.29)[6] develops international standards and regulations for vehicle safety and emerging technologies.

It is crucial for the HEIDI project to ensure compliance with the relevant regulations in the markets they operate in. These regulations aim to ensure that HMI systems do not compromise driver safety, minimise driver distraction, and maintain the overall integrity of the vehicle's safety features. Future reports (Y2 and Y3 reports of activities – D8.8 and D8.9) will provide more detailed information about the specific regulations that applies to HEIDI assets.

[4] New rules to improve road safety and enable fully driverless vehicles in the EU https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4312
[5] https://www.mlit.go.jp/en/
[6] https://unece.org/transport/vehicle-regulations/world-forum-harmonization-vehicle-regulations-wp29

4.2 Business Model Canvas

This Business Model Canvas provides an overview of the key elements involved in the business model for the HEIDI identified assets.

Figure 4–9: HEIDI's business model canvas

5. Sustainability activities plan

The sustainability strategy is part of the overall exploitation approach of the HEIDI project (as presented in Figure 3–1). It includes the necessary steps to enable the sustainability of project assets after the end of the project. The following steps, described also in the exploitation overview (section 3 and D8.3) are part of the sustainability activities planned for the HEIDI project:

1. ***Identification of outcomes to be sustained***: identification of concrete HEIDI assets that the consortium wants to sustain over time and the strategies that will be needed to sustain them.
2. ***Identification of resources required***: resources necessary to sustain the strategies and outcomes overtime (e.g., training, talent, technology, etc.).
3. ***Identification of main use cases***: providing a rationale for fundraising and grant-seeking activities describing the HEIDI values, purposes, and missions.
4. ***Intellectual Property Rights (IPR)*** identification: for this the instruments created and presented in the annex of D8.3 will be used to collect the necessary information.
5. ***Determine future funding strategies or synergies*** with other related projects, grant organisations, and or networks. Strengthen connections with sister projects, or other complementary research projects, in order to broaden even more the network.

In a more general view, sustainability activities also refers to actions taken by the project partners to promote the suitainabiliy of project outcomes within the environmental, social, and economic domains, ensuring long-term economic viability while contributing positively to society and the environment. Some example of these activities related to the scope of the HEIDI project and specific areas of sustainability based on their unique circumstances and impacts are:

a. assess and minimise the environmental footprint of the supply chain and logistics operations,
b. ensure ethical labour practices throughout the supply chain,
c. support community development initiatives,
d. engage in partnerships and collaborations with different types of organisations (e.g., nonprofit organisations, enterprises, etc.),
e. actively involve stakeholders, including employees, customers, suppliers, and local communities,
f. seek feedback from stakeholders to identify areas for improvement and align sustainability efforts with their expectations,
g. integrate sustainability into the product life cycle, from sourcing raw materials to end-of-life disposal or recycling.
h. conduct regular sustainability reporting to measure, track, and communicate the organisation's sustainability performance and progress,
i. encourage publication of both scientific papers and policy reports and briefs, to ensure that research findings are reachable by stakeholders,

The sustainability of HEIDI assets will not only depend on the maintenance over time of project results and findings. It will also fundamentally be based on the foundation of solid partnerships and relationships between HEIDI and all the relevant stakeholders or networks that could provide a platform to maintain and/or expand the project outputs after the end of the EU

funding. Furthermore, strong cooperation with the academic domain and its networks, technology providers and with policy makers at local, regional, and national level will be encouraged during the execution of the sustainability plan.

6. Conclusion

As mentioned in the introduction of this report, this is the first-year report of the exploitation, sustainability and standardisation activities related to the work carried out within WP8 of the HEIDI project. The information provided in the present deliverable includes a summary of the work presented in deliverable D8.3 and the information obtained from a phase of exploration, which aimed to identify an initial list of the expected assets, their main potential buyers, the first approach of exploitation strategies including the market analysis and the business model canvas definition. Furthermore, an initial description of sustainability activities that will be planned with the aim to maintain and expand project outcomes after the end of the EU grant is presented.

During the second year of the HEIDI project, the consortium will work towards providing additional insights into project results, possible exploitation pathways including the IP management of the assets. Next steps will be covered and described in future deliverables, specifically Year 2 (deliverable D8.8) and Year 3 (deliverable D8.9) reports of exploitation and sustainability. As the project implementation evolves, the focus will be placed on the detailed identification and definition of background IP, foreground IP, assets' ownership, and access rights and protection, using the instrument designed to gather this information during the project implementation stage (Annex 1 of D8.3). This instrument will be completed and updated as the project activities evolve.

This will be done by working in close collaboration with work package leaders, and the project partners through the instrument designed for that aim and during future internal workshop sessions under the activities of WP8.

7. Abbreviations

Term	Definition
ADAS	Advanced Driver Assistance Systems
API	Application Programming Interface
AR	Augmented Reality
B2B	Business to Business
CACC	Cooperative Adaptive Cruise Control
CAGR	Compound Annual Growth Rate
D	Deliverable
eHMI	Fluid external HMI
EM	Exploitation Models
FAIR	Findable, Accessible Interoperable, and Reusable
FMVSS	Federal Motor Vehicle Safety Standards
GA	Grant Agreement
HEIDI	Holistic and adaptivE Interface Design for human-technology Interactions
HMI	Human Machine Interface
HUDs	Head Up Displays
iHMI	Fluid internal HMI
IP	Intellectual Property
IPR	Intellectual Property Rights
ITS	Intelligent Transportation Systems
KERs	Key Exploitable Results
LiDAR	Light Detection and Ranging
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
NHTSA	National Highway Traffic Safety Administration
NLP	Natural Language Processing
OEMs	Original Equipment Manufacturer
PU	Public
R	Document, Report
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAM	Total Addressable Market
UCs	Use Cases
UNECE	United Nations Economic Commission for Europe
V2I	Vehicle-to-Infrastructure
V2V	Vehicle to Vehicle
WP	Work Package
Y	Year

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