



D6.2 – Integrating micromobility into city planning: design guidelines and prototype



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Authors List

Leading Author				
First Name		Last Name	Beneficiary	Contact e-mail
Fabio		Garista	VAIMOO	fabio.garista@angel4future.com
Co-Author(s)				
#	First Name	Last Name	Beneficiary	Contact e-mail
1	Rotondi	Giuseppe	VAIMOO	giuseppe.rotondi@angel4future.com
2	Pasculli	Francesco	VAIMOO	francesco.pasculli@angel4future.com
3	Visconti	Simona	VAIMOO	simona.visconti@angel4future.com
4	Panagiota	Chatzipanagiotidou	CERTH	phatzip@iti.gr
5	Stefano	Mauri	AEM	smauri@aemsa.ch

Reviewers List

Reviewers			
First Name	Last Name	Beneficiary	Contact e-mail
Cristina	Marchante Garcia	MUR	cristina.marchante@ayto-murcia.es
Guido	van Arkel	BHA	g.vanarkel@bruco.org

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Executive Summary

This report describes the activities and results of the AccessS project which aims to develop innovative urban micromobility solutions that are inclusive, with particular attention to the needs of elderly people and those with reduced mobility. The main objective is the design of an accessible, safe, and easy-to-use cargo e-bike, capable of improving urban accessibility and promoting sustainability in smart cities.

The design is based on a structured methodological approach starting from market analysis and stakeholder engagement, through the definition of technical requirements and engineering design. Data was collected through questionnaires and interviews involving end users, caregivers, and urban planners to identify needs, critical issues, and market opportunities. Market Analysis and Stakeholder Engagement highlights a growing demand for inclusive micromobility solutions, market gaps in terms of safety, comfort, and ease of use, and a favourable regulatory context at European level. The priorities identified include:

- Safety and stability: three-wheel tilting frame, reliable braking systems, aids for stability during mounting/dismounting.
- Modularity and adaptability: tool-free adjustments, ergonomic seats, intuitive interfaces.
- Digital support: electronic unlocking systems (NFC/tag), GPS tracking, clear visual signals.
- Emotional value: promoting autonomy and well-being through cycling.

The proposed cargo e-bike integrates advanced solutions for accessibility (low step-through, swivel seat, ergonomic controls), safety (hydraulic brakes, automatic lights, anti-theft systems), connectivity (app, telematics, removable battery), and transport of assistive devices. The design ensures ease of maintenance and customization, supporting adoption by both private users and urban fleets, while it ensures compliance with the main European directives and regulations on safety, electromagnetic compatibility, battery management, privacy, and cybersecurity, thus guaranteeing market access and user protection. A user-centred approach and collaboration among stakeholders is essential to develop truly inclusive and sustainable micromobility solutions. The integration of quantitative and qualitative data has enabled the definition of solid design guidelines aligned with European objectives for urban accessibility and technological innovation.



Table of Contents

1	Introduction.....	9
1.1	Scope and objectives of the deliverable	9
1.2	Structure of the deliverable	9
2	Methodology	10
3	Market Analysis and Stakeholder Engagement	11
3.1	Main Market Opportunities Identified	11
3.2	Stakeholder Engagement.....	13
3.3	Results.....	14
3.4	Product Features Required by the Market.....	17
4	Regulatory and Normative Framework.....	18
5	Product Description.....	20
5.1	General Overview	20
5.2	Accessibility Features	20
5.3	Structural and Mechanical Design	22
5.4	Powertrain and Performance.....	24
5.5	Safety and Security.....	25
5.6	Technology and Connectivity	26
5.7	Cargo and Usability	27
5.8	Maintenance and Customization	28
6	Conclusions.....	29
	Annex A – Technical Scheme.....	30
	Annex B – Overview of survey questions.....	31

List of Figures

Figure 1 Mounting/transfer geometry	21
Figure 2 Stationary stability aids enabling transfers and stops without foot support on the ground.	21
Figure 3 Chassis architecture – Front side Cargo e-Bike	22
Figure 4 Chassis architecture – Rear Side Cargo e-Bike	23
Figure 5 Tilting mechanics.....	23
Figure 6 IoT Assist system and transmission details.	24
Figure 7 Braking Systems.....	25
Figure 8 Primary visibility & signalling	26
Figure 9 IoT Module highlighted in green for access control, telematics and state of charge display.....	27
Figure 10 Cargo and Usability.	28
Figure 11 Technical Scheme	30

List of Tables

Table 1. Market segment by Number of Vehicles and European Cities	12
Table 2. Market segment by NUMBER OF VEHICLES per 10.000 inhabitants and European Cities	12
Table 3. Questions #1-#2.....	14
Table 4. Questions #3-#4.....	14
Table 5. Questions #5-#6.....	14
Table 6. Questions #7-#8.....	15
Table 7. Questions #9-#10.....	15
Table 8. Questions #11-#12.....	15
Table 9. Questions #13-#14.....	16

List of Acronyms and Abbreviations

Term	Description
EMC	Electromagnetic Compatibility
RED	Radio Equipment Directive
LVD	Low Voltage Directive
RoHS	Restriction of Hazardous Substances
WEEE	Waste Electrical and Electronic Equipment
GDPR	General Data Protection Regulation
IoT	Internet of Things
HMI	Human Machine interface
NFC	Near Field Communication
EPAC	Electrically Power Assisted Cycle
SoC	State of Charge
CE	Conformité Européenne
MQTT	Message Queuing Telemetry Transport
IEC	International Electrotechnical Commission
UN 38.3	UN Transport Regulation for Lithium Batteries

1 Introduction

1.1 Scope and objectives of the deliverable

This document presents a comprehensive technical description of the task T6.2 Micromobility and Inclusive City Planning activities of the AccessS project, providing a comprehensive assessment of existing urban infrastructure related to micromobility options. The task focuses on the development of an innovative, inclusive cargo e-bike, aiming to enhance urban accessibility for all, in particular to elderly citizens and those with reduced mobility.

1.2 Structure of the deliverable

This deliverable is structured into the following chapters:

- **Chapter 2: Methodology:** This section describes the structured product development process, from market analysis to engineering design. It ensures that each phase contributes to a coherent and efficient approach for creating the inclusive e-bike.
- **Chapter 3: Market Analysis and Stakeholder Engagement:** The chapter details the market research and stakeholder consultations conducted to identify user needs and market gaps. It highlights demographic trends, regulatory reviews, and technological assessments shaping the design requirements. This chapter presents findings from questionnaires and interviews, revealing priorities such as safety, modularity, ease of use, and digital support. It underscores the importance of emotional value and user-centered design in micromobility solutions.
- **Chapter 4: Regulatory and Normative Framework:** The chapter reviews European regulations and standards relevant to e-bike design, including safety, electromagnetic compatibility, and battery management. It stresses compliance as a prerequisite for market access, user safety, and sustainability.
- **Chapter 5: Product Description:** This section provides an overview of the proposed e-bike, detailing accessibility, safety, structural design, powertrain, and connectivity features. It emphasizes ergonomic design, advanced technology, and adaptability for diverse user needs.
- **Chapter 6: Conclusions:** This final chapter synthesizes the report's findings, confirming the importance of user-centered design and regulatory compliance. It calls for collaborative efforts to deliver inclusive, sustainable micromobility solutions aligned with EU objectives.

1.3 Relation to Other Tasks and Deliverables

The work carried out within Task 6.2 is connected to the activities performed for the other deliverables required for the completion of **WP6 – Intelligent Systems for Adaptive Building and Mobility Management**, in the sense of providing a holistic approach for the operation and management of the built environment. T6.2 takes on the results of the other tasks of WP1 and WP2 related to pilot conditions and user needs and translates them into technical solutions and concrete prototypes. In particular T6.2 focuses on the design and development of an inclusive cargo e-bike, integrating the needs that emerged from market analysis, stakeholders, and end users.

2 Methodology

This section summarizes the product development methodology from Market Analysis to Engineering Design. It outlines the key phases and their objectives to ensure a structured and efficient development process.

- **Market Analysis and Stakeholder Engagement**

The initial phase focuses on understanding market needs and identifying opportunities. It involves gathering data on customer requirements, competitor offerings, and industry trends.

- **Concept Definition and Technical Feasibility**

This phase validates the technical and financial viability of the proposed product concept. It includes risk analysis, impact assessment, and preliminary resource planning.

- **Requirements Definition**

In this phase, product features are translated into detailed system and subsystem requirements. It ensures compliance with standards and addresses reliability, maintainability, and safety aspects.

- **Engineering Design**

The design phase involves creating detailed specifications for each subsystem, integrating components, and defining the final product configuration. Documentation and review cycles ensure quality and readiness for prototyping.

3 Market Analysis and Stakeholder Engagement

The market analysis was conducted through an integrated approach involving:

- **Stakeholder engagement:** Urban planners and key stakeholders were consulted to understand the current state of urban infrastructure and to identify the best accessibility solutions for micromobility.
- **Data collection and trends:** Demographic data were gathered, with particular attention to the needs of older adults and people with reduced mobility, through targeted surveys and questionnaires.
- **Competitive analysis:** Existing solutions were compared with the proposed digital prototype, evaluating strengths and weaknesses against main competitors.
- **Regulatory review:** Regulations and incentives supporting inclusivity and road safety were analyzed.
- **Technology assessment:** The evolution of digital technologies and smart devices applied to mobility was monitored.

3.1 Main Market Opportunities Identified

The analysis is based on quantitative market research, comparing the number of shared mobility vehicles (bikes, kick scooters, mopeds, cars) across major European cities. Data is presented both per 10,000 inhabitants and as absolute numbers, allowing for benchmarking and identification of trends in micromobility adoption. Moreover, various existing inclusive mobility products (e.g., Exelentia Kyburz DX2, GaloxScooter Faster, KYMCO Healthcare K-LITE FE, Rascal Veo Sport, CareCo AirLite X) were evaluated based on features such as speed, range, motor, battery, and additional characteristics. This benchmarking helped identify strengths and weaknesses compared to the proposed digital prototype.

The analysis highlighted several market opportunities:

- **Growing demand for inclusive solutions:** The aging population and increasing focus on accessibility are generating significant demand for micromobility vehicles and services tailored to people with specific needs.
- **Market gaps:** There are unmet needs, especially regarding ease of use, safety, and comfort
- **Favorable regulatory evolution:** European regulations and incentives promote the adoption of inclusive and safe solutions.
- **Technological innovation:** The integration of digital technologies, such as sensors, GPS, and smartphone apps, opens new possibilities to improve user experience and the management of micromobility services.
- **Geographical segmentation:** Data collected in various European cities show strong variability in the adoption of different micromobility means, suggesting expansion opportunities in less mature markets.

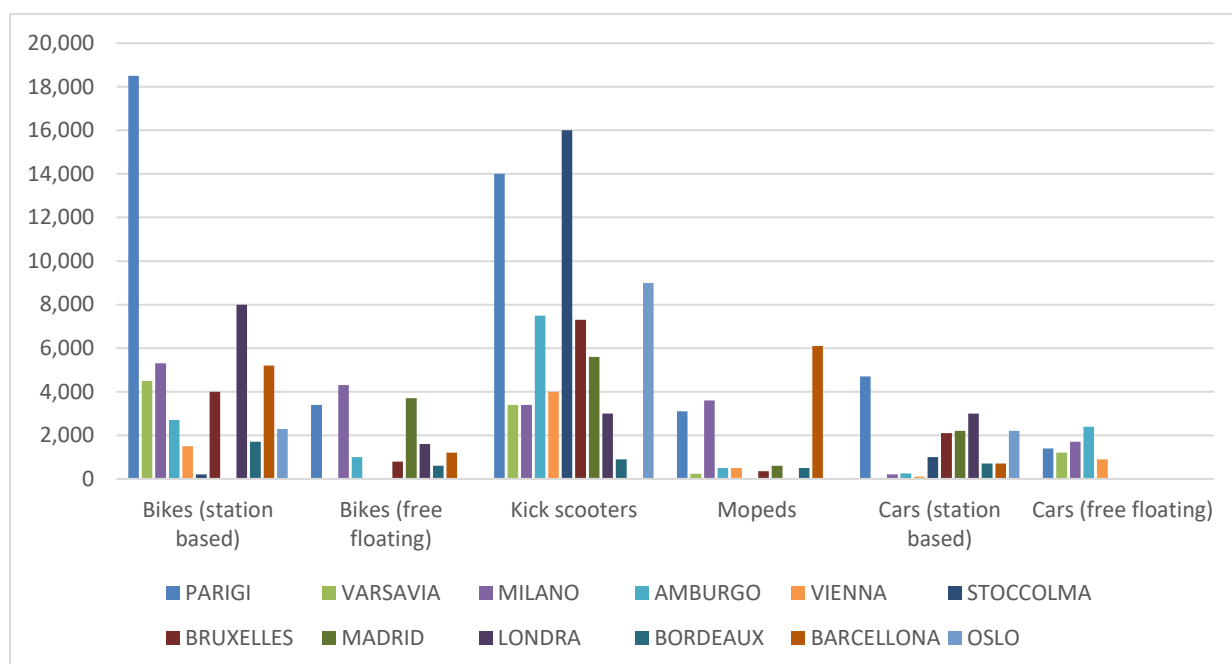


Table 1. Market segment by Number of Vehicles and European Cities

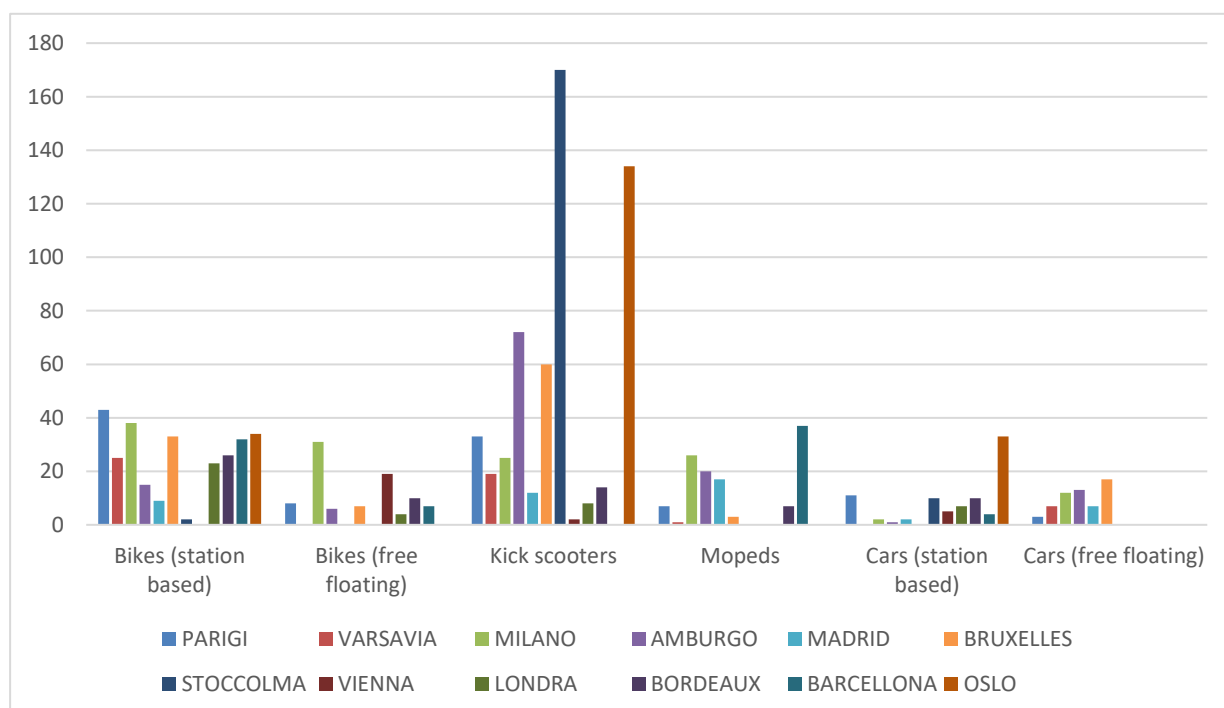


Table 2. Market segment by NUMBER OF VEHICLES per 10.000 inhabitants and European Cities

3.2 Stakeholder Engagement

A survey (Annex B) was carried out as part of Task 6.2 – Micromobility and Inclusive City Planning, within the AccessS project, to identify the most suitable accessibility features for inclusive cargo bikes in urban environments. The research aimed to gather comprehensive insights into both the physical infrastructure and the diverse needs of users, including older adults and people with reduced mobility.

There are at least 13 complete responses widespread among all AccessS participants. Each row represents an individual response, including data on height, weight, preferences.

The methodology combined a standardized questionnaire, the Inclusive Cargo Bike Survey, with in-depth interviews. The questionnaire systematically collected user experiences and accessibility requirements from a broad sample, focusing on aspects such as frame height, adjustability of saddle and handlebar, riding position, braking systems, stability features, ergonomics, cargo box design, safety accessories, digital unlocking methods, and information signals. Respondents were also invited to share open feedback about their main difficulties and desired features for accessible cargo bikes.

Recognizing that some target groups—such as residents with reduced mobility—could not complete the survey independently, the research team conducted interviews with caregivers and family members as for example for the case of Droom Je Thuis pilot site. These qualitative interviews explored additional themes essential for these users, including maximum stability and safety, modularity and adaptability, ease of use for caregivers, space for assistive devices, digital support, and the emotional value of cycling.

By integrating quantitative data from the survey with qualitative insights from interviews, the study provides a nuanced understanding of the practical, functional, and emotional requirements for accessible micromobility solutions. The results inform the design and development of a digital prototype for an inclusive cargo e-bike, ensuring that future solutions address both standard and specialized user needs within urban planning.

3.3 Results

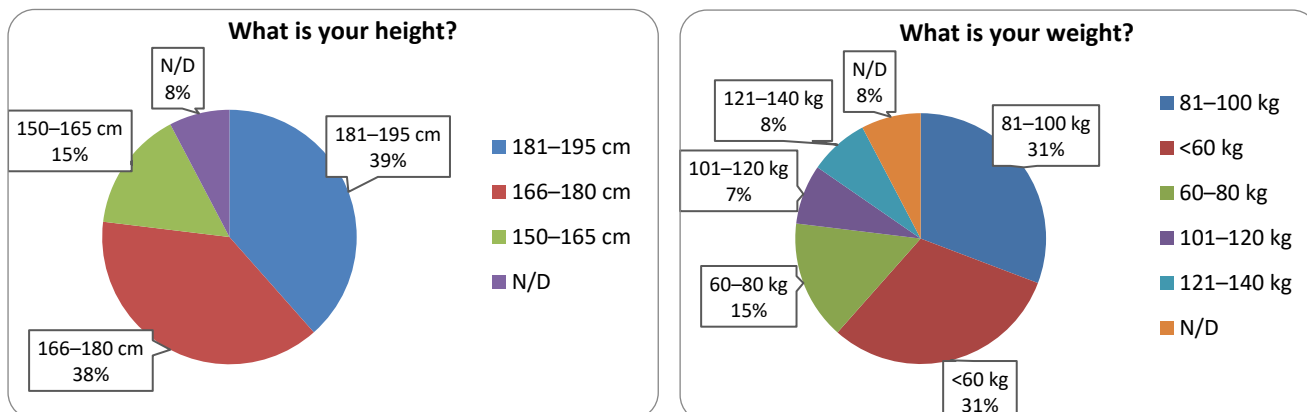


Table 3. Questions #1-#2

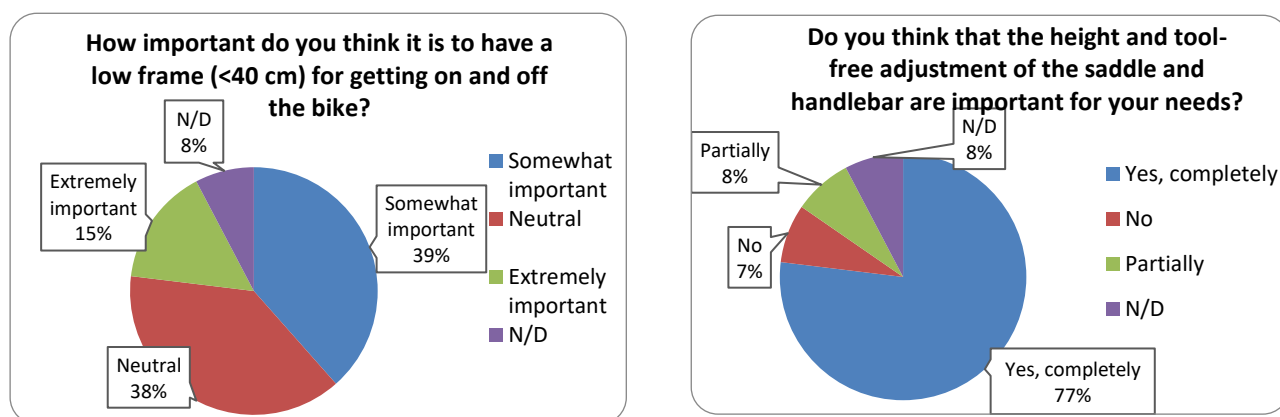


Table 4. Questions #3-#4

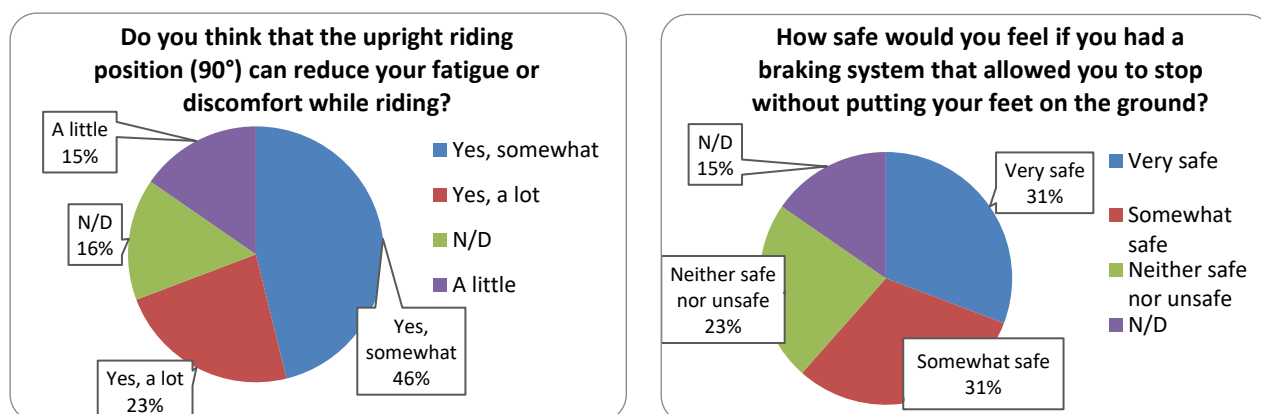


Table 5. Questions #5-#6

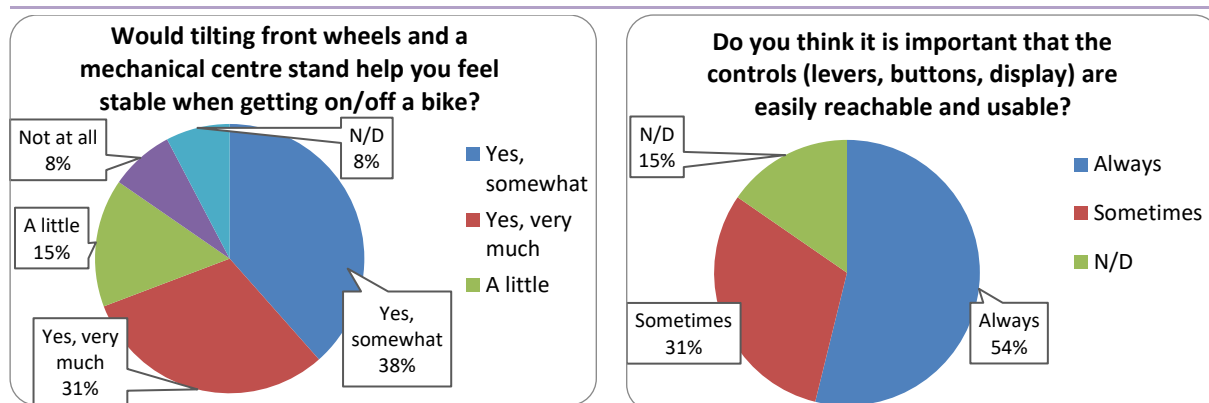


Table 6. Questions #7-#8

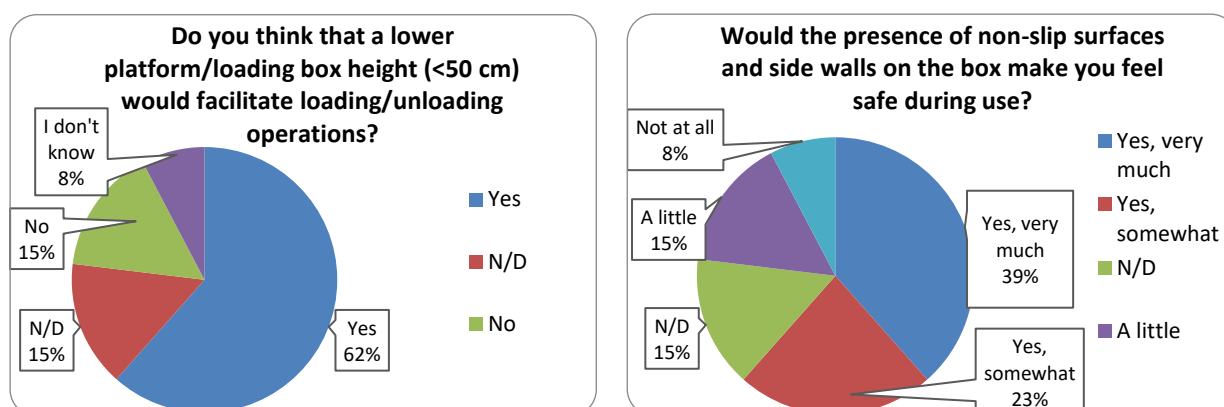


Table 7. Questions #9-#10

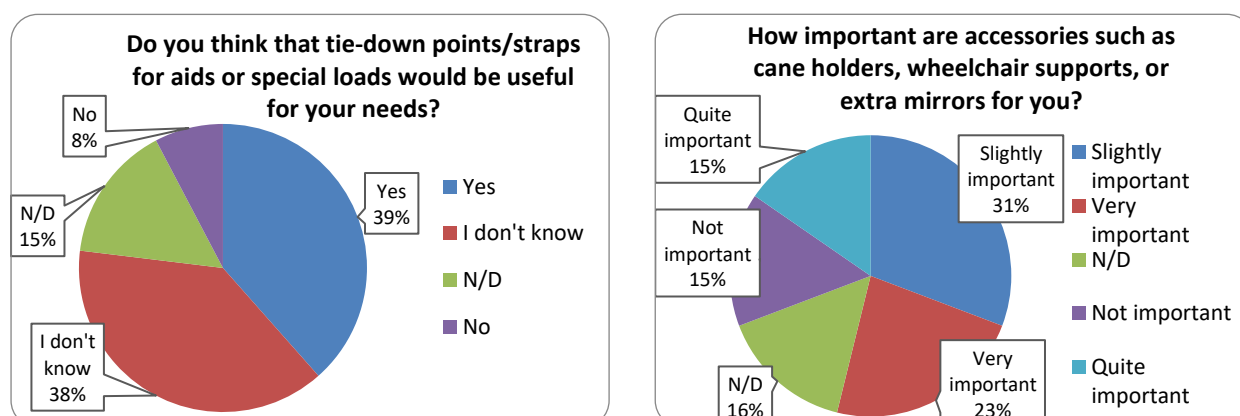


Table 8. Questions #11-#12

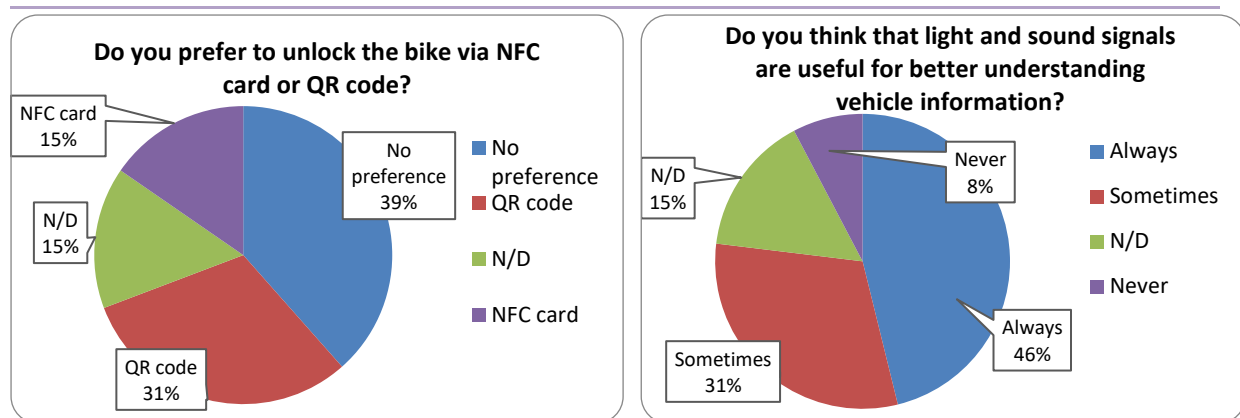


Table 9. Questions #13-#14

The results of the survey and interviews demonstrate that the development of inclusive cargo bikes for urban environments must be guided by a thorough understanding of the practical, functional, and emotional needs of people with reduced mobility. Several priorities have emerged:

- **Safety and Stability:** Features such as low step-through frames, secure seating (including bucket seats and belts), reliable braking systems, and parking brakes are essential for safe transfers and for preventing accidents, especially for users who cannot stabilize themselves with their feet.
- **Modularity and Adaptability:** There is significant variation in physical abilities among users. Modular and easily adjustable designs are needed to accommodate different physical profiles and preferences. Tool-free adjustments for seats, supports, and controls are highly valued.
- **Ease of Use:** Intuitive and ergonomic controls, simple gear systems, and accessible braking mechanisms are fundamental. The design should minimize physical effort and make daily use efficient.
- **Digital Support and Accessibility:** Electronic unlocking (e.g., NFC/tag systems), integrated tracking, and clear visual signals for battery status and unlocking are important for shared use and safety. These features facilitate access and management.
- **Emotional Value of Cycling:** Beyond practical mobility, cycling provides pleasure, autonomy, and a sense of freedom. An accessible cargo bike should be motivating and comfortable, supporting the emotional well-being of users.

In summary, the integration of quantitative survey data and qualitative insights highlights the necessity of user-centered design. Future cargo bike prototypes should prioritize safety, adaptability, ease of use, and emotional engagement, ensuring that micromobility solutions truly meet the needs of people with reduced mobility in urban contexts.

3.4 Product Features Required by the Market

From the competitive analysis and feedback collected, several key product features required by the market have emerged:

- Range: Greater autonomy to cover longer distances without frequent recharging.
- Safety: Automatic braking systems, obstacle sensors, and increased stability.
- Comfort: Ergonomic seats, effective suspension, and intuitive design.
- Ease of use: Simple controls, driving assistance, and automation of main functions.
- Portability: Lightweight design to facilitate transport and storage.
- Connectivity: Integration with GPS, smartphone applications, and remote monitoring systems.

These features are fundamental to meet inclusivity needs and to differentiate the product from competitors already present on the market.

4 Regulatory and Normative Framework

The widespread adoption of e-bikes and micromobility vehicles in urban environments has made it essential to analyze the European regulatory framework to ensure safety, sustainability, and compliance. The European Union has established a comprehensive system of directives, regulations, and technical standards governing the design, production, market placement, and lifecycle management of e-bikes. This chapter provides an overview of the main applicable regulations, highlighting recent updates and practical implications.

- **Machinery Safety and CE Compliance**

E-bikes fall under the scope of the Machinery Directive 2006/42/EC¹ and Regulation (EU) 2023/1230², which require CE marking and compliance with essential safety requirements. Electrically Power Assisted Cycles (EPAC) must be designed to avoid risks to users and third parties. Compliance is demonstrated through internal assessment procedures and laboratory testing as specified by the legislation.

- **Electromagnetic Compatibility and Low Voltage**

All electrical devices, including those installed on e-bikes, must comply with Directive 2014/30/EU (EMC)³ on electromagnetic compatibility and Directive 2014/35/EU (LVD)⁴ on low voltage. These directives ensure that e-bikes do not interfere with other electronic devices and that electrical components are safe for use.

- **Radio Frequencies and Connectivity**

For e-bikes equipped with wireless technologies (Bluetooth, GSM, LTE, NFC, GPS), Directive 2014/53/EU (RED)⁵ applies. This directive governs the use of radio frequencies and imposes safety and interoperability requirements for communication devices.

- **Hazardous Substances and Electronic Waste**

Directive 2011/65/EU (RoHS II)⁶ restricts the use of hazardous substances in electrical and electronic equipment, while Directive 2012/19/EU (WEEE)⁷ regulates the management and disposal of electronic waste, promoting recycling and environmental sustainability.

- **Batteries and Safety**

Batteries are subject to specific regulations: Directive 2006/66/EC⁸, Regulation (EU) 2023/1542⁹, and technical standards such as EN 50604-1:2016+A1:2021 lithium battery safety. Strict requirements apply to handling, transportation (UN 38.3), safety, and environmental impact reduction.

¹ <https://eur-lex.europa.eu/eli/dir/2006/42/oj/eng>

² <https://eur-lex.europa.eu/eli/reg/2023/1230/oj/eng>

³ <https://eur-lex.europa.eu/eli/dir/2014/30/oj/eng>

⁴ <https://eur-lex.europa.eu/eli/dir/2014/35/oj/eng>

⁵ <https://eur-lex.europa.eu/eli/dir/2014/53/oj/eng>

⁶ <https://eur-lex.europa.eu/eli/dir/2011/65/oj/eng>

⁷ <https://eur-lex.europa.eu/eli/dir/2012/19/oj/eng>

⁸ <https://eur-lex.europa.eu/eli/dir/2006/66/oj/eng>

⁹ <https://eur-lex.europa.eu/eli/reg/2023/1542/oj/eng>

- **Technical Standards and Safety Testing**

The EN 15194:2017+A1:2023 standard is the primary reference for EPAC, requiring tests on electrical systems, brakes, structure, and batteries. From August 23, 2025, this standard becomes mandatory for all e-bikes marketed in the EU. Other relevant standards include EN 17860 for mechanical components, IEC 60068-x, and ISO 9227 for environmental testing.

- **Privacy, Cybersecurity, and IoT**

Personal data protection is ensured by the GDPR (Regulation EU 2016/679)¹⁰, while cybersecurity is reinforced by ISO/IEC 27005 and the Cyber Resilience Act (Regulation EU 2024/2847¹¹). For IoT device communication, standards such as ISO/IEC 20922 (MQTT) and Bluetooth SIG v5.3 apply.

The analysis of the regulatory context highlights the complexity and dynamic nature of the European regulatory framework for e-bikes. Compliance with directives and technical standards is essential to deliver safe, reliable, and sustainable products aligned with the EU's goals for urban mobility and inclusivity.

Ultimately, every component of the bike is designed to meet the necessary standards: the frame and structure must comply with EN 15194:2017+A1:2023; IoT modules, batteries, and the powertrain system in general must comply with regulations related to Electromagnetic Compatibility and Low Voltage, Batteries and Safety, Privacy, Cybersecurity, and IoT. Overall, the entire product must conform to directives concerning Machinery Safety and CE Compliance.

¹⁰ <https://eur-lex.europa.eu/eli/reg/2016/679/oj>

¹¹ <https://eur-lex.europa.eu/eli/reg/2024/2847/oj/eng>

5 Product Description

5.1 General Overview

The main features of the innovative e-bike have been carefully designed to address the diverse needs of urban mobility, with a strong emphasis on accessibility, safety, and user experience. This section provides an overview of the key characteristics that distinguish the e-bike, highlighting its technical specifications, structural resilience, advanced connectivity, and thoughtful design elements that contribute to inclusive and sustainable city planning.

5.2 Accessibility Features

This section defines the human-factors requirements that enable people with reduced mobility to mount, fit, operate, and remain comfortable on the vehicle. It focuses on ingress/egress geometry, repeatable fit adjustments, upright posture for fatigue reduction, and low-effort, short-reach controls that ensure confident operation in daily use.

- Mounting/transfer geometry
 - Step-through height ≤ 40 cm to enable safe, low-effort ingress/egress during starts, stops and transfers.
 - Adjustable geometry and parts for users from 150 to 195 cm, max rider weight 140 kg
 - Seat swivel: $\frac{1}{4}$ -turn ($\approx 90^\circ$) rotating seat module to permit lateral transfers to/from a wheelchair without lifting.
 - Riding posture: Near-upright $\sim 90^\circ$ seat-to-torso angle to reduce fatigue/discomfort over typical trip durations.
 - Tool-free adjustability for seat height and handlebar reach/height; repeatable settings (e.g., indexed markings on posts/stems) to ensure consistent fit across sessions.
- Operator interface & reach
 - Large-throw, low-effort levers and clearly labelled buttons/display within short reach envelope; lever reach adaptable for small hands/low grip strength.
 - Stationary stability aids enabling transfers and stops without foot support on the ground.

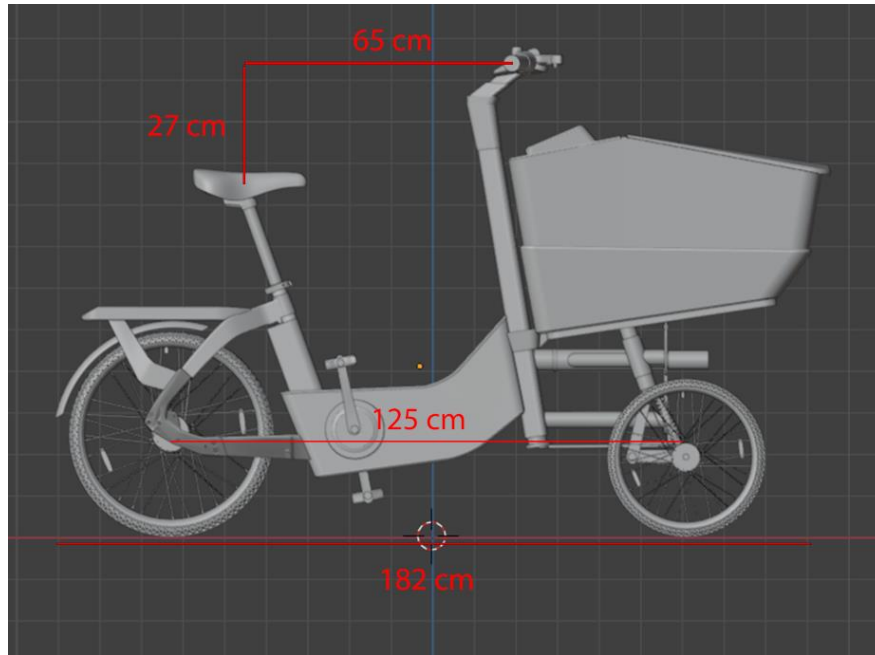


Figure 1 Mounting/transfer geometry



Figure 2 Stationary stability aids enabling transfers and stops without foot support on the ground.

5.3 Structural and Mechanical Design

This section specifies the chassis architecture and kinematics needed to deliver high static and dynamic stability on uneven or crowned pavements. It covers the three-wheel configuration, leaning/tilting behaviour, seat architecture, centre-stand/parking mechanics, and load-interface surfaces that together enable safe transfers, predictable handling, and secure rider support.

- Chassis architecture
 - Three-wheel configuration prioritized for static and dynamic stability; preference for 2-front/1-rear layout to optimize steering behavior and load stability and side clearance awareness
 - Leaning/tilting kinematics recommended to mitigate lateral “launching” on uneven or crowned pavements and to reduce corrective counter-steer demand.
 - Frame and components resistant to extreme weather and saline environments, weight ≤ 40 kg, resistant to falls and vandalism, shockproof parts.
- Stands and parking mechanics
 - Mechanical central stand (or stabilization system) operable while seated to stabilize the vehicle during mounting/dismounting and at traffic lights and stops.
 - Parking brake with positive lock; advisable centralized brake lock engaging multiple wheels for predictable hold on mild gradients (hill-hold support).
- Cargo body interface
 - Non-slip surfaces and side walls on cargo space to prevent item movement and improve perceived safety.
 - Platform height targets: load interface suitable to reduce lifting effort and improve handling.

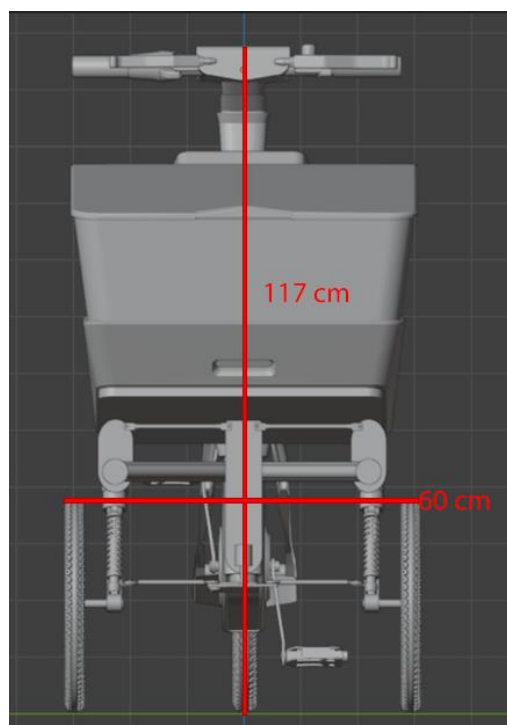


Figure 3 Chassis architecture – Front side Cargo e-Bike

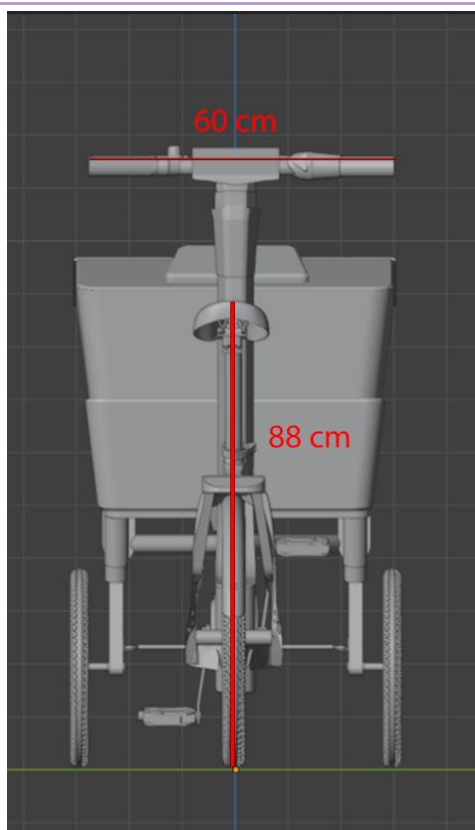


Figure 4 Chassis architecture – Rear Side Cargo e-Bike



Figure 5 Tilting mechanics

5.4 Powertrain and Performance

This section sets performance targets for starting torque, climbing ability, and cruising effort through an e-assist system and tolerant transmissions. Emphasis is placed on low-cadence, high-torque launches, simple or automated shifting, and ride compliance so that users can manage inclines, headwinds, and longer distances with minimal physical strain.

- Assist system
 - Electric pedal assist with torque and range sized for urban gradients and headwinds; support for low-cadence, high-torque starts.
 - Central motor with torque ≥ 80 Nm and peak power ≥ 700 W, motor efficiency $\geq 85\%$, range 30-100 km based on assistance level
 - High capacity, range up to 100 km, standby ≥ 20 days, option for second battery, integrated theft-proof container with quick opening, waterproof
- Transmission
 - Low-range gearing for hill starts; preference for simple, robust shifting (e.g., automatic or indexed) tolerant of sub-optimal shift timing.
- Ride quality
 - For poor surfaces, consider robust puncture proof tires and, where feasible, suspension seatpost and front suspension tuned to limit shock inputs to the saddle, handlebar and cargo.



Figure 6 IoT Assist system and transmission details.

5.5 Safety and Security

This section aggregates the systems that prevent incidents at speed and at standstill. It details braking architecture (including lock/hold functions), visibility and status signaling, and anti-theft/locating features, ensuring the vehicle remains controllable, conspicuous, and recoverable across typical urban operating scenarios

- Braking
 - Dual, independent hand brakes sized for low grip strength; option for hydraulic actuation (from open responses) to reduce lever effort.
 - Lockable brake function (handbrake) and hill-hold at standstill to prevent roll-back/roll-away on bridges/slopes.
 - Operational concept that enables stopping without without the need to set foot on the ground
- Primary visibility & signaling
 - Automatic lighting and conspicuous reflectors; clear visual status indicators (battery SoC, lock/unlock, faults).
 - Where sensory overload is a concern, visual cues preferred over loud acoustic alerts.
- Antitheft & locating
 - Permanently mounted wheel or handlebar lock plus electronic access control; integrated GPS/ “Air Tag like” tracking for asset recovery and fleet oversight.
- Automatic unlocking
 - Unlocks at speeds > 2 km/h to prevent misuse



Figure 7 Braking Systems



Figure 8 Primary visibility & signalling

5.6 Technology and Connectivity

This section defines access control, telematics, and energy-management interfaces that streamline shared use and day-to-day operation. It prioritizes NFC/tag unlocking, integrated tracking, clear visual state feedback, and practical battery handling to minimize friction from first unlock to end-of-ride charging.

- Access & control
 - NFC/tag-based unlocking as primary method; optional QR code as fallback.
 - Bicycle status (available, low battery, etc.) shown via standardized LED colors.
 - Feedback for main operations (unlock, unauthorized movement) via buzzer.
- Telematics
 - Embedded tracker with location reporting; optional device mount for smartphone (navigation/status).
- Energy subsystem
 - Removable battery for indoor charging/swaps; magnetic power connector to minimize mis-mating and handling errors; on-device state-of-charge display.



Figure 9 IoT Module highlighted in green for access control, telematics and state of charge display.

5.7 Cargo and Usability

This section translates everyday transport needs into stable, ergonomic load solutions. It addresses carriage of assistive devices and personal items via front-biased cargo architecture, low deck height, non-slip/retentive surfaces, and dedicated tie-downs—optimizing both handling and workflow during frequent stops.

- Assistive devices transport
 - Cargo volume ≥ 100 liters, load capacity ≥ 20 kg, rear basket up to 10 kg/10 liters, structural rear rack
 - Provisions for wheelchair carriage (rear carrier or integrated platform) when required at destination (Optional)
 - Additional mounted cargo box includes dedicated tie-down points/straps for rollators, crutches, and personal bags (Optional)
- Human factors & workflow
 - Low cargo deck for loading ergonomics; interior non-slip finish and side retention to secure loads.
 - Compatibility with panniers/rear rack where the full front cargo space is unnecessary.
 - Quick-opening system, no excessive force or complex movements



Figure 10 Cargo and Usability.

5.8 Maintenance and Customization

This section outlines serviceability and configurability, so the platform stays reliable over time and adaptable to user evolution. It specifies routine safety checks, modular seating, tool-free indexed adjustments, and parts/commonality principles that support high uptime and consistent ergonomics.

- Serviceability
 - Routine checks formalized for tire pressure, brake function/wear, lighting; components selected for durability and easy field replacement.
- Configurability
 - Modular seating (optional backrest, belts, side supports)
 - Tool-free adjustments with indexed scales/markings to speed repeat set-up and ensure reproducible ergonomics across users.
- Fleet operations
 - Standardized parts (brake pads, tires, rotors) and battery swap workflow to maximize uptime; telematics to support security and maintenance scheduling.

6 Conclusions

The AccessS project has demonstrated that a user-centred approach and collaboration among stakeholders are essential for developing truly inclusive and sustainable micromobility solutions. The integration of quantitative and qualitative data, collected through market analysis, questionnaires, and interviews, has made it possible to identify the specific needs of people with reduced mobility and elderly citizens, translating them into concrete design guidelines.

The proposed cargo e-bike integrates advanced features for accessibility, safety, modularity, and connectivity, addressing the priorities identified in the analysis and ensuring ease of use, comfort, and autonomy. Compliance with European regulations regarding safety, electromagnetic compatibility, battery management, privacy, and cybersecurity ensures product conformity and user protection.

The report highlights the need to continue actively involving end users and stakeholders in the development and validation phases, to ensure that micromobility solutions truly meet societal needs and contribute to European objectives for urban accessibility and technological innovation.

The intellectual property related to the project results, including the product, its design, and its components, is the exclusive property of Vaimoo.

Annex A – Technical Scheme

This scheme represents the overall architecture of the vehicle, highlighting the main structural and mechanical components, the electric assist systems, and the integrated IoT connectivity.

In detail, the scheme shows the three-wheel frame with a 2-front and 1-rear wheel configuration, which ensures static and dynamic stability. It illustrates the tilting mechanics that allow the mitigation of lateral forces on uneven surfaces, improving manoeuvrability without requiring excessive effort from the rider.

Elements such as the central motor with electric assistance, hydraulic brake systems, accessible ergonomic controls, removable battery, and the IoT module for access control, telematics, and state of charge display are also highlighted.

The technical scheme thus synthesizes in a single image the complexity and innovations of the cargo e-bike design, integrating safety, accessibility, and technology aspects with the goal of an inclusive and sustainable urban vehicle.

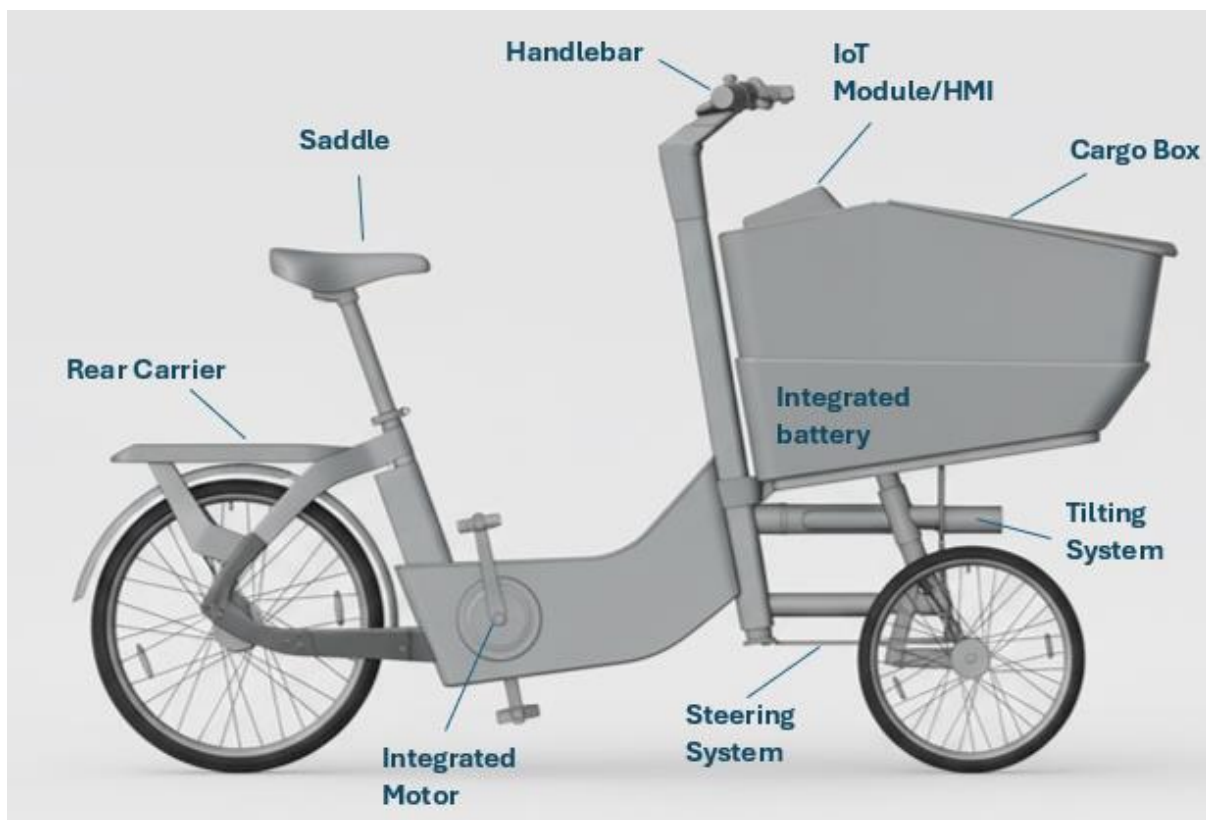


Figure 11 Technical Scheme

Annex B – Overview of survey questions

Below is the list of questions asked to identify the most suitable accessibility features for inclusive cargo bikes in urban environments.

1. What is your height?
2. What is your weight?
3. How important do you think it is to have a low frame (<40 cm) for getting on and off the bike?
4. Do you think that the height and tool-free adjustment of the saddle and handlebar are important for your needs?
5. Do you think that the upright riding position (90°) can reduce your fatigue or discomfort while riding?
6. How safe would you feel if you had a braking system that allowed you to stop without putting your feet on the ground?
7. Would tilting front wheels and a mechanical centre stand (operable from a seated position) help you feel stable when getting on/off a bike?
8. Do you think it is important that the controls (levers, buttons, display) are easily reachable and usable?
9. Do you think that a lower platform/loading box height (<50 cm) would facilitate loading/unloading operations?
10. Would the presence of non-slip surfaces and side walls on the box make you feel safe during use?
11. Do you think that tie-down points/straps for aids or special loads would be useful for your needs?
12. How important are accessories such as cane holders, wheelchair supports, or extra mirrors for you?
13. Do you prefer to unlock the bike via NFC card or QR code?
14. Do you think that light and sound signals are useful for better understanding vehicle information (e.g. bicycle status, battery state of charge, unlocking operations)?
15. What are the main difficulties you encounter when using traditional or cargo bikes?
16. What additional features would you like to see on an accessible cargo bike?

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