



EUCNC - 6G Summit

The 6G series workshop by Hexa-X-II

## Hexa-X-II: Environmental, social and economic impacts of 6G

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[hexa-x-ii.eu](http://hexa-x-ii.eu)



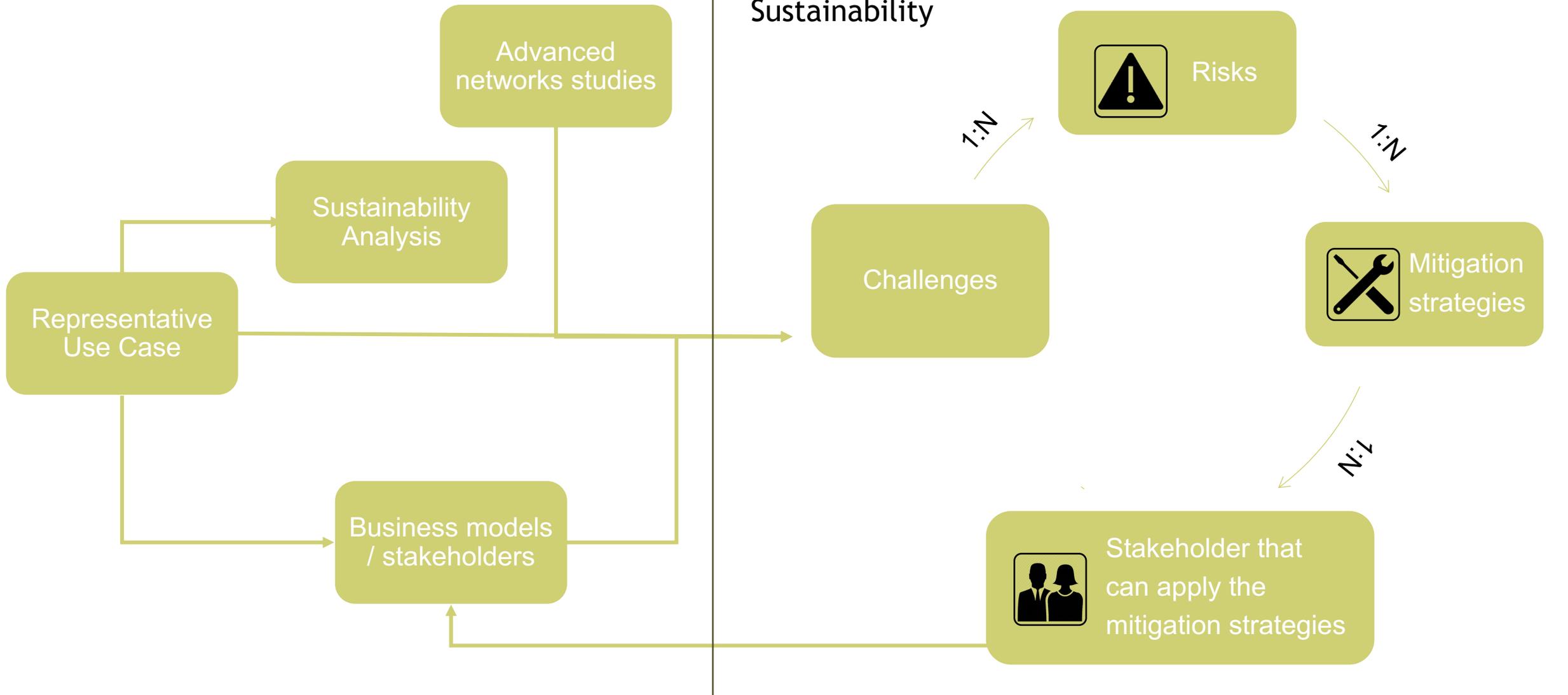


# The Methodology

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# Methodology





# Indicative Example - Cooperating Mobile Robots

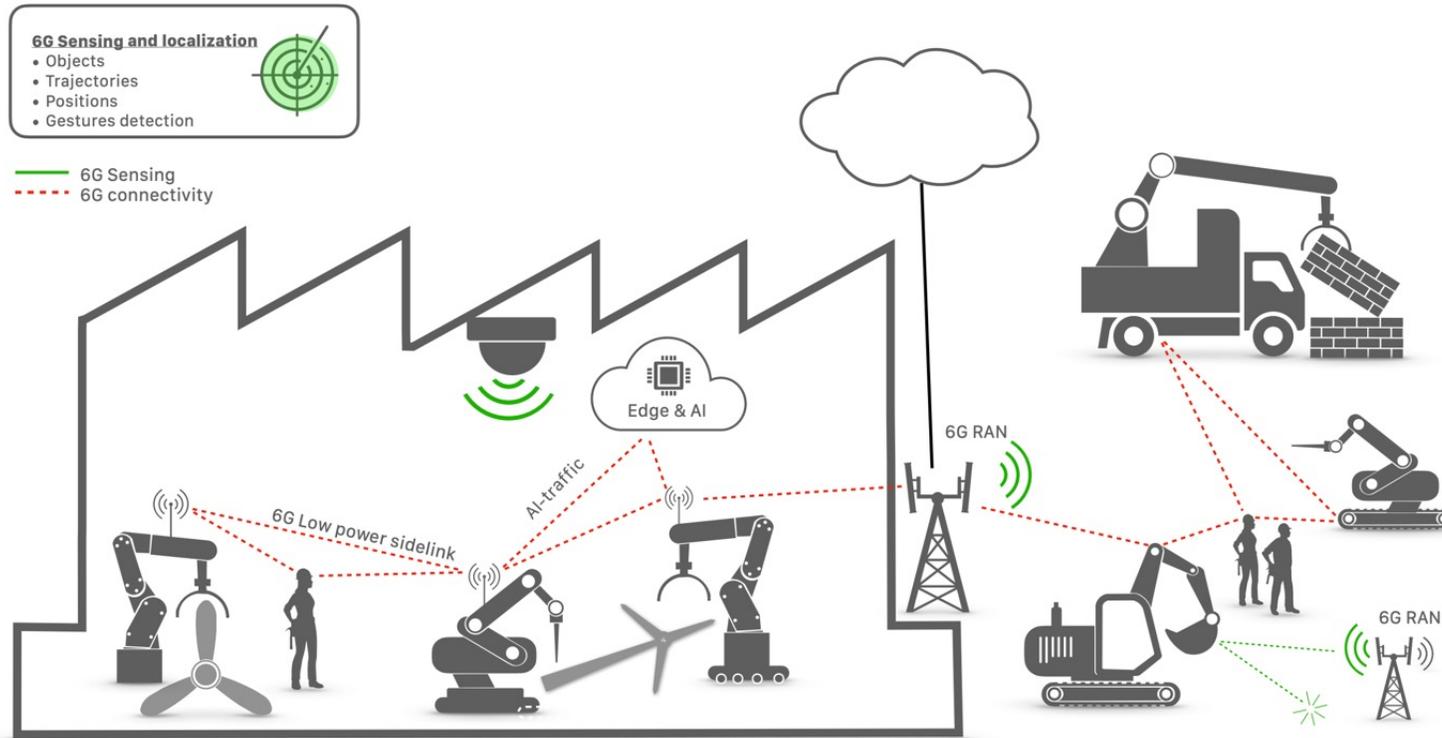
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# Cooperating Mobile Robots



Collaborative Robots



## Cooperating mobile robots

Robots communicate locally to perform tasks beyond their individual capabilities. E.g., flexible manufacturing, autonomous construction site

## Autonomous embodied agents

AI/ML and integrated sensing enable tools/machines to make decisions.



# Sustainability Analysis

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# Cooperating Mobile Robots

Main categories for further impact analysis

Collaborative Robots

<b>Environmental</b> 	<b>Social</b> 	<b>Economic</b> 
 Resource efficiency	 Accessibility	 Productivity & efficiency
 Energy consumption	 Work environments	 New business opportunities
 E-waste	 Support & Distribution	 Monopolization risks
 Manufacturing, extraction, transportation	 Privacy & Security	 Investments



# Business Modeling

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# Cooperating Mobile Robots: Ecosystem Business Model Canvas



## Supply Side

### Stakeholders

Suppliers of robots/cobots, mobile network operators, system integrators

### Resources

Networks, robots, IoT devices, data, sensing and monitoring capabilities, domain specific competences

### Activities

Coordination and cooperation between stakeholders and robots, integration, circular business

## Ecosystem Value Propositions

**Value proposition:** Improved efficiency, quality, security, flexibility and reliability from collaborative mobile robots conducting complex tasks.

**Value co-creations:** A total solution for robots, machines and humans to conduct tasks using network.

**Value capture:** Higher efficiency and economies of scale through collaborative automation.

**Value co-destruction:** Lack of collaboration due to interoperability challenges

**Partnerships:** system partnerships

## Demand Side

### Customer segments

Manufacturing and constructions sites, and other campuses

### Stakeholders/key partners

Manufacturers, co-workers of cobots

### Customer relationships

Dedicated sale and support

### Channels

Digital channels, key account managers

## Outcomes

### Benefits

Higher resource efficiency and productivity, improved reuse of resources, cost savings

### Revenues

Solution as a service, building owner investing and renting facility

### Pricing

As a service pricing models, based on improved efficiency or other values

### Costs

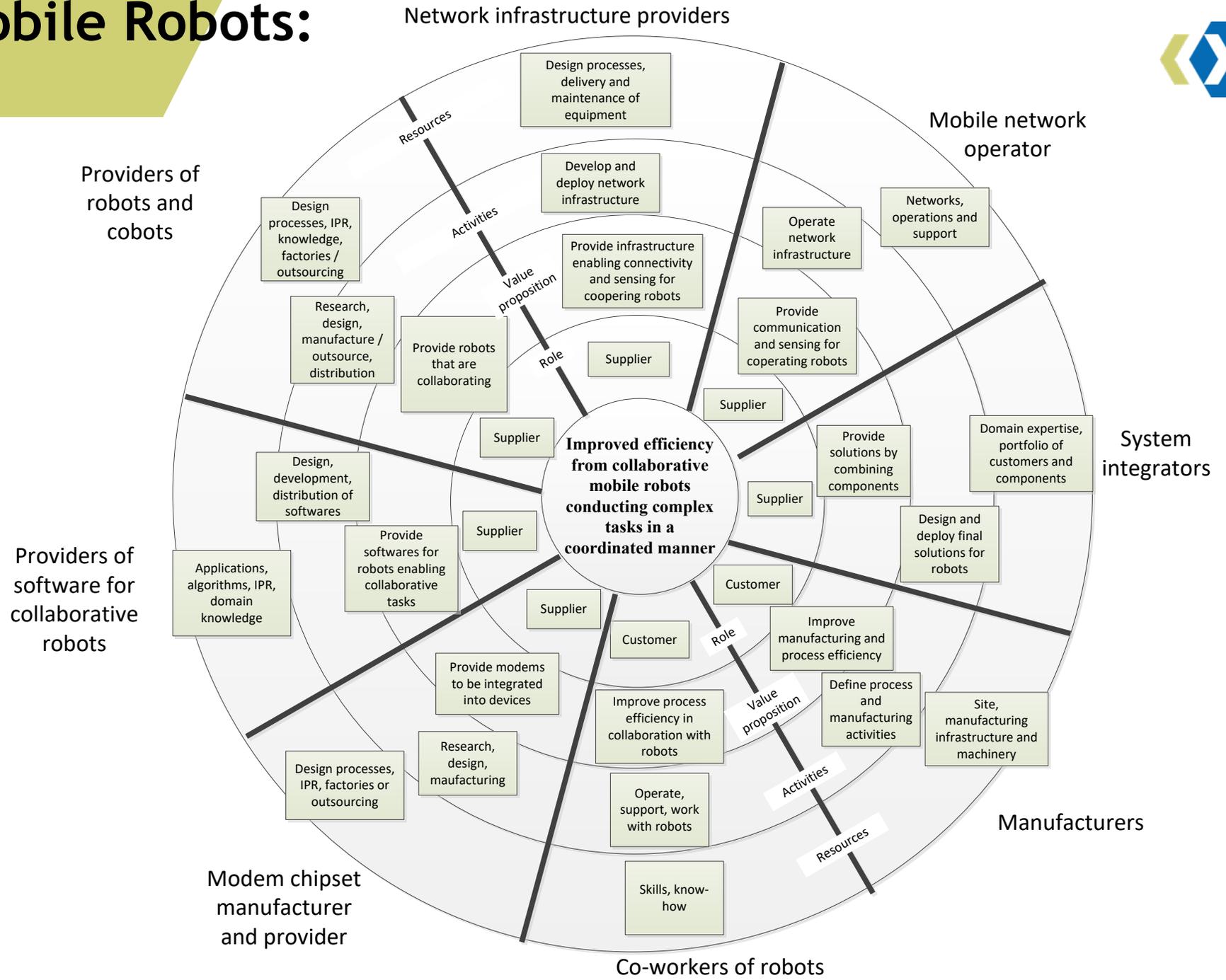
Economic and environmental costs from manufacturing of robots/cobots, system investment costs

# Cooperating Mobile Robots: Stakeholder Analysis



<b>Stakeholders</b> 	<b>Value propositions</b> 	<b>Activities and resources</b> 
Suppliers of robots/cobots (supplier)	Provide robots, which are collaborating, using network infrastructure, building new business opportunities	Research, design and manufacturing processes, IPR, knowledge, people, factories
Mobile network operator (supplier)	Provide communication and sensing for running cooperating robots in target area	Local/wide area network, network operation and support, authentication
System integrators (supplier)	Offer system-level solutions by recombining, reconfiguring, and handling components cost-efficiently	Combining components into final solutions, expert knowledge, portfolio of customers and certified tested components
Manufacturer (customer)	Improve manufacturing and process efficiency by means of cooperating mobile robots	Manufacturing site, infrastructure, machinery and devices

# Cooperating Mobile Robots: Ecosystem pie





# Preparedness for 6G Environmental, Social and Economic Sustainability

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# Preparedness for 6G Environmental, Social and Economic Sustainability: Collaborative robots Representative UC



## Challenges



- increased production flexibility → increased material usage and resource allocation in (robot) production, increased energy consumption in operation and e-waste formation at the end-of-life.



- Support workers performing tasks beyond their capabilities that risk their lives (e.g., carrying large weights, working in dangerous environments) vs. job losses
- Balance new processes with existing processes



- Scaling of the collaborative mobile robots' solutions to make the use case economically feasible

## Risks



- Too many robots
- Jobs eliminated
- Lack of standardization

## Mitigation Strategies



- Domain tailored solutions
- Smooth transition
- Reinforce standardization

## Mitigating stakeholders



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



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**6G**SNS

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- 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
- Sustainability Analysis:
  - Including Environmental, Social and Economic sustainability aspects
  - **Sustainability Footprints**: In the context of Hexa-X-II, the term “footprint” is defined in alignment with ITU-T L.1480, encompassing direct, i.e., first-order negative environmental effects, extended to direct negative social and economic effects. Furthermore, the Hexa-X-II definition of sustainability footprints includes second-order and higher-order environmental, social, and economic negative effects.
  - **Sustainability Handprints**: In the context of Hexa-X-II, the term “handprints” refers to the positive effects enabled by a 6G-enabled solution. These encompass positive first-order, second-order, and higher-order environmental, social, and economic effects that do not only help mitigate and reduce direct negative effects but also generate additional positive contributions to the environment, society, and economy.



- Preparedness for 6G Environmental, Social and Economic Sustainability
  - **Challenge** refers to difficulties or resistance that may prevent the Use case (UC) sustainability handprints and minimization of the sustainability footprints and therefore jeopardizes the potential 6G benefits for environmental, social or economic sustainability.
  - **Risks** refer to both the likelihood of not realizing the Use Case (UC) sustainability handprints and of sustainability footprints becoming larger than expected. Risks also include the likelihood of the UC resulting in not yet identified footprints. In order to identify the risks, one needs to analyse further the challenges, and describe what could go wrong so that the UC does not meet the sustainability handprints, or the sustainability footprints grow larger.
  - A **mitigation strategy** is a plan to reduce or eliminate the impact of a potential risk. The plan should take into account what technical decisions / technologies that can be applied on the 6G blueprint to help avoiding the risk not to meet environmental, social and economic sustainability targets, i.e., reduce the probability that the undesired outcome happens, or managing it in terms of reducing the undesirability of the outcome but also recommendation to stakeholders outside of the ICT sector, e.g., policy makers.