HEXA-X-II D1.3 Deliverable

Environmental and social view on 6G

Hexa-X-II

hexa-x-ii.eu

Introduction

WP1 and D1.3 objectives

WP1 - Objectives

Overall Objective

WP1 will set the prerequisites to define a 6G system

- **Acting as enabler for environmental sustainability**
- **Providing value for the society**
- **Being economically sustainable**

D1.3	**Objective 1**	**Ensure foundation of 6G design will integrate environmental, social and economic sustainability**
	Objective 2	Define use cases and determine requirements to drive 6G design
	Objective 3	Connect HEXA-X-II with the business ecosystem & anchoring 6G in society

D1.3 - Objectives

Objective 1	Prepare stakeholders and act proactively to ensure 6G sustainability and 6G for sustainability.
Objective 2	Develop a deep understanding of society's expectations and needs regarding networks
Objective 3	Raise awareness of the challenges and the risks that 6G networks, and solutions offered above them, may come across
Objective 4	Define mitigation strategies (in the technical design and in the policies and practices) so as to increase the positive impact of 6G solutions and services while limiting unwilling and unexpected effects
Objective 5	Define business models for Cooperating Mobile Robots, Network Assisted Mobility, Human Centric Services representative UCs
Objective 6	Complement Business Ecosystem and Key Stakeholders with stakeholders that can apply the mitigation strategies

Develop an Understanding of Society's Expectations and Needs Regarding Networks

Surveys on advanced communication services - Main outcomes

- Numerous government and private institutions engage in conducting opinion surveys to understand the public perception of the evolving digital environments.
- Dynamic nature of social acceptability concerning technological advancements, influenced by diverse factors such as COVID-19, cultural norms, individual beliefs, ethical considerations, and perceived societal impact.
- Technology adoption and usage behavior are chiefly shaped by environmental awareness, curiosity, facilitating conditions, and perceived satisfaction, highlighting the multifaceted nature of user preferences.
- Potential effectiveness of public environmental awareness campaigns in dispelling misconceptions, emphasizing the eco-friendly nature of advanced telecommunication technologies, and its minimal impact on privacy and the ecological system.
- French landscape: more localized perspective, incl. environmental implications of digital technology, apprehensions surrounding the introduction of new technological advancements.
- Hexa-X-II project addresses some of the privacy and ecological shortcomings and assessing the EMF exposure from new technology components with the aim of creating a 6G platform characterized by sustainability, inclusivity, and trustworthiness.

Societal Dialogue – Main Outcomes

- Societal dialogue can be defined as an inclusive and collaborative communication process among various stakeholders in society
  - Beneficial when introducing a new technology: it allows for the consideration of the stakeholders' concerns and expectations before designing the technology
- Chronological framework for the dialogue:
  - Defining the context
  - Selecting and planning the appropriate dialogue methodology
  - Gathering data and expertise
  - Mobilizing stakeholders and providing necessary information
  - Facilitating and moderating dialogue workshops
  - Analyzing, evaluating and reporting on the dialogue
- First series of workshops in France with various stakeholders (employees, consumer customers and local authorities) include rapid advancement of new technologies and questions on the relevance of a new generation of networks
  - Needs to be duplicated in other countries
  - Supplemented by a quantitative approach to weight the results

Business models

Business models

- Business models describe how a company creates, captures, and delivers value.
- In Hexa-X-II, a new ecosystem-level business modelling approach has been developed for use case specific sustainability-oriented business modelling. It consists of three steps:
  - **ecosystem business model canvas**: value proposition of the use case at ecosystem level including stakeholder identification
  - **stakeholder analysis**: characterization of stakeholders' role in the ecosystem
  - **ecosystem pie**: ecosystem-level business model visualization
- This new approach has been applied to three of the representative use cases (seamless immersive reality, real-time digital twins, and ubiquitous network)
- The use cases were selected as a good set to explore the different business offerings and ecosystems around the use cases in 6G

Cooperating Mobile Robots: Business Model Canvas

Supply Side

- **Stakeholders/key partners:** suppliers / providers of robots / cobots (sector specific: manufacturers / rental companies); network infrastructure provider; network operator (public/private network); modem chipset manufacturer and provider; providers of programs/SW (for collaborative robots); system integrators; "space stakeholders"
- **Resources:** high-quality local network; robots; platform; sensing and monitoring capabilities; IoT devices; compute resources; AI algorithms; data and access to data; domain specific competence; funding; design processes; IPR.
- **Activities:** Coordination and cooperation between stakeholders and robots; R&D; design; manufacturing; deployment; sales; operation maintenance; circular business; sustainability / life cycle /ethical management; authentication; development SW solutions; production of devices; design and operation of networks; integration of solutions

Ecosystem Value Propositions

- **Value proposition**: Improved efficiency, quality, security, flexibility and reliability from collaborative mobile robots conducting complex tasks in a coordinated manner.
- **Value co-creations:** Co-creation and enabling a total solution for robots, machines and humans to efficiently conduct tasks through the exchange of information using the network.
- **Value capture:** Higher efficiency and economies of scale through collaborative automation for all involved (including moving production back to Europe); safer environment to work in (safety).
- **Value co-destruction:** Lack of collaboration due to interoperability challenges between components hindering innovation and the ability to achieve economies of scale for the solutions. People losing skills to conduct tasks and solve problems and high dependency on robots.
- **Partnerships**: robot providers and software providers (compatibility) for system partnerships; production site and robot providers; network providers and data center service providers; network providers and operators.

Demand Side

- **Customer segments**: different campuses (area with buildings) including e.g., manufacturing sites; hospitals, harbors/airport/cargo handling/logistics centers, construction sites (temporary factory); construction/campus management company; manufacturer; constructor; construction rental companies.
- **Stakeholders/key partners**: manufacturers; co-workers of cobots;
- **Customer relationships**: dedicated customer sale and care for the account; B2B; support for the solutions.
- **Channels**: digital channels for all instrumental information exchange between seller and customer; key account manager (human channel)

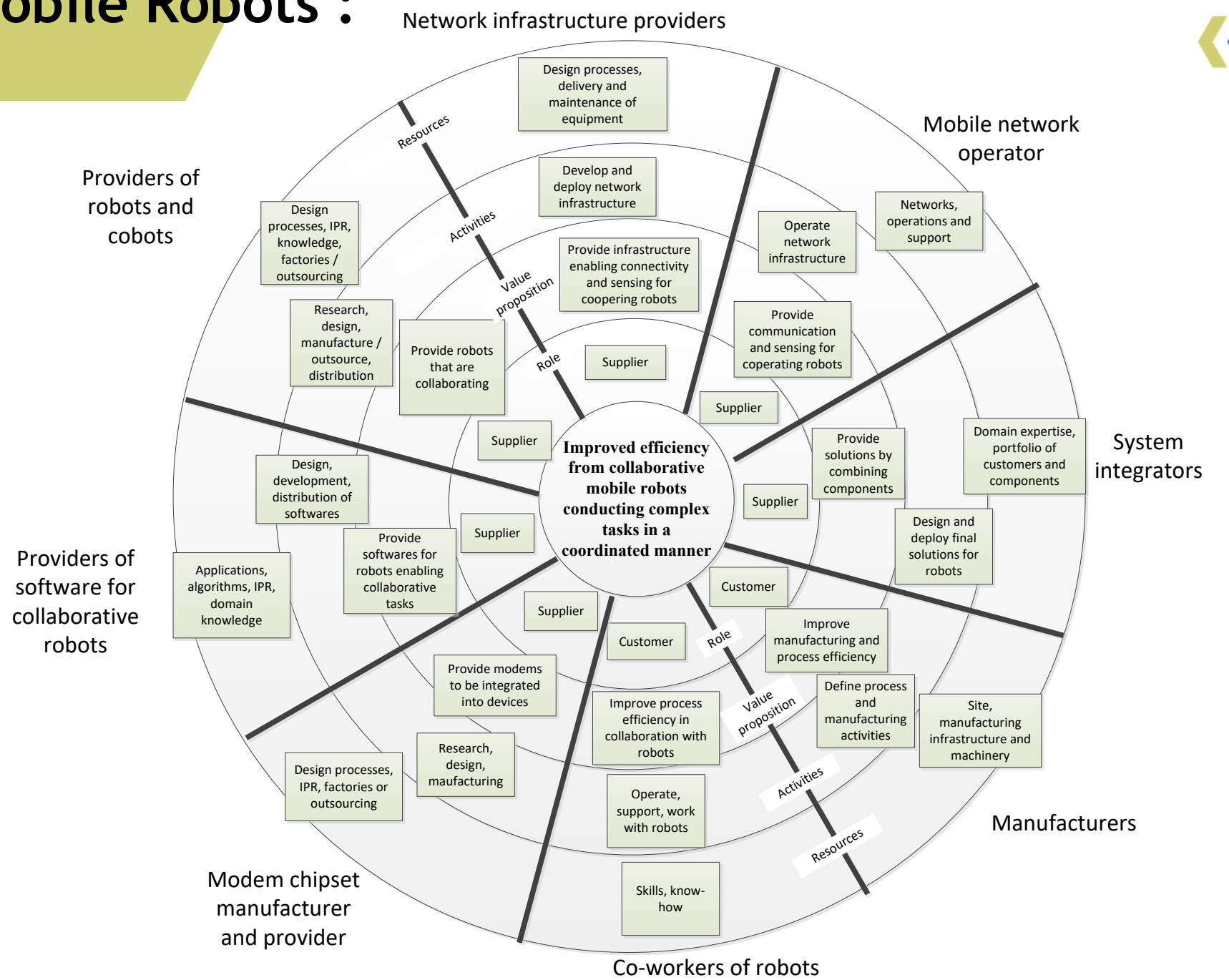
Outcomes

- **Benefits:** higher resource efficiency and productivity of processes; cost savings from same solution used in multiple factories; high precision leading to less waste; improved safety for workers; new business from developing and manufacturing robot/cobots; improved reuse of resources; productivity processes (construction as manufacturing); opportunity for automizing production and produce closer to customer; setting up factory rapidly; allowing remote operations; potential environmental and social benefits from bringing production to Europe.
- **Revenues (revenue streams)**: solutions as a service; whole solution from one major player that partners with others; paying per robot; building owner invests in building with the robots and rents the facility as a service/contractual agreement; manufacturing (construction, logistics) as a service.
- **Pricing**: as a service (monthly) pricing models; fixed price per component; paid per delivered unit; pricing based on customers' improved efficiency or other values (% of margin).
- **Costs**: Economic and environmental costs from the manufacturing of robots; people are replaced by robots - people need to learn new skills; coordination of robots for energy/charging; back up for robots in case of failures; high upfront investment from the deployment of the whole system (phased approach needed).

Cooperating Mobile Robots : Stakeholder Analysis

Stakeholder	Description	Role	Value proposition	Activities	Resources
Suppliers/providers of robots/cobots	Providers of robots and cobots	Supplier	Provide robots, which are collaborating, using network infrastructure, for different segments, building new business opportunities.	Research, design, manufacturing (outsourced), sale/distribution,	Design processes. IPR, knowledge. People. Own factories - or outsourcing expertise.
Network infrastructure provider	Vendor of network infrastructure equipment.	Supplier	Provide infrastructure enabling communication and sensing for cooperating robots, for different purposes and customers. Extract synergy effects, keep installed base maintained and up to date.	Develop and deploy network infrastructure that support communications and sensing. Research, design, manufacturing, outsourcing, sale/ distribution	Design processes, IPR, knowledge, people, own factories, outsourcing expertise, scaling capabilities
Mobile network operator (public/private network)	Provider of local / wide area connectivity services.	Supplier	Provide communication and sensing for running cooperating robots in the target area, where investment and costs in network can be justified by the use and users, and what they pay for deploying and running the network.	Operate local / wide area network. Handle relationship with network owner/financer - and users, access rights of network. Authentication.	Local / wide area active (and passive network). Network operation and support.
Modem chipset manufacturer and provider	Manufacturer of the modem chipset	Supplier	Provide modems, which are integrated into different devices/equipment with e.g. the right form factors.	Research, design, manufacturing (outsourced), sale/distribution.	Design processes, IPR, knowledge, people. Own factories - or outsourcing expertise.
Providers of software for collaborative robots	Provider of software and applications needed for the robots to function.	Supplier	To provide software for robots to collaboratively conduct tasks enabling e.g. efficient and automatic choice of network "paths"	Design and development, sales and distribution, management of access / licenses, etc.	Algorithms, application, IPR and copyright, experts, vertical domain knowledge
System integrators	Integrators of components from different providers.	Supplier	Offer system-level solutions by recombining, reconfiguring, and handling many types of components. cost-efficiently.	Combine components into solutions. Design and deploy final solutions for robots. Contract, customer relationship	Expert knowledge, large portfolio of customers and certified tested components
Manufacturer	Company that operates the manufacturing site where the robots are located.	Customer	Improve manufacturing and process efficiency by means of collaborative robots	Define processes and manufacturing activities, define requirements, operate robots	Site, infrastructure, other manufacturing machinery and devices
Co-workers of robots	People working with robots	Customer	Improve process efficiency in collaboration with robots	Operate robots, work with robots	Skills, know-how.

Cooperating Mobile Robots : Ecosystem pie



Network Assisted Mobility: Business Model Canvas

Supply Side

- **Stakeholders/key partners:** car / drone / vehicle manufacturers, mobile network operators, network infrastructure vendors; modem chipset manufacturer and provider; cloud companies, sensor providers, authorities (incl. transport and communication regulators), transport and logistics companies; insurance companies; software providers; integrators.
- **Resources:** infrastructure (roads, sensors, cameras, networks, etc.), cars / drones / vehicles and resources used for producing them; algorithms; data; standards and protocols; sensors and devices.
- **Activities**: collecting and processing of data; offering of situational awareness information; development, manufacturing and deployment of equipment/vehicles; development of standards and protocols; operations of transportation (governance).

Ecosystem Value Propositions

- **Value proposition:** Optimized mobility by reducing negative externalities such as accidents, pollution, and traffic congestion through situational awareness obtained with 6G network and devices.
- **Value co-creations:** Improved efficiency and safety including energy efficiency improvements/reduced traffic congestion through collecting and sharing of information about the moving objects and operational environment to optimize the paths.
- **Value capture:** Reinforced role in modern society for transport sector; improved safety in city environment.
- **Value co-destruction:** interoperability issues; compatibility; quality and amount of data; privacy issues; algorithms used for optimizing operations; liability issues/safety; trust in people/machines; problems from more mobile objects (rebound effect).
- **Partnerships:** Many partnerships: car manufacturers with cloud companies and sensor manufacturers; car manufacturers with authorities.

Demand Side

- **Customer segments:** drivers/consumers; transportation/logistics/delivery companies (public/private).
- **Stakeholders/key partners:** end users/citizens (including pedestrians); public authorities; transport and logistics companies; cities (urban planners)
- **Customer relationships:** alliance for implementing systems (B2B); subscription from end customers (B2C); digitally.
- **Channels:** digital channels for reaching final users

Outcomes

- **Benefits:** Make transportation more efficient by reducing its negative externalities such as accidents, pollution and traffic congestion; improved safety; less Greenhouse Gases (GHG) emissions; improved comfort.
- **Revenues (revenue streams):** from transport companies to providers of situation awareness data (or both ways); consumer subscribes to a service; insurance companies' role from reduced traffic accidents; two-sided where vehicle providers and transport companies pay to offer free service to users; free service for data providers; cities pay for providers for reduced environmental footprint; car manufacturers to pay for sensor providers; situational awareness provider pays for algorithm providers.
- **Pricing:** Alternatives: based on usage; pricing of other related digitalized services.
- **Costs:** high density urban networks; blame game/liability issues; legal challenges; risks from technology (AI).

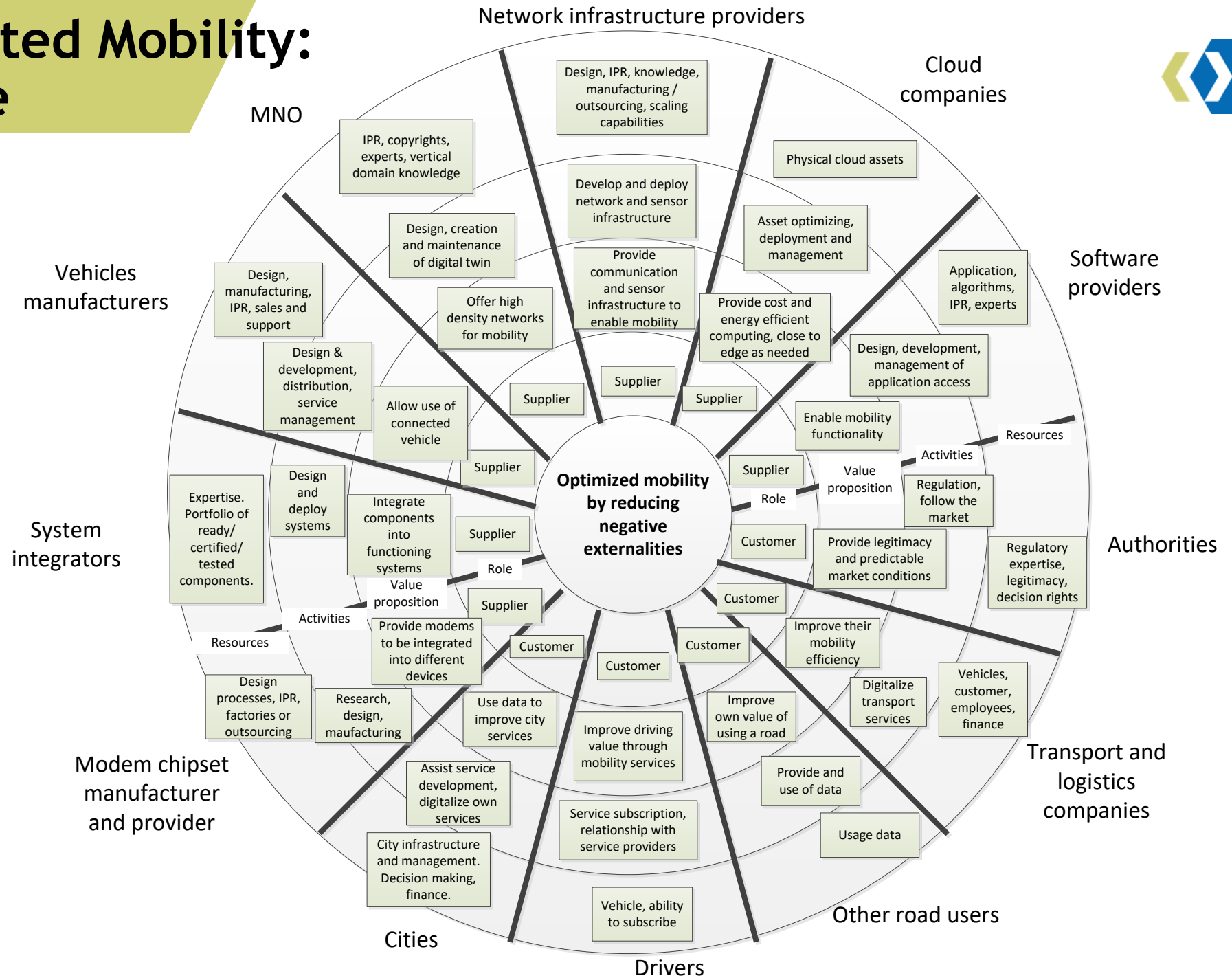
Network Assisted Mobility: Stakeholder Analysis (1/2)

Stakeholder	Description	Role	Value proposition	Activities	Resources
Vehicle manufacturers	Entity manufacturing and providing vehicles for assisted mobility.	Supplier	To allow use of device and its core functions to be applicable in any location, connecting seamlessly to any network, to part of a mobility scenario.	Design and development, sales and distribution, service management.	IPR. Research, manufacturing, marketing and sales, support
MNO	Network operators providing communication and sensing functionality.	Supplier	Offering high-density network communication and sensing required for urban mobility of vehicles.	Operate local / wide area network. Handle relationship with network owner/financer - and users, access rights of network. Authentication.	Local active (and passive network). Human operation and support.
Network infrastructure providers	Infrastructure providers for communication and sensing infrastructure	Supplier	Offer communication and sensor network infrastructure to enable mobility	Develop and deploy network infrastructure that supports both communication and sensing. Research, design, manufacturing (outsourced), sale/distribution.	Design processes. IPR, knowledge. People. Own factories - or outsourcing expertise. Scaling capabilities
Cloud companies	Entity hosting the applications enabling mobility scenarios. Low latency requirements demand edge functionality.	Supplier	Cost- and energy efficiency computing, close to edge when needed;	Asset optimizing, deployment and management, optimizing use of servers and installations, maintenance, sales and customer relationships, energy optimizing activities	Physical assets, capital, capital investors. Servers, cooling installations, contracts for green and cost-efficient energy, licenses for platform SW
Modem chipset manufacturer and provider	Manufacturer of the modem chipset	Supplier	Provide modems, which are integrated into different devices/equipment with e.g. the right form factors.	Research, design, manufacturing (outsourced), sale/distribution.	Design processes, IPR, knowledge, people. Own factories - or outsourcing expertise.
Softwares providers	Providing AI enabled applications	Supplier	Enables mobility functionality through applications, e.g., efficient and automatic choice of network "paths"	Design and development, sales and distribution, management of access/licenses etc.	Algorithms, application, IPR and copyright, experts, vertical domain knowledge
System integrators	Entity that combines resources and components into one end-to-end network service or system, according to a predefined service-level agreement.	Supplier	Integrating different components into a functioning system, by combining and configuring different parts. Carries the risk of a functioning system according to a predefined QoS.	Design and deploy systems. Contracting, and customer relationship. Risk/revenues portfolio management.	Expert knowledge. Best practice processes. Sufficiently large portfolio of customers to carry risk. Portfolio/stock of ready/certified/tested components.
Authorities	Governance bodies regulating how to implement and operate mobility services.	Customer	Predictable market environments. Perceived legitimacy from policy makers.	Follow market evolution, desired and non-desired market situations. Suggest, handle process, and act on regulatory mandate.	Mandate and decision rights. Expertise. Regulatory means. Legitimacy.

Network Assisted Mobility: Stakeholder Analysis (2/2)

Stakeholder	Description	Role	Value proposition	Activities	Resources
Cities	Governing body in a city.	Customer	Use data generated by network assisted mobility to develop and offer digital city services. City can act also as a local regulator.	Coordinate or assist service development and infrastrcuture deployment. Digitalize city services.	City infrastructure and expertise. Mandate for suggestions and decisions. Finances.
Drivers	Person driving a vehicle and subscribing to a mobility service.	Customer	Improve their driving value by reducing accidents, traffic, etc, by means of assisted mobility. To be able to pay for a service, so that specific parties can extract the benefits from the service without hazzles	Assess advantages of service, decide to subscribe, manage subscriptions, manage relationship with service provider(s)	Vehicle. Ability to pay/financial resources.
Transport and logistic companies	Private or public firms owning and/or operating transport services.	Customer	Optimize their processes and improve their mobility efficiency	Transport service design and planning, digitalize and optimize transport services by means of assisted mobility	Vehicles. Customer base. Employees. Ability to pay/financial resources.
Other road users	People using the roads (excluding drivers), including pedestrians, cyclists, kick bikes, unprotected road users.	Customer	Improve their road user value by means of coordination, safety and information offered by the networks.	Providing and use of data	Usage data

Network Assisted Mobility: Ecosystem Pie



Human Centric Services: Business Model Canvas

Supply Side

- **Stakeholders/key partners:** mobile network operator; network infrastructure providers; domain specific service providers (e.g., health); modem chipset manufacturer and provider; authorities; sensing device providers.
- **Resources:** monitoring equipment of public and private domains; devices, service, applications, and software.
- **Activities**: sensoring / monitoring of humans/environment; privacy preservation / trust building; distribution of sensors to users;

Ecosystem Value Propositions

- **Value proposition:** Improved safety and wellbeing through non-intrusive and trusted monitoring and response using sensors and network;
- **Value co-creations:** Trust building, public-private sector collaborations and co-creation between local service providers (such as caretakers) and the system supporting local service provisioning.
- **Value capture:** Savings for society through different early warnings (e.g., natural disasters, personal health) and improved safety and security services.
- Value co-destruction: Balance between being monitored vs. improved safety; misuse of and access to material (videos); non-transparency; institutional barriers from availability of data; lack of compatibility of data and devices;
- **Partnerships:** network operator and provider of human centric services; parties in the specific domain (e.g., healthcare); private-public-partnerships

Demand Side

- **Customer segments:** humans/end users (the elderly, children, …); consumers; hospitals; healthcare providers/institutions; schools; insurance companies; safety/security companies;
- **Stakeholders/key partners:** humans/end users (the elderly, children , …); consumers; hospitals; healthcare providers/institutions; schools; insurance companies; safety/security companies;
- **Customer relationships:** order online; via "prescription" from professionals; domain-specific client relationship; customers can be consumers or institutions (individuals, schools, care-places)
- **Channels:** digital channels; human dialogue (appointments)

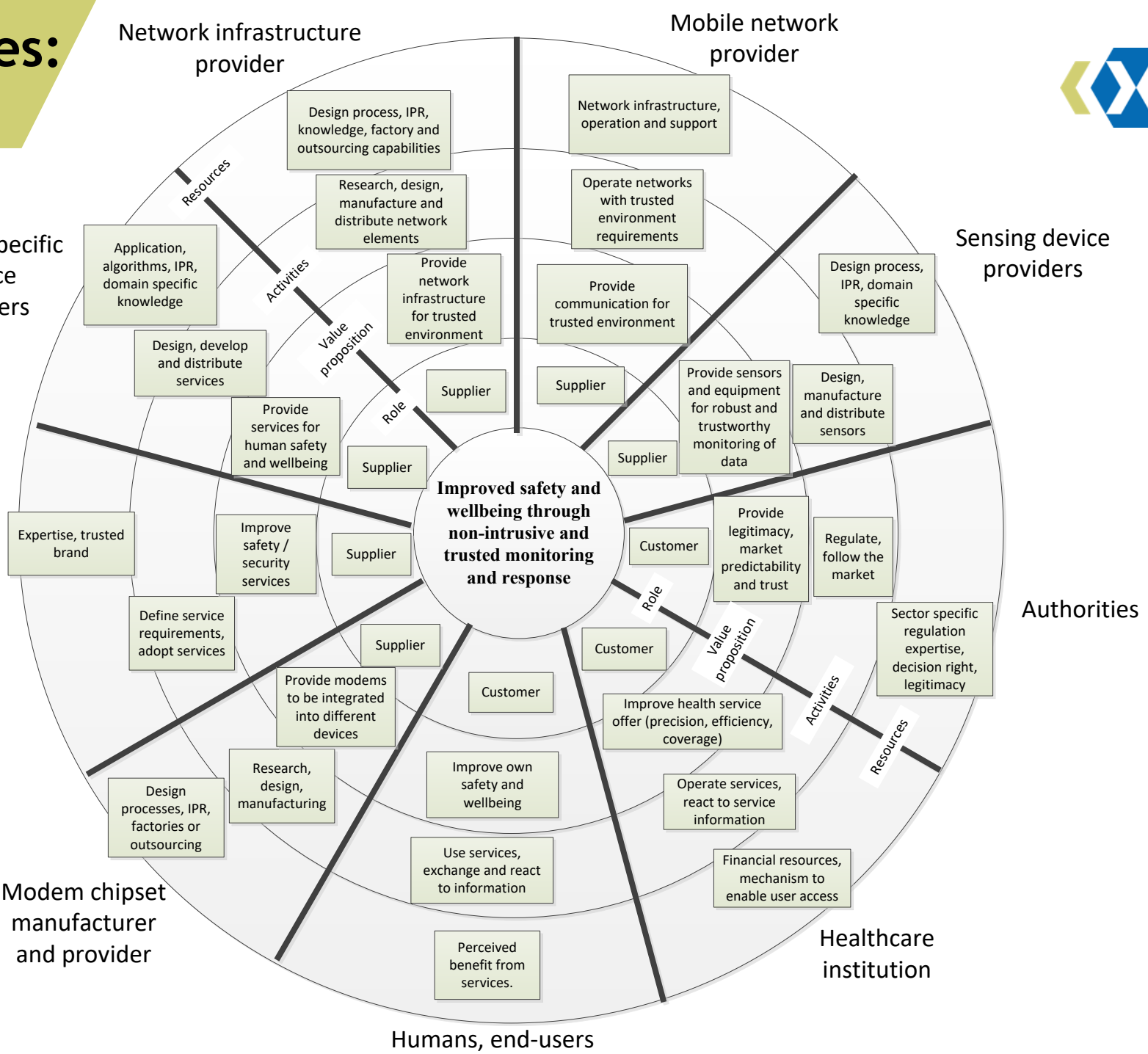
Outcomes

- **Benefits:** improved safety and feeling of being safe in familiar and non-familiar environments; less stress from security concerns; improved efficiency of enabling more care services with same (limited) resources; new business opportunities for local providers (e.g., caretakers) to expand service coverage and customer base.
- **Revenues (revenue streams):** Alternatives: Fixed yearly fee per government, private companies, NGOs giving basic service. Additional fee for end-users based on usage. Revenues from data streams.
- **Pricing:** Alternatives: differentiated by age/condition/responses; based on risk level; based on potential savings;
- **Costs:** Infrastructure investments; service development investments; privacy and security; environmental and economic costs of sensors (waste); intrusion; overwhelming of data;

Human Centric Services: Stakeholder Analysis

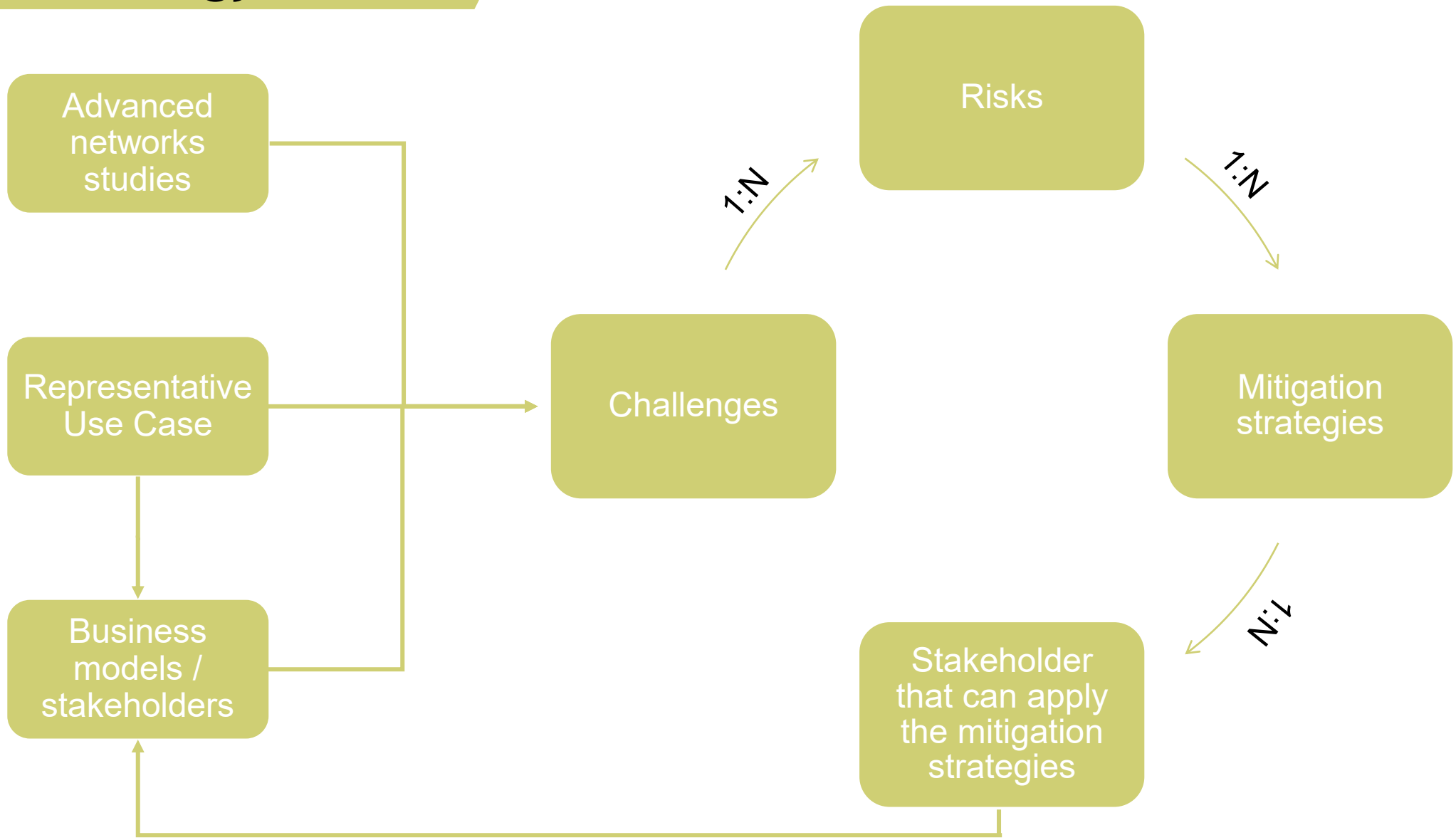
Stakeholder	Description	Role	Value proposition	Activities	Resources
Network infrastructure provider	Vendor of communication network infrastructure.	Supplier	Provide network infrastructure with the requirement of trusted environments, building new opportunities for different customers segments and human needs.	Research, design, manufacturing (outsourced), deployment and distribution of network elements.	Design processes. IPR, knowledge. People. Own factories - or outsourcing expertise.
Mobile network operator	Provider of local / wide area connectivity services.	Supplier	Provide communication services for trusted environment, which can be justified by the use and users.	Invest and operate local /wide area networks. Handle relationship with network owner/financer - and users, access rights of network. Authentication.	Local / wide area active (and passive network). Human operation and support.
Sensor device providers	Providers of sensors of different types	Supplier	Provide robust and predictable installations of specific sensors/equipment and make available trustworthy monitoring data. Two ways - receive data and instructions.	Research, design, manufacturing (outsourced), sale/distribution.	Design processes. IPR, knowledge, experts. Domain-specific knowledge.
Modem chipset manufacturer and provider	Manufacturer of the modem chipset	Supplier	Provide modems, which are integrated into different devices/equipment with e.g. the right form factors.	Research, design, manufacturing (outsourced), sale/distribution.	Design processes, IPR, knowledge, people. Own factories - or outsourcing expertise.
Domain specific service providers (e.g., health)	Providers of the human centric services.	Supplier	Provide specific services for human needs, combining different components together.	Design and development of application, distribute and operate specific services.	Algorithms, application, IPR and copyright, experts, vertical domain knowledge
Authorities	Governance bodies regulating the operations.	Customer	Provide predictable market environments, legitimacy and trust by policy-making decisions.	Follow market evolution, desired and non-desired market situations. Suggest, handle process, and act on regulatory mandate.	Mandate and decision rights. Sector-specific regulation expertise. Legitimacy.
Humans/end users	People using the human centric services.	Customer	Improve own safety and wellbeing conditions utilizing a non-intrusive and trusted monitoring system	Use services, exchange information, react to provided information. Give feedback to suppliers.	Time, motivation, perceived benefits from services
Safety/security company	Companies providing safety/security services.	Supplier	Improve service offer by using human centric infrastructure and applications	Define service requirements, adoption of services and applications, react /improve their services	Expertise. Trusted brand.
Healthcare institution	Organizations where the human centric services are used (e.g. elderly care homes).	Customer	Provide healthcare services with improved precision, efficiency and coverage by a non-intrusive and trusted monitoring system, and related applications	Operate trusted human-centric services, ensure data is correct, analyze data and react to service information	Domain specific expertise, mandates for health services, budgets: financial and resources,

Human Centric Services: Ecosystem pie



Preparedness for 6G Environmental, Social and Economic Sustainability

Methodology



Main environmental, social and economic challenges

- Designing and implementing resource-efficient communication systems, including both materials and energy.
- Ensuring backwards compatibility and interoperability on hardware and software levels for e.g., maximizing the usage of existing infrastructure.
- Design for circularity, i.e., design hardware to be durable, easily upgradable, able to be disassembled, recyclable, reusable, and modular; etc.
- Strategic deployment planning and network architecture by balancing flexibility, interoperability, and capacity requirements, also while optimizing the choice between TN and NTN elements.
- Identifying and using environmentally friendly materials in the production of 6G devices and infrastructure to reduce environmental impact.
- Promoting sustainable and efficient spectrum usage and sharing.

Main environmental, social and economic challenges

- Maximizing the adoption of renewable energy sources and the integration of smart grid technologies depending on the country and the respective regulations
- Comprehensive lifecycle assessments are pivotal to understand the hotspots in a product or system, but simpler and applicable methodologies are needed to be used more broadly.
- Social engagement and building trust in the use of the new technologies while taking into account cultural and regulatory aspects of all countries.
- Increasing network investments due to e.g., increased amount of data, and infrastructure costs for digital inclusion.
- Building new business models, e.g., new types of collaborations, contracts and financial flows, and incentives for attracting large investments for the benefit of the society.

Seamless Immersive Reality Representative UC

Risk

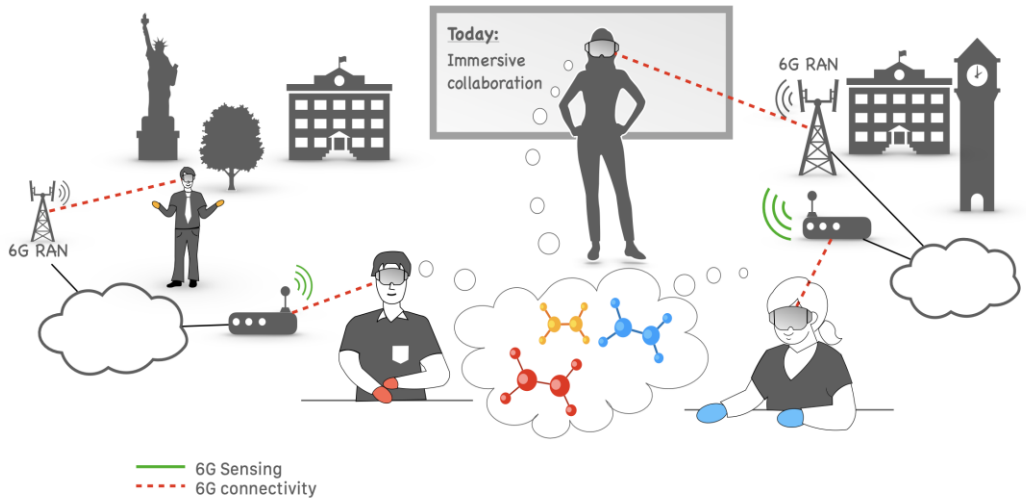
- Exaggerated levels of energy/resources
- Individual isolation and alienation (i.e., loss of human physical contact)
- Service monopoly

Mitigation

- Environmental impact assessments into development processes
- Health specialists in design process
- Global and open standards and interoperability

Mitigating stakeholders

- Tech developers, suppliers, and telecom operators
- Content companies
- User groups, vendors, service providers, standards bodies



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)

Collaborative robots Representative UC

Risk

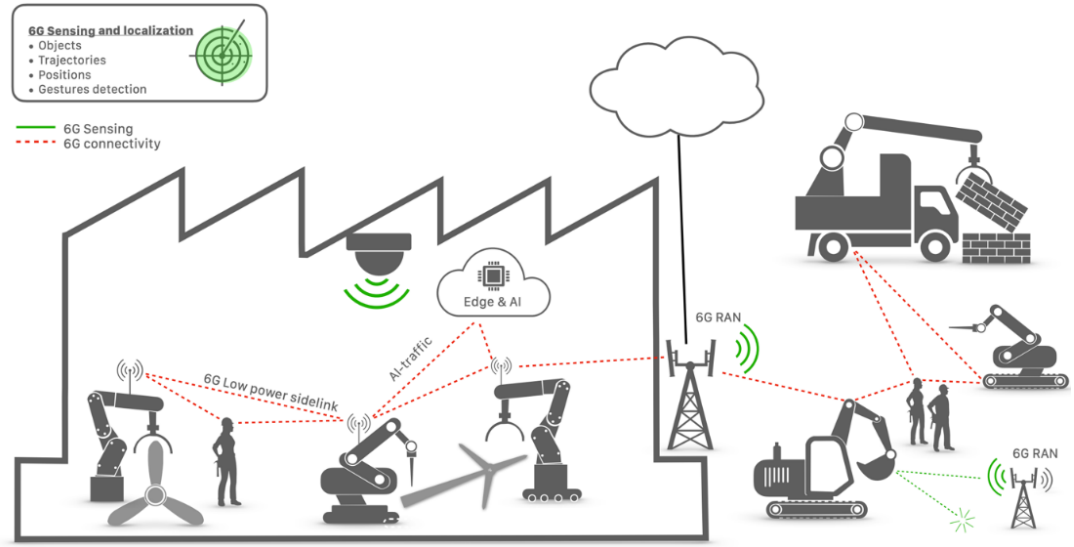
- Too many robots
- Jobs eliminated
- Lack of standardization

Mitigation

- Domain tailored solutions
- Smooth transition
- Reinforce standardization

Mitigating stakeholders

- Developers and operators
- Policy makers
- Operators, SDOs, alliances



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)

Network Assisted Mobility Representative UC

Risk

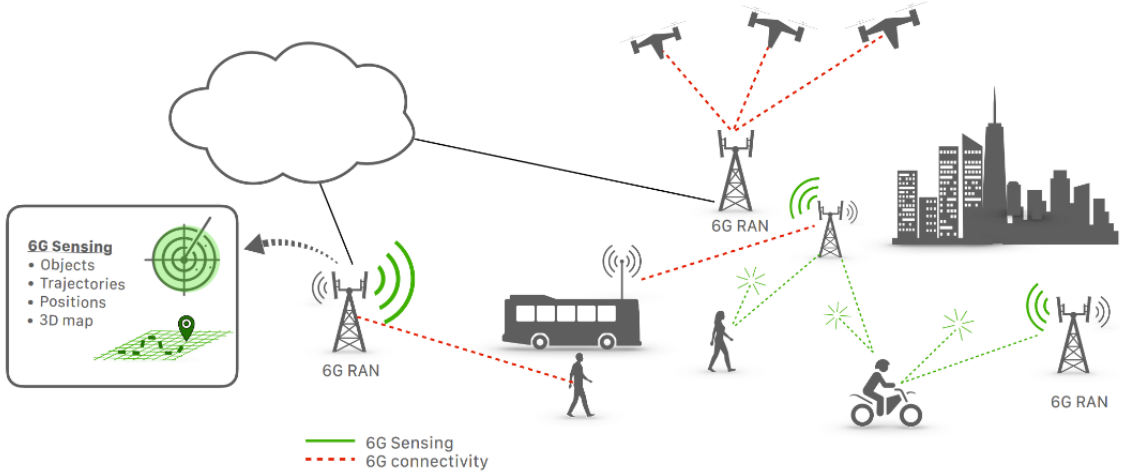
- Unanticipated traffic congestion
- Fragmentation of responsibility
- Too many dependencies between road infrastructure, networks, and devices

Mitigation

- Continuously monitor and adjust traffic management strategies
- System level governance, regulation and end to end insurance
- Understanding the dependencies across many domains

Mitigating stakeholders

- Telecom operators and tech developers and suppliers
- Providers of mobility solutions; Customers,
- Road authorities, vehicle associations



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)

Realtime Digital Twins Representative UC

Risk

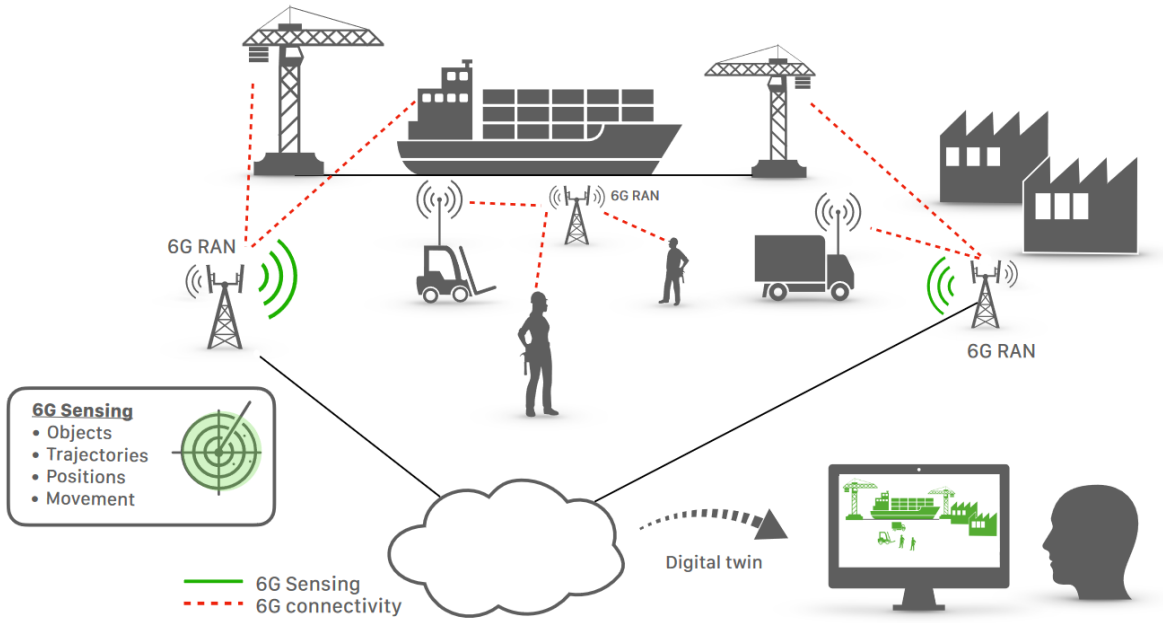
- Reduced DT adoption due to reluctance in embracing new working methods
- Resilience of a society in the event of e.g., Smart City DT fails
- Manufacturers fear that losing control limits market take-off.

Mitigation

- Effective on-the-job demonstration and training
- Early engagement of DT users for proper definition of the needs
- Transparent systems with modular architecture

Mitigating stakeholders

- Employers and organizations responsible for overseeing the workforce,
- Researchers; DT providers; Users of DT applications; Network providers
- DT providers



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)

Ubiquitous Network Representative UC

Risk

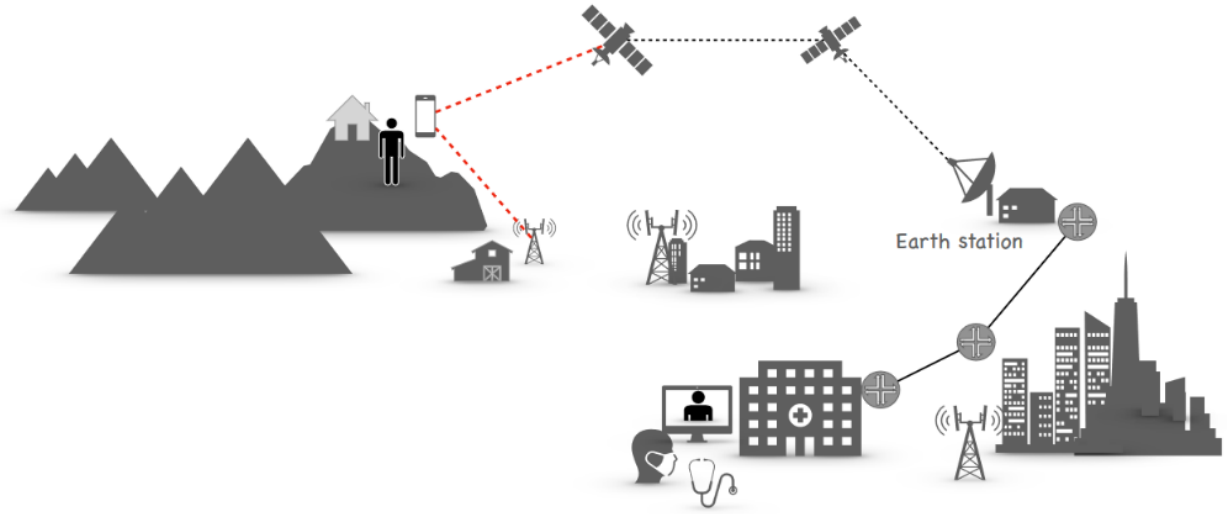
- Increased connectivity may not result in less travel/transport in total
- Risk of the technology being used with harmful purposes
- Deployment costs become too high hindering wider availability of connectivity

Mitigation

- Understand the needs and decide on what is good enough from a capabilities level/QoS.
- Security / privacy by design
- Create affordable satellite connection for the most remote areas.

Mitigating stakeholders

- Investors in network infrastructure and operation force consolidation;
- Policy makers, local and central legislators; Providers
- Local networks provider (DSP); Local, small-scale base station operator/owner (radio resource)



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)

Human Centric Services Representative UC

Risk

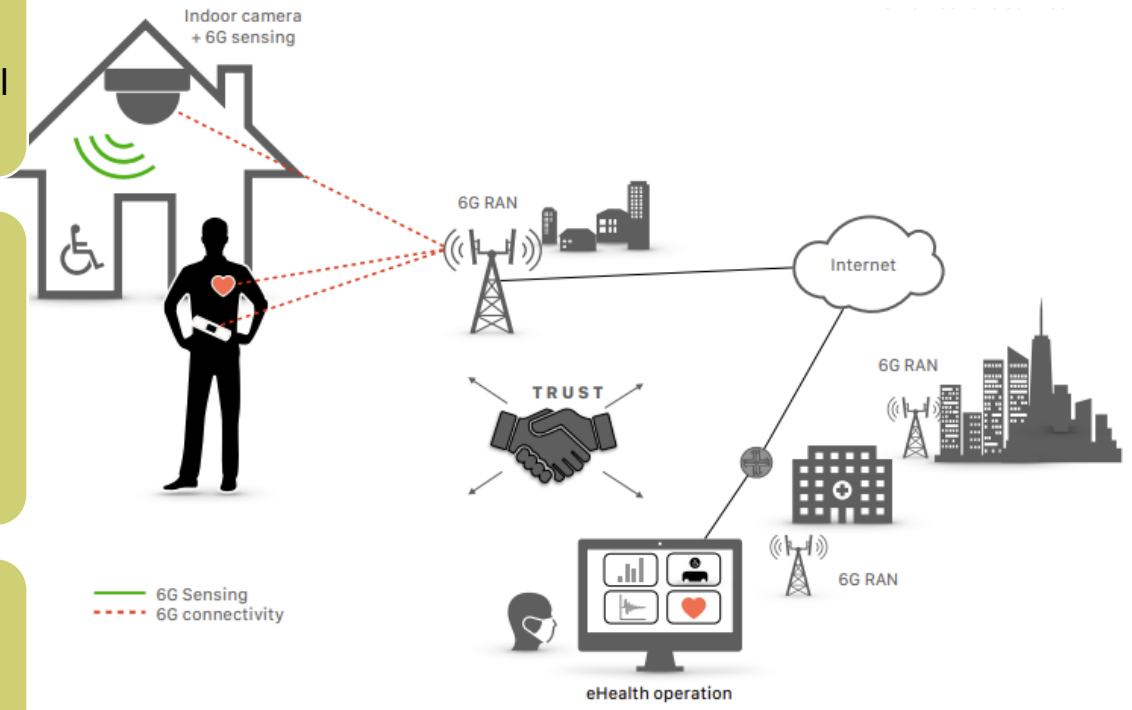
- Electronic waste due to the disposal of outdated or malfunctioning on-body sensors and devices.
- Privacy risks from monitoring humans
- Generating false/malicious data could lead to financial loss for stakeholders involved.

Mitigation

- Design devices with modular and upgradable parts to extend their lifespan.
- Education of people of the data collected
- Reputation mechanism

Mitigating stakeholders

- Hardware and software developers, engineers
- Regional and global governing bodies
- Service providers, users



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)

Conclusions and Next Steps

Conclusions

- Many challenges and risks are shared within different UCs:
  - Challenges and risks related to trustworthiness;
  - Early engagement of the stakeholders for ensuring the exploitation of the proposed solutions;
  - Energy, spectrum and materials re-use and circularity;
  - Need for cost-effective infrastructure and services, aiming at affordability and limiting the possibility of digital divide;
  - Need for new business models that will allow sharing of infrastructure and service costs as well as the need of shared investments for service provision and digital inclusion for the benefit of society even in areas with disperse populations.
- Holistic challenge:
  - Balance the trade-offs across the environmental, social and economic sustainability axis
  - Balance risks within the same sustainability axis.
  - Need to detail
    - The use case and the context / conditions within the solutions are designed
    - The implementation approach and the technology enablers that will be used.
- Cross-sector challenges and risks: challenges of one sustainability axis that may pose risks in other sustainability axis
  - E.g., peoples' distrust in technology or reluctance in using the technology coming from the social sustainability axis vs. unnecessary environmental cost in terms of materials usage for building antennas and economic costs for building the infrastructure).

Conclusions

- 2 categories of mitigation strategies
  - Related to the design of the 6G blueprint (technical aspects)
  - Related to policies, regulations and standardization.
- Stakeholders that have the know-how, the authority and the capabilities to apply mitigation strategies are also part of the business ecosystem of 6G networks and solutions.

Next Steps – up-coming deliverables

Deliverable	Content of the deliverable
D1.4 – 6G Value, requirements and ecosystem (April 2025)	Provide the final analysis on the value to be created by 6G for society & people (incl. environmental and economic sustainability) + Provide the final set of use cases and requirements + Present the outcome of various exchanges with the ecosystem

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