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6G4SOCIETY

KVI Value Sheets

Inclusivity, Trust, Safety, Quality of Life (Well-Being), Building Knowledge and Skills

DEFINITION AND SUPPORT SHEETS, WITH EXEMPLAR KVIS

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INCLUSIVITY FOR AND BY 6G

1. Key Value Definition

Pillar: Societal

KV: Inclusivity (Digital and Social)

Explanation of KV:

Inclusivity underscores the importance of ensuring that all individuals and groups, regardless of background, socioeconomic status, geographic location, or personal ability, have equal opportunities to access resources, participate in societal development, and have their voices heard in both physical and digital spaces [1] [2]. It is often described as bridging the digital divide [3]. **Social inclusivity** involves the ongoing effort to improve the terms of engagement for marginalized individuals and communities, ensuring equitable representation and participation in all aspects of society [4]. **Digital inclusivity** emphasizes global accessibility, affordability, and participation in the digital economy [1] [5] [6]. But, just as importantly, access alone does not provide inclusivity; it is also tied to elements like digital skills and rights needed for individuals or communities to make use of that access. The aim is to ensure that new technologies do not widen existing inequalities but instead help reduce the digital divide. It involves not just access to technology but also the capacity to use it meaningfully, shifting the goal from technological inclusion to equity in resulting well-being outcomes [7]. This includes digital literacy, cultural relevance, and addressing systemic barriers such as affordability, biased algorithms, and limited infrastructure [8] [9]. Achieving inclusivity requires that technologies and services be designed to be culturally sensitive, linguistically diverse, and adaptable to varied needs, empowering everyone to fully participate in and benefit from the opportunities of the digital age.

Relevance to 6G: Inclusivity is crucial for 6G to be a truly transformative technology, but it risks widening the digital divide and creating new forms of social exclusion. Therefore, it is essential that inclusivity is a core consideration in the development and deployment of 6G from the outset.

2. Sub-Objectives

These sub-objectives outline specific areas where 6G can contribute to inclusivity.

- **Ensuring access, physical, economic, and social**: to technology and services for all, including underserved and marginalized communities, accounting for income disparities and geographic challenges. The aim is to ensure that no one is left behind or excluded in the digital age, regardless of where they live or their economic circumstances. The EU's Digital Decade targets, gigabit connectivity for everyone and 5G coverage in all populated areas by 2030, represent essential but insufficient conditions, as the quality, reliability, and cost of access determine whether connectivity enables or constrains participation [10].
- **Promoting digital literacy and skills:** to enable full participation in the digital society. This focuses on building human capacity, ensuring people have the confidence and knowledge to meaningfully use digital tools for their personal and professional growth and supporting individual agency [11] [8] [12]. The Digital Decade target of 80% of adults with basic digital skills by 2030 reflects recognition that technical access without competencies produces exclusion.

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- **Equitable outcomes:** It means equitable access to opportunities to obtain resources, participate in society, and benefit from services. It means designing systems that proactively challenge existing biases and removing barriers that hinder access. This requires systematic assessment of whether digital engagement produces tangible benefits distributed equitably across social groups [13].
- **Culturally sensitive and adaptable to diverse needs:** to design technologies and applications that respect unique (multi-)cultural contexts, (multi-)languages, and abilities, that are locally validated. Doing so fosters a sense of validation and belonging, allowing everyone to express themselves and participate [14] [7]. **This requires transparent and participatory processes** around deployment and local use-cases, consistent with EU environmental participation obligations under the Aarhus Convention and EIA Directive, that address concerns about not being heard, providing meaningful voice in infrastructure decisions that shape communities.
- **Supporting vulnerable and marginalized communities:** to empower groups facing systemic disadvantages, ensuring technology actively uplifts them and amplifies their voices and opportunities. It aims to build social resilience, solidarity, and foster a sense of belonging, strengthening the entire societal fabric [4] [15] [16]. **This includes accessibility by design** for persons with disabilities and older adults, as mandated by the Web Accessibility Directive, European Accessibility Act, and harmonized standard EN 301 549.

3. Stakeholders and Pain Points (What's at stake for who?)

Stakeholder	Their potential pain-points the KV could help illuminate
Individuals with disabilities	Lack of access to affordable 6G, lack of digital skills, exclusion from online services, and potential for discrimination in AI-driven systems. Interfaces, devices, and applications are often not designed with built-in accessibility features (e.g., for visual, auditory, motor, cognitive impairments), requiring costly retrofits or separate solutions.
Marginalised groups/ Civil Society Organizations	Affordability of access, cultural irrelevance/insensitivity, digital literacy gaps, lack of representation in design. Their voices and unique needs are often not considered during the design and development phases of 6G technologies, leading to solutions that do not address their specific challenges or promote genuine inclusion.
Governments and Public Sector	Securing sufficient public funds or incentivizing private investment for equitable 6G rollout, especially in unprofitable or underserved areas. Challenges in developing adaptable regulatory frameworks that ensure broad access while balancing innovation and market forces and preventing the exacerbation of existing digital divides.
Rural Communities	The high cost and logistical challenges of deploying dense 6G infrastructure in sparsely populated areas make them less commercially attractive for providers. Even if regional hubs exist, the last mile challenge often results in unequal access and resiliency issues due to limited provisions, hindering their ability to participate in the increasingly digital society. They also face the physical challenges of infrastructure.
Technology Developers/Providers	Investing in accessibility features, cultural localization, and equitable deployment models that may not offer immediate or high commercial returns, impacting their commercial viability. Complexity in meeting the vast and often conflicting requirements for diverse user needs across a global user base, alongside ethical considerations like avoiding algorithmic bias.

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Service Providers	Risk of services in less connected areas or with smaller market groups being unable to leverage 6G advancements, creating competitive disadvantages. Difficulty in reaching and serving diverse customer bases if digital inclusion is not prioritized, leading to potential loss of market share or legal challenges related to accessibility.

4. Impact

How Can Stakeholders Benefit (from engaging this value)?

Stakeholder	Positive and Negative Impacts
Individuals with disabilities	Greater access to information, education, and economic opportunities, leading to improved social connections and empowerment through digital participation. They gain a stronger voice and sense of belonging in the digital society. Negative Impact: Excluding individuals from online services or different interfaces, limiting their ability to participate in the digital economy, and potentially eroding cultural heritage, cost of adaptive technology, social isolation through interaction format shifts.
Marginalised groups/ Civil Society Organizations	They gain a stronger voice and sense of belonging in the digital society, leading to improved social connections and empowerment through digital participation. Negative Impact: Potentially eroding cultural heritage, widening the digital divide, new forms of social exclusion, lack of digital skills.
Governments and Public Sector	More efficient and effective delivery of public services, improved citizen engagement and trust, and better overall social outcomes due to broader participation. This enhances democratic processes and strengthens social capital. Negative Impacts: citizens could be excluded from civic participation, lack of funds to deploy 6G or added costs to reach last mile areas, inferior services in poorer regions, vendor lock-in, new cybersecurity risks, decrease in in-person services.
Rural Communities	Enhanced social cohesion, stronger local economies, and greater ability to address local needs through inclusive digital solutions. This fosters more resilient and self-sufficient communities. Negative impact: widening the digital divide, new forms of social exclusion, lack of digital skills.
Technology Developers/Providers	Increased capacity to reach and support marginalized groups, stronger advocacy for digital inclusion, and greater impact through digital tools and collaborative platforms. This amplifies their ability to drive positive social change. Negative: May have limited resources to advocate for digital inclusion and monitor 6G's social impact.
Service Providers	Access to a larger and more diverse customer base, reduced operational costs through streamlined digital inclusion, and enhanced innovation driven by insights from diverse perspectives. This can lead to new market opportunities and improved brand reputation. Negative Impact: For businesses, this means difficulty in reaching and serving diverse customer bases and being excluded from 6G-enabled supply chains

What Actions or Decisions Will Result?

e.g. who makes decisions around this objective? What kind of decisions?

Stakeholder	Who would use the results of assessments within this value frame? How?
Individuals with disabilities	To better assess if a technology will provide them benefits. Individuals could use assessment results to make informed decisions about adopting 6G services, participating in digital literacy programs, and advocating for services that truly meet their needs. They can understand how to modify behaviour or daily routines for better engagement.
Marginalised groups/ Civil Society Organizations	To advocate for the rights of marginalized groups and monitor the impact of 6G on social inclusion. They could use assessments to gather evidence for advocacy campaigns, identify areas of concern, and hold technology providers and governments accountable for inclusivity commitments.
Governments and Public Sector	To develop policies and regulations that promote digital inclusion, such as encouraging development in areas where it is lacking or supporting literacy programs. They would use assessments to identify systemic barriers, allocate resources strategically, and enforce standards for equitable access and ethical AI deployment. Investment in 6G infrastructure and applications for public benefit by government agencies would be a key decision. Funding agencies could use insights to prioritize projects that address the digital divide and promote social equity. They would use assessment results to evaluate the potential social impact of proposed projects and allocate funding to initiatives that demonstrate measurable progress towards inclusivity objectives.
Rural Communities	Empower communities to co-own and integrate infrastructure, co-create relevant applications, and boost digital literacy to cultivate a thriving local tech ecosystem.
Technology Developers/ Providers	To design more accessible and inclusive 6G technologies and applications. They would use assessment results to identify and mitigate algorithmic biases, incorporate diverse user feedback into design iterations, and ensure built-in accessibility features from the outset. To provide evidence that the use case is effective in fostering inclusion.
Service Providers	To better assess if a technology will be of benefit to the communities they intend to serve and to better understand what kind of education/literacy is needed. To become more aware of specific requirements unique to different communities. They could use assessments to identify gaps in service accessibility or usability, inform pricing strategies for affordability, and tailor support programs to reach underserved communities. Could also use assessments to identify market opportunities in underserved areas and design inclusive products.

5. Implications for Technology and Use Case/PoC

Use Cases/PoCs

Objective	How might it affect use cases?
Ensuring equal access	Use cases should prioritize establishing and maintaining basic, affordable 6G connectivity as a fundamental right, ensuring everyone can access essential online services like emergency communications, telehealth, and education, regardless of their location or income. This directly combats the digital divide by ensuring a foundational level of participation.

	Key Question: How does 6G explicitly ensure basic, affordable, and equitable connectivity for services that improve lives and livelihoods?
Promoting digital literacy and skills	Use cases could centre on creating highly intuitive, personalized, and culturally relevant 6G-enabled platforms for digital skills training. Aim to empower individuals with the confidence and capability to fully participate in the digital economy, access better job opportunities, engage in civic life, and protect themselves from online harms. *Key Question: How do the activities foster digital literacy and confidence in communities to use 6G-enabled technologies?*
Equitable Outcomes	Use cases should demonstrate that 6G technologies lead to measurable improvements in life outcomes for disadvantaged groups, not just access to a technology. This means validating that services reduce disparities. Key Question: How do the activities demonstrate that 6G reduces existing disparities and delivers tangible improvements in underserved communities?
Culturally sensitive and adaptable to diverse needs	Use cases would prioritize dynamic adaptation of digital content, interfaces, and services based on users' cultural background, language, and individual accessibility requirements. *Key Question: How do the interactions supported by 6G adapt to and address diverse needs?*

Technology

What technologies are implicated most in this value? What tech features or enablers may reflect or even reinforce this problem?

Objective	Technology Enabler
Ensuring equal access	General: • AI as a Service (AIaaS) (Supports greater personalization and improves digital inclusion through application development) • Global APIs (Facilitate easier and wider access to infrastructure and technologies) • Lightweight computational solutions (Reduces latency, improving accessibility) • Equipment agnostic/reusable solutions (Reduces hardware cost and dependency) Geographic: • Non-Terrestrial Networks (NTNs) (Extends coverage in rural areas and mobility) • Distributed Multiple-Input Multiple-Output (D-MIMO) systems (Enhance service availability in challenging environments) • UAV-enabled networks (Provide localized coverage and high data rates in remote or disaster-affected regions) • Temporary Connectivity Solutions in Rural Areas (Addresses unreliable connectivity in agricultural areas)

	Economic: • Cost efficient network deployments, solutions.
Promoting digital literacy and skills	• (none identified directly from projects, so far)
Equitable Outcomes	• AI/ML integration (Enables remote work and industrial participation regardless of location) • Automation technologies (Enhance job accessibility/efficiency) • D-MIMO structures (Increase availability and quality of services like educational and cultural immersive products)
Culturally sensitive and adaptable to diverse needs	• Immersive Remote Education (High-quality, low-latency content delivery for learning environments) • AI-driven personalization and simplified interfaces (Enhances ease of use and accessibility)

6. Key Value Indicators (KVIs)

Grounding Framework

What frameworks does the literature provide to support which KVIs matter for your objective/stakeholder/decision combination? What elements do your stakeholders say need to be covered?

This is an example of how this could work. It doesn't fully translate to the indicators provided here, as the indicators provided are selected examples from the projects, as much as possible. But ideally, there should be a direct correlation between research on what to monitor and what indicators are selected.

To monitor inclusivity in contemporary society, one must adopt a multi-dimensional framework that treats digital inclusion not as a peripheral technical issue, but as a core component of social inclusion where the focus is not on deficits but on initiatives, such as the ability to get new jobs, stay in touch with loved ones, or receive life threatening emergency warnings [17] [18]. Social inclusion is defined by an individual's ability to participate fully in their social world, a goal that is increasingly dependent on the expansion of individual capabilities within digital environments, and requires not just immediate solutions but the ability to address the systemic dynamics that create the divides in the first place [19]. It is grounded not in if a person has technology at their house but if they can use that technology in the ways that they need to [20]. Therefore, monitoring efforts must look beyond mere infrastructure to evaluate different levels: physical access to broadband and devices; the acquisition of digital literacy and skills; and the actual ability to derive socio-economic benefits from that access [21]. It also requires looking

at uptake of services offers, trust in those services, improved outcomes such as education levels or jobs, and increased innovation in the domain [22] [23]. In the European Union, for instance, 44% of citizens lack the foundational digital skills necessary to thrive in a digital economy, underscoring a persistent divide where educational attainment and occupational status remain the primary barriers to social and economic inclusion [24]. A comprehensive monitoring approach should integrates infrastructure investment, educational programs, and inclusive (city, community, technology) planning [25]. This also means looking at specific demographic features like income, occupation, and rural/urban areas, which have been identified as critical to bridging this gap [26].

Monitoring inclusivity should prioritize equitable outcomes and cultural agency over simple participation metrics. This requires moving toward a strategy that centres the experiences of historically marginalized communities through intentional community engagement and the recognition of intersectionality. What is considered about accessibility needs to also be tailored to specific technology, where emerging technology is showing to require different types of actions and monitoring than traditional technology [27]. To prevent the loss of autonomy for the elderly, disabled, or low-income populations in a digitised society, monitoring must account for the presence of diverse voices at the design table. This is particularly important as policy and decisions are often data driven, which, without participation, makes those on the wrong side of the divide doubly invisible. Effective inclusion is not achieved through a one-size-fits-all approach; it requires tailoring to unique cultural situations to ensure interventions meet the specific decision-making needs of diverse communities.

KVI Formulation

Exemplar KVIs: These are not intended to be standards or to be used by all projects or necessarily ones that actually get used. These exemplars offer ideal qualities that can be imitated to develop good KVIs. Each is presented as a stakeholder/objective pairing (e.g. what stakeholder is being considered or who might use it, and the objective within the value) to help narrow the focus.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Increase in coverage footprint (example from 6G-Senses) Increased service quality (example from Origami) Affordable high speed and low latency network connectivity even in in low-density populated areas (example from 6GNTN).	Rural Communities & Service Providers	Ensuring equal access	Supporting technical design choices, focused on the infrastructural improvements needed within the testbeds. (Dimension 1)
Rationale: This directly measures the quality and reliability of access being delivered to Rural Communities. Rural communities suffer most from the digital divide, characterized by sparse infrastructure, geographical barriers, and sparse populations that make traditional network deployment economically unviable. Low service availability or high cost means unreliable coverage and thus access to essential services reinforcing social and economic isolation.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Accessibility for All: Easiness of using accessible hardware / solutions example (example from 6G-XR)	Individuals with disabilities	Culturally sensitive and adaptable to	To assess if a technology will provide people with different accessibility needs benefits and what

Perceived usefulness of the provided service, by demographic (example from 6G-Path). The enhanced communication services accessible to end users with diverse abilities, needs, and skills (from 6G-Cloud).		diverse needs	design decisions can be made to increase this. (Dimension 2)
Rationale: Move beyond mere availability of technology to measuring its true usability and effectiveness in driving digital inclusion and achieving true equity. A high-performing network is useless if the device required to access it is difficult or impossible to operate or requires prohibitively expensive proprietary interfaces.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Percentage of who is involved in the trials in comparison to who should be involved based on the target community (example from FIDAL) Percentage of the population that has access to the solution/service (example from HEXA-X-II) Digital literacy (Target-X)	Marginalised groups / Civil Society Organizations & Rural Communities	Supporting vulnerable and marginalized communities Promoting digital literacy and skills	To assess if their concerns are being considered as they monitor the impact of 6G on their communities. (Dimension 3)
Rationale: This measures a project's commitment to inclusivity in its development process, focusing on procedural equity. These groups are often excluded from or tokenized in technology development processes. Without their genuine involvement, the 6G solution risks failing to address their real-world barriers or, worse, creating new ones.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Inclusivity by design metrics: Proportion of development decisions informed by underserved community input [28]. Policy Alignment Indicators: Number of regional or national policy frameworks the solution is designed to support [29].	Governments and Public Sector, Service Providers	Equal Access and Equitable Outcomes	Identify systemic barriers; allocate resources strategically; to prioritize projects. (Dimension 4)
Rationale: Captures whether 6G solutions are designed *with* marginalized communities rather than *for* them, ensuring technologies address real needs and can be adopted by public services. By tracking community input in development decisions and alignment with policy frameworks, it provides early evidence that solutions will be implementable by governments and service providers at scale.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
SRL readiness level/ Digital readiness assessment (through infrastructure assessments and stakeholder capacity evaluations) [30].	Governments and Public Sector	Equal Access and Equitable Outcomes	Encouraging development in areas where it is lacking or supporting literacy programs; Know when to

			invest in 6G infrastructure and applications for public benefit. (Dimension 5)
Rationale: Communities need the foundational infrastructure and capacity to absorb and sustain 6G technologies. Identifying gaps that must be addressed before deployment is key to this. By assessing societal readiness alongside technical readiness, it helps governments target investments in infrastructure and literacy programs where they're most.			

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TRUST AND TRUSTWORTHINESS FOR AND BY 6G

1. Key Value Definition

Pillar: Societal

KV: Trust/Trustworthiness

Explanation of KV: Trust relates to feelings of control, a stakeholder's willingness to be vulnerable to the actions of another, and confidence that the system will act as intended [1] [2]. It correlates directly with economic growth, increased security and justice, solidarity and higher levels of happiness and freedom, and is tied to individual economic status [3] [4] [5]. Trust is the cornerstone of collaboration and knowledge sharing within groups and is needed to counter social fragmentation. In communities, fostering trust is essential for the adoption of technology and compliance with policies [6]. Yet, how it is understood varies by discipline: sociologists view it as relational, psychologists as cognitive, and economists as calculative [7]. Importantly, trust is dynamic and context-specific, shaped by factors such as transparency, ethics, security, control, reputation, feeling heard and shared expectations [8] [9]. It is deeply shaped by societal needs, power dynamics, and lived experiences, is not a universal standard. In particular, different communities have varying perspectives on what makes technology trustworthy [10].

Trustworthiness is a multifaceted concept encompassing interpersonal trust (between individuals), group trust (in organizations and communities), institutional trust (in governments and corporations), and generalized social trust (in broader systems). Others categorise it as horizonal trust (trust in fellow citizens) and vertical trust (trust in institutions and hierarchies), where vertical trust, grounded in systems based on reciprocity and fairness, is necessary for other forms of social trust to flourish [11] [12] [5] [13].

Either way, Trust is foundational for social and economic interactions. Interpersonal trust includes balancing skills, benevolence, and integrity. This extends to 6G-enabled products and services: they must be designed to behave in this way to be accepted [1]. Institutional trust is the belief that institutions act according to the expectations of the public. This extends to the technology used; if the technology fails or is too opaque (e.g. 5G, AI) then the public's overall confidence in institutions can be damaged [14] [15]. Generalised trust, the idea that most people can be trusted even strangers (e.g. those making 6G, those using 6G), is key to participative behaviours and one of the strongest predictors of digital trust [16].

Trust is also socio-technical construct representing a user's willingness to be vulnerable to a technology system despite the inability to monitor it [8]. It blends human trust derived from interpersonal models (e.g. benevolence and integrity) and system trust, which is rooted in technology models (e.g. functionality, helpfulness, and reliability) [17]. 6G will connect an increasing number of tools and services, new, hybrid human-technology forms of trustworthiness likely need to be defined, that allow different forms of negotiation and assessment needed to enable trust [1] [18]. It is crucial for the successful implementation of new technologies, as it affects perception, engagement, and impact. Reliable, secure, and transparent systems such as those that protect privacy, ensure communication security, and clearly communicate how they function help foster this trust. Ultimately, maintaining this value requires transparency, user agency, and ongoing dialogue to ensure that digital transformations respect human values and long-term societal wellbeing [19] [10].

Relevance to 6G: Trust is paramount for the widespread adoption and societal benefit of 6G. Policy and industry goals must prioritize building trust to overcome potential user resistance and ensure the technology is seen as a positive force. It also potentially requires new forms of technology design and revisiting what it means to develop trustworthy technology and services.

2. Sub-Objectives

- **Maintain public trust and confidence in services**: Employ 6G in a manner that maintains and enhances public trust in fellow persons, businesses, agencies and the technologies they use [14] [12].
- **Enhance the security, reliability, and resilience of networks and services**: Ensuring that technology consistently meets expectations fosters confidence. They provide the objective assurances necessary for users to accept vulnerability in digital interactions [15] [1] [7].
- **Promote transparency, reciprocity, and user control in services**: When people understand how systems make decisions, it fosters a sense of control and predictability, which are key to trust. Addressing how 6G (and related technologies, like AI) might influence choices or opinions, transparency helps alleviate fears of manipulation, strengthening trust in digital interactions [20]. This includes fostering ongoing dialogue with stakeholders.
- **Establish clear accountability and governance frameworks**: People are more likely to trust and adopt technologies when they perceive that those technologies are developed and deployed responsibly, with human well-being and societal impact as a priority, beyond compliance. Clarity of responsibility, e.g. defining who is responsible when things go wrong, fosters a sense of reassurance and reducing uncertainty. When clear frameworks exist for recourse and redress, it signals a commitment to fairness and justice, which enhances public acceptance and adoption and reinforces trust in organisations and institutions [20] [12] [14].
- **Maintain Integrity**: Integrity signifies a consistent adherence to strong moral and ethical principles, even when unobserved. This commitment builds trust by assuring stakeholders that the organization acts with honesty and fairness, reduce minimum impacts, not just focus on compliance. It means being truthful about intentions, capabilities, and limitations [1] [3] [7] [19].

Trust is also directly tied to maintaining economic and social prosperity and wellbeing [3] [4] [5]. It is also tied to foster collaboration and knowledge sharing [6].

3. Stakeholders and Pain Points (What's at stake for who?)

Stakeholder	Their potential pain-points the KV could help illuminate
Individual Users	Overall disconnect between expectations and confidence. Concerns about erosion of privacy (e.g. data breaches, surveillance), increased vulnerability, unreliable services, loss of autonomy and agency (e.g. lack of control over their data), generalized loss of trust in technology as being beneficial, lack of perceived value-exchange from services.
Businesses (using 6G)	Trust is a business imperative to maintain a competitive advantage. Risks of cyberattacks, data loss, operational disruptions due to unreliable 6G infrastructure, legal liabilities related to data privacy, reputational damage and loss of customers, operational disruptions and financial losses. Gap between high level principles/policies and actionable/practical implementation. Fear of being accused of ethics-washing.
Governments and Regulatory Bodies	Loss of public confidence and legitimacy due to challenges in ensuring compliance with regulations, preventing misuse of 6G for malicious purposes, and maintaining public order in a hyper-connected society, challenges in keeping accountability and security frameworks from falling behind innovation. Need to navigate risk-based approaches without stifling economic or social growth.

Technology Providers	Market rejection and competitive disadvantage leading to loss of customers, negative publicity. Legal and business liability for damages resulting from security breaches, privacy violations, or algorithmic biases.
Society as a whole	Erosion of social cohesion and democratic values, potential for manipulation, loss of trust in institutions and fellow members of society.

4. Impact

How Can Stakeholders Benefit (from engaging this value)?

Stakeholder	Their potential pain-points the KV could help illuminate
Individual Users	High levels of trust enable individuals to enjoy greater perceived control over their data, lives, better life chances, access to economic benefits. Users also benefit from personalised experiences and improved service delivery when they are willing to share data with trusted providers, as well as a safer digital environment. Negative Impacts: When trust is violated or low, users experience vulnerability and loss of control, unheard, and experience raised anxiety.
Businesses (using 6G)	Trust offers a competitive advantage, increased consumer loyalty, increased revenue. Trust in technology can lead to enhanced productivity while respecting human creativity. Negative Impacts: data breaches can be catastrophic to trust, businesses perceived to engage in ethics-washing face public backlash, The complexity of 6G and AI makes accountability difficult to assign.
Governments and Regulatory Bodies	Improved ability to ensure security and protect citizens, better governance of 6G technologies, and increased public trust in technological advancements, improved efficiency and objectivity of public administration. Negative Impacts: Malfunctioning technical systems can lead to loss of public confidence. Low trust leads to social fragmentation, political disengagement, and lower voter turnout. Over-reliance on private technology providers can lead to a loss of institutional memory and governance capacity.
Technology Providers	Stronger brand reputation, increased market competitiveness, and long-term sustainability by fostering user loyalty and attracting investment, motivation to shift to a human-centric approach. Negative Impact: the need to translate social factors into technical design, need to provide accountability mechanisms, fear of accountability gaps.
Society as a whole	Greater societal acceptance of 6G, reduced digital divide based on trust concerns, and a more ethical and responsible deployment of advanced technologies. Improved economic growth and social solidarity. Negative Impacts: Distrust fuels anti-establishment sentiment. It also exacerbates the digital divide.

What Actions or Decisions Will Result?

e.g. who makes decisions around this objective? What kind of decisions?

Stakeholder	Who would use the results of assessments within this value frame? How?

Individual Users	To make informed decisions about adopting and using 6G services based on their level of trust, when to share data, when to opt-out of features, and provide manual verification of services and information.
Businesses (using 6G)	To make informed decisions about adopting and investing in 6G services, to ensure the reliability and security of their 6G services and to communicate these assurances to their customers.
Governments and Regulatory Bodies	To develop effective regulations and standards that promote trust in 6G technologies and protect user rights, decide what technologies to promote or prohibit, build adaptive regulations,
Technology Developers	Design choices by engineers, e.g. to design and build more secure and privacy-preserving 6G systems and applications, adjust level of human oversight, develop assurance mechanisms that address public wariness.
Society as a whole	Safeguard the social contract and implicit social agreements, define the digital good, clarify what it means to respect the laws. They could decide to revoke the political mandate for 6G or decide to participate in the innovation process.

5. Implications for Technology and Use Case/PoC

Use Cases/PoCs

Objective	How might it affect use cases?
Maintain public trust and confidence in services	Use cases could focus on showing how users or businesses interact with services in a way that reinforces their belief in the service's fairness and safety, and consider what happens if trust is not maintained. Use cases involving sensitive (personal) data will require a much higher emphasis on trust and security in their design and deployment, where the use case focuses on designing for trust as a central core. Use cases could focus on what users consider tangible returns. *Key Question: What interactions, from the public's perspective, build or erode trust, and how can we design those interactions to foster confidence?*
Enhance the security, reliability, and resilience of networks and services	Use cases could focus on how various actors are able to actively protect and restore the operational integrity of the system against threats in ways that offer continuity on their sides. They could focus on how critical services deliver consistent and dependable results for stakeholders doing their jobs, especially in high-stakes environments. They could also focus on user or societal risk perception, support users in identifying and mitigating vulnerabilities, and ability of users to implement, understand, and demonstrate security mechanisms. Technical resilience requires proactive trust repair strategies. *Key Question: What interactions are necessary to proactively prevent, detect, respond to, and recover from operational disruptions? How does the system dependably deliver the expected outcome?*
Promote transparency, reciprocity, and user control in services	These use cases could focus on consumer, user, and public understanding of systems and services and their ability to predict resulting experiences. They could focus on how stakeholders can gain insight into the logic, data, and outcomes of systems, e.g. from explanation or audit. They could also include situations where bias could emerge and thus be mitigated. Use cases could focus on if technology or services consistently meet stakeholder expectations, both in terms of quality of service as well as effects on their ability to act.

	Key Question: What interactions enable stakeholders to understand the system, verifying its fairness, accuracy, and adherence to policy?
Establish clear accountability and governance frameworks	Use cases could focus on working with stakeholders to establish how they want to approach ethical standards and be set up such that it is possible to assess or anticipate if stakeholders see the standards as being met. Use cases here are less about direct external user interaction and more about internal organizational processes and system capabilities that support oversight, auditability, responsibility, and adherence to rules. Use cases could focus on ensuring frameworks of responsibility are able to be defined, are clear, and able to be acted upon. They could also focus on engaging policy and standards so as to find gaps or further clarify or build consensus as to what it means to act within such a framework. *Key Question: What technological design features alleviate negative ethical concerns from stakeholders? What internal processes and system features are required to clearly define responsibilities, track actions, and ensure adherence to established policies and ethical guidelines?*
Maintain Integrity	Use cases should both technically and socially preserve the accuracy, completeness, and trustworthiness of data and information throughout its lifecycle, protecting against malicious or accidental alteration. Use cases should help build the public perception that an organisation adheres to acceptable principles, honesty, and reliability, rather than acting only out of a desire for profit or stop at basic legal compliance. They should focus on public communication. *Key Question: How can 6G management processes and technologies ensure technical and social integrity?*

Technology

What technologies are implicated most in this value? What tech features or enablers may reflect or even reinforce this problem?

Objective	What technology could be enablers?
Maintain public trust and confidence in services	• Explainable AI, to provide human-interpretable explanations • Human-machine intent interface design, to include human concerns. • Intent-based networking, to allow users to declare high-level goals • Secure and privacy-enhanced machine learning; Privacy-Preserving Data • **Holographic/Immersive Visualization,** to foster interpersonal trust, cooperation, and shared understanding
Enhance the security, reliability, and resilience of networks and services	• Secure and privacy-enhanced machine learning • Zero-Trust Security & SDP • Privacy-Enhanced AI Models • Trusted Execution Environment • Post-Quantum Cryptography and related security services, for long term data integrity • Anomaly Detection, to identify and respond to cyber threats and hardware failures in real-time. • Distributed MIMO, to enhance service availability and reliability • Streamlined network function interfaces & interaction • Trustworthy 3rd party management • Physical Layer Deception • Multi-domain/Multi-cloud federation

Promote transparency, reciprocity, and user control in services	• Explainable AI, to provide human-interpretable explanations • Auditable systems, to provide • Intent-based networking, to allow users to declare high-level goals • Self-Sovereign Identity, so users have complete ownership of their data • User-Centric Privacy Interfaces, users to view and adjust privacy settings
Establish clear accountability and governance frameworks	• Trustworthy AI; Sustainable AI/ML-based control; Trustworthy AI/ML-based control • Trustworthy 3rd party management, Level of Trust Assessment Function, to monitor service health and provider reputation • Smart Contracts, to ensure all parties are held accountable
Maintain Integrity	• Sustainable AI/ML-based control • Trustworthy AI/ML-based control • Privacy-Enhanced AI Models; Secure and privacy-enhanced machine learning; Privacy-Preserving Data Processing & Collecting • Physical Layer Security, to protect transmissions against eavesdropping • Continuous Authentication, to verify user identity • E2E context awareness management • Trusted Execution Environment (TEE) • Digital Twin (DT) Simulation, to test in safe environments

6. Key Value Indicators (KVIs)

Grounding Framework

What frameworks does the literature provide to support which KVIs matter for your objective/stakeholder/decision combination? What elements do your stakeholders say need to be covered?

(For this exemplar document, see key value, objectives, and references. Were there to be a specific use of this for a project, it is expected that additional research would be done to explain why each indicator was chosen, or how the selected indicators, as a group, are interrelated to the broader project goals. See the inclusivity sheet for a partial example.)

KVI Formulation

Exemplar KVIs: These are not intended to be standards or to be used by all projects or necessarily ones that actually get used. These exemplars offer ideal qualities that can be imitated to develop good KVIs. Each is presented as a stakeholder/objective pairing (e.g. what stakeholder is being considered or who might use it, and the objective within the value) to help narrow the focus.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
System resilience against faults and attacks, via measurements and redundancy to detect and mitigate errors (example from 6G-DISAC) Ensure security in communication between remote and application, via tests (example from NANCY) Number of downtime events where there's no identifiable cause (example from HEXA-X-II)	Technology Developers	Enhance the security, reliability, and resilience of networks and services	Where to invest resources in system hardening and resilience improvements for service reliability; identify technological vulnerabilities (Dimension 1)

Rationale: Addresses failures and measures consistent performance quality; together they capture worst-case resilience and routine reliability. Technology developers need concrete metrics to demonstrate that systems embody the technical features that form the foundation of system trust. When technical systems fail, there is often loss of public trust in institutions, not just trust in the technology.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Level of Trustworthy, an index that measures user-centric perspectives on Safety, Security, Privacy, Resilience, and Reliability (example from Safe-6G) Reported user confidence in the digital devices, systems, and services used in the use-case development and operation (example from TrialsNet)	Individual Users	Maintain public trust and confidence in services	Assess if they feel safe using the technology and thus want to adopt it; assess what kinds of interactions and feedback they would like to provide (Dimension 2)
Rationale: Trust fundamentally involves a stakeholder's willingness to be vulnerable to the actions of another and confidence that the system will act as intended. These indicators directly measure whether users are willing to adopt that vulnerable position.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Operators expressing confidence and trustability in digital devices, systems, and services and their overall transparency/understandability (example from 6G-Path, HEXA-X-II) Trust in the system's behaviour and governance, assessed via expert evaluation, subjective feedback gathered from trials (example from FIDAL)	Businesses (using 6G)	Promote transparency, reciprocity, and user control in services	Can an institution trust the system enough to invest or collaborate further? Can we safely vouch for this system to our citizens? (Dimension 3)
Rationale: Municipal/operator confidence is a proxy for the perceived risk for communities. Indicator 1 addresses technology trust, while indicator 2 captures human trust, which supports assessment of if there is sufficient institutional trust to proceed.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Expert reviews and simulations that solutions that can manage risk that would impact fundamental rights [20].	Governments and Regulatory Bodies	Establish clear accountability and governance frameworks	Do we grant a license to the 6G service? Do we mandate further accountability and responsibility mechanisms? (Dimension 4)
Rationale: Trust is often a reflection of the tangible returns citizens receive for their contributions, such as high-quality education and healthcare. Regional systems maintain trust when they are perceived as suitable and appropriate for society, balancing innovation with social norms. Overall, the capacity of a			

regional system to redistribute value is compromised if it cannot be held accountable for systemic failures.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Evidence of conformity with ethical principles, legal requirements, and post market monitoring plans before full-scale market entry [20]. Assessment of if citizens feel the value exchange is fair, via survey of general citizens after demonstration of whether the benefits they imagine receiving (e.g., better services) justify the risks they would have to take (e.g., sharing personal data) [13].	Governments and Regulatory Bodies; Society as a whole	Maintain Integrity	Whether current ethical and legal frameworks are sufficient or require updating. If additional safeguards or monitoring requirements are needed before authorization (Dimension 5)
Rationale: A key indicator is whether vertical trust (trust in the hierarchy/institutions) is strong enough to foster horizontal trust (trust between fellow citizens), which allows value to flow freely across social networks.			

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SAFETY FOR AND BY 6G

1. Key Value Definition

Pillar: Societal

KV: safety

Explanation of KV:

Safety is the protection of individuals from harm and ensuring they are not exposed to vulnerable situations. It consists of public interventions designed to assist individuals, households, and communities in managing risk and providing support to those who cannot provide for themselves. Safety focuses on the absence of physical, mental, environmental, and emotional harm. Safety requires multi-layered approach to the protection of individuals, spanning **economic security, occupational safety, human security, digital rights, and internal security**. Protection is framed not only as the prevention of physical or intentional harm but also as the mitigation of subjective perceptions of lack of safety and the reduction of systemic vulnerabilities [1] [2] [3]. It also has to consider that exposure to harm and vulnerability is unevenly distributed across the population, with vulnerable and marginalized populations often taking the greatest burden [4]. Safety is also when individuals and communities benefit from proactive measures, robust and resilient systems, and readily accessible resources that minimize the likelihood and impact from hazards, threats, and crises. This includes not only protecting individuals and communities from immediate danger and vulnerable situations but also fostering an environment of security, well-being, and trust that enables them to thrive and recover effectively in the face of adversity.

2. Sub-Objectives

These sub-objectives outline specific areas where 6G can contribute to enhanced safety.

- **Protection from hazards and risks:** Enhance resilience against natural disasters, crime, and other hazards (e.g. environmental, food health). This includes safety from terrorism, crime, cyberattacks, environmental hazards, as well as the ability to anticipate future systemic shocks, such as public health emergencies or natural disasters, as well as the maintenance of free movement across borders [5] [1]. Resilience, adaptation, and mitigation, are all key aspects of this element of safety, especially as they relate to supporting livelihoods, food security, and disaster recovery [6]. Similarly, this includes the protection of digital harm, such as the harmful effects of AI, constant surveillance, and automated systems that can function without human command [7].
- **Workplace and Home Safety:** To create safer living and working conditions through real-time monitoring and proactive risk mitigation. Minimize injuries, fatalities, psychological trauma, and long-term health issues caused by hazards and risks. This includes reduced work-related accidents and illnesses, safety throughout the R&D phases, protection in remote work, and the protection from psychosocial risks like work-related stress or bullying [4] [8] [9].
- **Freedom from social risks:** Contribute to safer communities by improving public safety (e.g., enhanced surveillance for crime prevention, faster emergency response), and mitigating risks of violence through improved communication and awareness. This includes protection of vulnerable groups such as migrant workers, platform workers, children, and women, who face higher levels of insecurity and inequalities, cultural and language barriers, different forms of isolation and exclusion, and are at more risk to experience poverty or violence [1] [10] [4] [9]. It also involves the reduction of people at

risk of poverty and social exclusion, equal and adequate access to social protection systems [10].

- **Access to basic needs and a reliable social security system:** Ensure equitable access to essential goods and services required for a life in dignity (e.g., efficient delivery of aid, remote monitoring of critical infrastructure, food, child care, energy/heat, lighting, minimum income, housing), and to support robust social safety nets through improved communication and information sharing [11] [12] [13] [14]. In the context of disasters or climate change, social protection is viewed as the first line of defence, providing assistance to help vulnerable groups absorb shocks and recover faster [6]. Often care is not accessed because of administrative complexity.
- **The perception of safety and feeling secure in daily life:** Foster a sense of security and well-being enabling individuals and communities to flourish without constant fear or vulnerability [2]. This relates to social Cohesion and safe public spaces, ensuring people are not exposed to vulnerable situations in public, and see what they expect to be safety signals [15] [16]. This includes designing public spaces in ways that support this perception.

Relevance to 6G:

If the underlying 6G system is not designed with safety in mind, vulnerabilities in one part of the system could cascade and expose individuals to harm or could erode the general well-being of individuals and communities. 6G also offers an opportunity to proactively monitor and build awareness of potential harms and vulnerabilities in the world that are faced by stakeholders. This means not just reacting to threats but anticipating them during the design phase.

3. Stakeholders and Pain Points (What's at stake for who?)

Stakeholder	Their potential pain-points the KV could help illuminate
Individuals/ Citizens	Impacted by personal safety, health, and well-being. Exposure to risks from disasters, accidents in public or workspaces, lack of timely warnings, and inefficient emergency response. Feeling safe in their neighbourhood.
Workers	Protection from dangerous working conditions. Injuries and fatalities in the workplace due to hazardous conditions, lack of real-time safety information, and inadequate training or remote support. Protection from work-related musculoskeletal disorders due to non-ergonomic postures
Consumers	Impacted by product safety and the safety of services.
Vulnerable Groups	Including children, the elderly, and those with disabilities, who may have specific safety needs, heightened risks during emergencies, difficulties in accessing timely information and assistance, or greater susceptibility to harm.
Businesses/ Organisations	Need to comply with safety regulations or implement safety protocols to ensure the safety of their employees and customers. Costs associated with workplace accidents, legal liabilities, reputational damage, and the need for more effective safety protocols.

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Emergency Response Teams	Challenges in coordinating efforts, lack of real-time situational awareness, difficulties in accessing affected areas, and inefficient resource allocation.
Governments/ Policymakers	Responsible for setting and enforcing safety regulations and ensuring public safety, and the burden of managing disaster response and recovery.
Communities	Crime rates, crises, and disasters are negatively connected to vibrant communities.

4. Impact

How Can Stakeholders Benefit (from engaging this value)?

Stakeholder	Their potential pain-points the KV could help illuminate
Individuals/ Citizens	Impacted by personal safety, health, and well-being. Exposure to risks from disasters, accidents in public or workspaces, lack of timely warnings, and inefficient emergency response. Feeling safe in their neighbourhood.
Workers	Protection from dangerous working conditions. Injuries and fatalities in the workplace due to hazardous conditions, lack of real-time safety information, and inadequate training or remote support. Protection from work-related musculoskeletal disorders due to non-ergonomic postures
Consumers	Impacted by product safety and the safety of services.
Vulnerable Groups	Including children, the elderly, and those with disabilities, who may have specific safety needs, heightened risks during emergencies, difficulties in accessing timely information and assistance, or greater susceptibility to harm.
Businesses/ Organisations	Need to comply with safety regulations or implement safety protocols to ensure the safety of their employees and customers. Costs associated with workplace accidents, legal liabilities, reputational damage, and the need for more effective safety protocols.
Emergency Response Teams	Challenges in coordinating efforts, lack of real-time situational awareness, difficulties in accessing affected areas, and inefficient resource allocation.
Governments/ Policymakers	Responsible for setting and enforcing safety regulations and ensuring public safety, and the burden of managing disaster response and recovery.
Communities	Crime rates, crises, and disasters are negatively connected to vibrant communities.

What Actions or Decisions Will Result?

e.g. who makes decisions around this objective? What kind of decisions?

Stakeholder	Who would use the results of assessments within this value frame? How?

Individuals/Citizens; Communities	Understand the benefits and limitations of 6G safety technologies, leading to greater trust and willingness to adopt them. Understand how to modify behaviour or daily routines.
Workers	To assess the impact of 6G technologies on worker safety and inform best practices, identify training needs, and prevent safety failures.
Consumers	Make informed purchasing decisions, choosing solutions that genuinely enhance their safety and peace of mind, avoiding ineffective or risky technologies.
Vulnerable Groups	Understand the benefits and limitations of 6G safety technologies, leading to greater trust and willingness to adopt them and advocate for their specific needs.
Businesses/ Organisations	To make informed decisions about investing in 6G safety solutions and implementing them effectively in the workplace. Procurement of 6G-enabled equipment and systems.
Emergency Response Teams	To evaluate the effectiveness of 6G tools in improving disaster preparedness, response, and recovery.
Governments/Policy makers	To develop standards and guidelines for the deployment and use of 6G in safety-critical scenarios. Investment in 6G infrastructure and applications for public safety by government agencies. Prioritize funding for 6G initiatives
Tech Developers	To identify weaknesses or gaps in a use case's ability to deliver on safety objective. Provide evidence that the use case is effective in creating safer conditions. Use findings to implement safeguards and ethical guidelines.

5. Implications for Technology and Use Case/PoC

Use Cases/PoCs

Objective	How might it affect use cases?
Protection from environmental hazards and risks	Use cases should enable the anticipation of hazards before they cause significant harm. They should prioritize use cases with a direct and significant impact on preventing harm and improving safety, such as real-time worker fatigue monitoring, and drone-based disaster damage assessment, and situational awareness systems for localized hazards. The design and capabilities of 6G applications are driven by the specific safety needs of users and communities rather than solely by maximizing technical performance metrics like speed or capacity. They should prioritize robustness and alternative pathways to ensure continuous operation even under stress. Key Question: How can 6G-enabled systems provide transparent and actionable insights to stakeholders, allowing them to understand and identify potential hazards and risks?

Freedom from social risks	Use cases should improve understanding of evolving public safety situations, provide ways for citizens to report concerns or seek help, for authorities to disseminate vital information, and reduce the likelihood of criminal activity or violence. Key Question: How can 6G support the necessary identification, understanding, and communication of public safety concerns?
Access to basic needs and a reliable social security system	Use cases are developed with a strong focus on ensuring that safety benefits are accessible to all individuals and communities, including those with limited digital literacy, disabilities, or in underserved areas. Key Question: What deliberate strategies can be engaged to proactively identify and dismantle any barriers to potential safety benefits?
The perception of safety and feeling secure in daily life	Enhance the sense of security and well-being through reliable communication, access to support networks, and technologies that promote mental, physical, and emotional safety. Key Question: How can 6G-enabled technologies provide the public with a clear sense of control, promoting a sense of safety?

Technology

What technologies are implicated most in this value? What tech features or enablers may reflect or even reinforce this problem?

This list in the following table is not complete, but an initial derivation from the enablers listed in discussion with the KVIs based on what is being done currently in projects. It is expected to be expanded and refined, as a living resource.

Objective	What technology could be enablers?
Protection from environmental hazards and risks	• Monitoring and Telemetry Framework • Programmable Network Monitoring and Telemetry • Anomaly Detection and Classification • Network Digital Twins • Threat Model for Joint Communication and Sensing (JCAS) • Resilient Positioning, Navigation, and Timing (PNT) • Camera-based and wearable sensing technologies
Freedom from social risks	• Secure Data Sharing • Secure and Privacy-Enhanced Machine Learning • Trusted Execution Environment (TEE) • Remote Attestation (RA) • Multi-domain / Multi-cloud Federation • 3rd Party Facing Services • Cryptographic Agility • Decentralized Identity Management (DID)
Access to basic needs and a reliable social security system	• Network Migration • Multi-Radio Spectrum Sharing (MRSS) • Network of Networks • Multi-cloud Management Mechanisms • Subnetworks Architecture • Integration Fabric • Zero-Touch Closed Loop Governance and Intent-Based Management • Low Latency Scheduling Based on UE Traffic Patterns • Multi-Layer Downlink Radio Resource Control • Energy-Efficient Massive MIMO • Open RAN with Service Exposure

	• 6G Satellite Integration
The perception of safety and feeling secure in daily life	• Secure Workload Provisioning • Homomorphic Encryption • Quantum-Safe Cryptography • Zero-Touch Closed Loop Governance • Real-Time Zero-Touch Control Loops Automation and Coordination System • Management Capabilities Exposure Framework • Physical Layer Deception • Use of Synthetic Data • Intent-Based Management (Zero-Touch) • Human-Centric HMI (Human-Machine Interfaces)

6. Key Value Indicators (KVIs)

Grounding Framework

What frameworks does the literature provide to support which KVIs matter for your objective/stakeholder/decision combination? What elements do your stakeholders say need to be covered?

(For this exemplar document, see key value, objectives, and references. Were there to be a specific use of this for a project, it is expected that additional research would be done to explain why each indicator was chosen, or how the selected indicators, as a group, are interrelated to the broader project goals. See the inclusivity sheet for a partial example.)

KVI Formulation

Exemplar KVIs: These are not intended to be standards or to be used by all projects or necessarily ones that actually get used. These exemplars offer ideal qualities that can be imitated to develop good KVIs. Each is presented as a stakeholder/objective pairing (e.g. what stakeholder is being considered or who might use it, and the objective within the value) to help narrow the focus.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Decrease in communication outages during disaster events, measured by network coverage and speed of new connectivity establishment (example form 5G-Stardust, ECO-eNET)	Emergency Response Teams, Vulnerable Groups, Tech Developers	Protection from environmental hazards and risks	How to balance commercial traffic with emergency traffic, how to best manage combining alternative services. (Dimension 1)
Rationale: A failure in service during a disaster is a failure of the safety net.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Stakeholder perception of personal safety resulting from solution use in trials (example from FIDAL, 6G-Path) Traffic accident rate reduction, assessed via expert evaluation, subjective feedback from trials (example from TARGET-X)	Individuals/Citizens, Communities, Vulnerable Groups	The perception of safety and feeling secure in daily life	Decide if they think a system is acceptable; Decide if they should trust a system. (Dimension 2)

Rationale: This combination balances statistical probability with safety perceptions, a combination shown to be more accurate than either individually, balancing what is technically possible with the need to ensure psychological safety.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Measures the speed of response to critical events, as measured in trials, compared to baseline (example from ENVELOPE) % of actions taken with a device (before vs after) that suggest decreased risk taken by first responders/workers (example from ADROIT6G).	Workers, Businesses	Protection from environmental hazards and risks	Managers can decide whether to remove physical barriers in favor of virtual safety zones, or if a system is reliable enough to improve their working environments. (Dimension 3)
Rationale: A worker's physical integrity is directly tied to the system's ability to stop a machine before a collision or know when an incident has happened in order to be able to respond.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Affordability of Access: The percentage of individuals reporting an inability to use the service because they cannot afford it [14]. Digital Literacy Gaps: The disparity in digital skills across different age groups, educational levels, and geographical locations [14].	Vulnerable groups, Government/ Policymaker	Access to basic needs and a reliable social security system	Governments can decide if the cost of the new 6Gs solution is worth the benefits or if new policy might be needed. Vulnerable groups, in collaboration with technology developers, can establish the training and cost needs. (Dimension 4)
Rationale: Safety includes protection from social risks and economic security. If a citizen cannot afford 6G, they cannot access the 6G-enabled social safety nets or emergency services, making them fundamentally unsafe.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
The percentage of essential public services (healthcare, education, social assistance) that are able to be migrated to the proposed 6G-enabled network in the next 2 years [14].	Individuals, Emergency Response Teams, Government	Access to basic needs and a reliable social security system	Assessing if service design needs to be more adaptable to different circumstances. (Dimension 5)
Rationale: If 90% of healthcare is on 6G but the network is prone to outages, the population feels *less* safe. This indicator forces projects to prove that the 6G network is robust and resilient enough to do the job. Tracking the migration rate tells you how effectively you are removing the barriers to care.			

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QUALITY OF LIFE (WELL-BEING) FOR AND BY 6G

1. Key Value Definition

Pillar: Societal

KV: Quality of Life

Explanation of KV: Quality of Life and well-being are deeply interconnected concepts that operate at multiple levels. Quality of Life assesses an individual's position relative to their broad social and cultural environment, while well-being provides a more focused measure of their subjective cognitive and emotional state. It includes economic prosperity, health, as well as a subjective sense of well-being and fulfilment shaped by individual experiences, cultural values, and personal aspirations [1] [2] [3]. Involves various dimensions such as income, housing, health, education, strong relationships, leisure, quality of surrounding environment, and enriching cultural experiences.

Well-being consists of two distinct but correlated components: life satisfaction (a long-term cognitive evaluation) and happiness (a more immediate emotional state) [4] [5]. Together, these create a multi-level framework based on complex interplay between individual, societal, and systemic drivers [2] [3]. Quality of life is determined not by wealth alone, but by how society supports its citizens through various forms of capital—human, social, economic, and planetary [4] [6] [7]. These elements are important to consider together because studies show how they manifest and what is prioritized among them can change even across Europe [8] [2].

It is about using technology, innovation, and social systems to make everyday life easier, more accessible, more resource-conscious in ways that supports long-term environmental, social, and economic well-being. This can include making public services more accessible to underserved populations, improving food production and access, improved water management, better transportation systems, or the opportunity for more flexible work environments. It also relates to the physical and emotional consequences of the emotional consequences of living in a constantly connected system. It also highlights the importance of social interactions and belonging.

2. Sub-Objectives

These sub-objectives outline specific areas where 6G can contribute to well-being.

- **Physical and Mental Health:** Core individual well-being includes physical health, psychological state, social relationships, personal environment, and spirituality [1] [9]. Elements like energy levels, self-esteem, capacity for work, personal relationships, and access to quality healthcare form the foundation of individual well-being.
- **Independence and Mobility:** A critical feature is a person's capacity to perform daily living activities and their ability to work [1]. Monitoring should focus on whether innovations or social changes enhance or restrict individual mobility and autonomous functioning.
- **Agency and Control:** Individuals must feel their life is steered by personal decisions rather than external fate [2] [10]. A shift toward external locus of control signals that systems (technological or political) are becoming too intrusive or disempowering.
- **Economic prosperity:** The generosity and accessibility of social programs directly impact well-being [7]. Tracking availability of quality healthcare, financial resources, and universal social protections ensures necessary economic capital remains intact [11].

- **Social Cohesion:** social cohesion has a significant positive effect on well-being and acts as a moderator, reducing the relative importance of income in determining life satisfaction [12]. Well-being elicits civic-mindedness, meaning that satisfied individuals are more likely to operate in a cooperative and trustful manner for the common good [13].
- **Environmental and Home Quality:** Physical safety, quality home environments, and access to clean green spaces are prerequisites for stability [14] [11]. Protection of these is essential, as unsafe or polluted living environments diminish subjective well-being regardless of income. Conversely, higher levels of life satisfaction predispose individuals to adopt environmentally responsible behaviours [13].
- **Work-Life Balance:** Working conditions matter, specifically predictable hours and degree of autonomy over professional tasks [2] [15]. Encroachments on personal time or reduced workplace agency are leading indicators of declining human capital and life satisfaction [16] [17].
- **Leisure and enriching cultural experiences:** A person's capacity, opportunity, and inclination to participate in relaxation and pastimes, including physical activities, social activities, home-based entertainment [1]. Cultural diversity, freedom, and modernity all facilitate happiness [3].
- **Personal fulfilment:** Empower individuals to pursue their goals, express their creativity, continue to learn, problem-solve and live more fulfilling lives. This is a core component of long-term well-being, driven by both psychological factors and external structures [2] [18].

In addition, these are considered a sub-objective of well-being or a key value in itself, depending on the perspective taken:

- **Digital Inclusion and Service Accessibility:** The ability to access essential services remotely (such as eHealth records or telework opportunities) increasingly impacts quality of life [19] [15]. Ensuring digital equity prevents technological shifts from creating gaps in social capital for underserved communities [15].
- **Institutional and Interpersonal Trust:** Trust serves as the primary buffer against socio-economic stress [14]. While income accounts for about two-thirds of variance in life satisfaction, trust accounts for one-third and significantly dampens the negative impact of low income [12]. While Europeans are united in diversity, significant tensions exist between different generations and educational levels regarding their feeling of closeness to Europe and trust in institutions [3]. This could be considered either a sub-objective here, or a key interlinked value of its own.

Relevance to 6G: 6G has the potential to significantly enhance quality of life across various dimensions. For example, 6G's high speed and low latency can enable new applications in telemedicine, smart cities, and virtual reality, which can improve healthcare, create more liveable urban environments, and enrich entertainment, cultural, and community experiences. However, these benefits should be distributed equitably. Potential negative impacts, such as increased inequality or social isolation, should be mitigated.

3. Stakeholders and Pain Points (What's at stake for who?)

Stakeholder	Their potential pain-points the KV could help illuminate
Individuals (citizens, patients, consumers)	Job Insecurity and Disruption, Intrusive monitoring, psychological strain, lack of educational opportunities, social isolation, difficulties in accessing essential services and healthcare, barriers to personal fulfilment.

Communities (urban and rural)	Infrastructure gaps and digital divide, imbalanced regional development, social disparities, environmental challenges, limited opportunities for cultural enrichment.
Healthcare providers	Integration and connectivity hurdles, Challenges in delivering quality care to remote areas, difficulties in managing patient data, the rising cost of healthcare, cybersecurity risks, technological complexity.
Educational institutions	Difficulties in providing personalized and accessible education, the digital divide, the need to adapt to new technologies, early age personal and social anxiety.
Businesses (various sectors)	Need to adapt to changing consumer demands, new forms of competitive pressures, blurred work-life boundaries, skill shortages
Governments and public sector	Challenges in addressing social inequalities, providing efficient public services, promoting economic development, political instability, inadequate social protection.

4. Impact

How Can Stakeholders Benefit (from engaging this value)?

Stakeholder	Positive and Negative Impacts
Individuals	Improved health and well-being, greater access to education and economic opportunities, stronger social connections, enhanced personal fulfilment. Negative impact: Exacerbation of existing inequalities, with some groups benefiting more than others; increased social isolation and digital divide for those who lack access to or skills to use 6G technologies. Mental health impacts from constant connectivity.
Communities	More liveable and sustainable environments, improved access to services and resources, greater social inclusion, and enhanced cultural vibrancy. Negative impact: Exacerbation of existing inequalities, with some groups benefiting more than others, lack of funds for access. Health services where the technology substitutes the human, isolation.
Healthcare providers	More efficient and effective healthcare delivery, improved patient outcomes, and reduced healthcare costs. Negative impact: increased need for care for the public due to mental health issues, increased stress or sedentary lifestyles. Health services where the technology substitutes the human, isolation.
Educational institutions	Enhanced learning experiences, greater accessibility to education, and improved student outcomes. Negative Impact: increased dependence on technology, leading to a decline in critical thinking and problem-solving skills.
Businesses	New market opportunities, increased productivity and innovation, and enhanced competitiveness. Negative Impact: always on culture, workplace surveillance, data extraction, planned obsolescence.

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Governments and the public sector	Improved public services, greater citizen engagement, and more sustainable economic and social development. Negative Impact: expansion of surveillance, algorithms without governance, vendor lock-in, loss of privacy in public spaces, overreliance on data-based technologies for public services, civic disengagement.

What Actions or Decisions Will Result?

e.g. who makes decisions around this objective? What kind of decisions?

Stakeholder	Who would use the results of assessments within this value frame? How?
Individuals (citizens, patients, consumers)	Can decide how they want 6G to fit into their daily lives, such as proactively manage their health using 6G-enabled tools, embrace flexible work environments, utilize immersive learning platforms, or decide to use smart community services.
Communities (urban and rural)	Can strategically invest in 6G-powered smart infrastructure to enhance liveability and sustainability. Can decide how to prioritise initiatives that bridge social and digital divides to ensure equitable access and foster cultural vibrancy.
Healthcare providers	Can decide to include telemedicine, remote diagnostics and surgical assistance to reach underserved areas, and use advanced data analytics to personalize care, optimize resources, and boost efficiency.
Educational institutions	Can decide on the best ways to integrate 6G-powered immersive technologies for personalized and accessible learning and invest in lifelong learning platforms to bridge the knowledge divide.
Businesses (various sectors)	Can better address consumer demands, unlock new business models, identify what harms might arise from new technologies on the market, identify ways to best support underserved communities.
Governments and public sector	Can decide how best to fund 6G infrastructure for underserved areas, boost access and economies, and implement data-driven urban planning and public safety with 6G for social cohesion and sustainable development. Can understand controversies that they need to act on.

5. Implications for Technology and Use Case/PoC

Use Cases/PoCs

Objective	How might it affect use cases?
Physical and Mental Health	6G must transition from simple data access to proactive well-being monitoring and humanization of care. It could enable real-time tracking of parameters like stress, mood, and fatigue to ensure safety. Use cases should

	avoid exacerbating the age of loneliness or social anxiety caused by excessive screen time. Key Question: Does this design improve protecting the user from mental and physical strain or social isolation?
Independence and Mobility	6G should be treated as multi-purpose platform, allowing the elderly or those with chronic illnesses to live independently through remote monitoring and autonomous transport. Focus not just on what the tech can do, but on the impacts of the life ability of the person, such as their capacity to perform daily living activities regardless of physical location. Key Question: Does the use case enhance functional autonomy for vulnerable groups in remote or rural areas?
Agency and Control	Systems must move avoid black box logic where algorithms or technology decides for humans. Incorporate human-in-the-loop frameworks that supports rather than replaces human decision-making. Key Question: Does this technology empower the individual's to be in control, or does it lead to intrusive monitoring?
Economic prosperity	Services should drive community wealth building, ensuring economic benefits are anchored locally rather than just for shareholders/industry. Distinguish between absolute growth and inclusive growth. Key Question: Does this service contribute to decent work and a living wage, or does it risk job polarisation and displacement?
Social Cohesion	Use cases must mitigate social fractures and prevent the creation of second-class citizens who are excluded from the digital fabric. Use cases should facilitate spontaneous, natural social interactions across distances, strengthen community resilience through shared digital spaces, and enable new forms of collaborative problem-solving that bridge geographical or social gaps. Key Question: Does this use case foster a sense of belonging or mattering or does it deepen societal polarisation?
Environmental and Home Quality	Uses cases can focus on environmental stewardship and monitoring, focusing on creating sensors, data, and related systems (house, city, environment) that users can directly employ to make key planning decisions, experts can use to make models for urban planning, environmental resilience, or transport, etc, that meet both environmental and human needs. Provide data that supports green procurement needs. Key Question: How can 6G-enabled monitoring improve the physical safety, resource efficiency, and overall liveability of the home environment?
Work-Life Balance	Uses cases could focus on digital boundaries, supporting the right to disconnect, improved worker control or employee autonomy. They could also balance this by focusing on issues of social isolation, engaging different kinds of tools that balance autonomy with interaction. Key Question: Does this technology encourage a constant-on culture, or does it provide the user with the agency to shut down work-related data flows?
Leisure and enriching cultural experiences	Use cases could foster partnerships between public, academic, cultural heritage, and industrial institutions, new forms of tourism and entertainment that protect local places, support long term growth instead of short-term entertainment. Key Question: How does the technology support long-term flourishing through immersive and active cultural participation?

Personal fulfilment	Use cases could have an overall focus on meaningful social interactions, creativity, and problem-solving, shifting away from short term happiness. They should focus on being human enablers rather than replacements of human agency. Key Question: Does the technology help individuals reach their full potential?

Technology

What technologies are implicated most in this value? What tech features or enablers may reflect or even reinforce this problem?

This list in the following table is not complete, but an initial derivation from the enablers listed in discussion with the KVIs based on what is being done currently in projects. It is expected to be expanded and refined, as a living resource.

Objective	What technology could be enablers?
Physical and Mental Health	• Enhancing Joint Communication and Sensing (JCAS) Capabilities • Sustainable AI/ML-based Control • **IoT-driven Monitoring (e.g. Wearable sensors)** • Real-time Zero-touch Control Loops Automation and Coordination System • Human-machine Intent Interface Design • **Assistive Technology (e.g. Occupational exoskeletons)**
Independence and Mobility	• **Autonomous Mobility (CCAM):** • **UAV Corridors: UAV-enabled networks** • **Reliable Coverage: Non-Terrestrial Networks (NTN)**
Agency and Control	• **User-Centric Trust Management:** • Network Security • Machine Learning Operations that support human-in-the-loop • AI Transparency and Auditability • **Privacy-aware data management frameworks** • **Distributed AI agents**
Economic prosperity	• AI-as-a-Service (AIaaS) • Machine Learning Operations (MLOps) • Cloud Transformation in 6G-quantum Architecture • Real-time Zero-touch Control Loops Automation and Coordination System • Distributed Ledgers • Multi-vendor Automation and Management • Intent-Based Orchestration and Lifecycle Management • **Cost of Ownership** • **Cell-free massive MIMO** • **AI-driven resource orchestration**
Social Cohesion	• Human-machine Intent Interface Design • **holographic telepresence** • Enhancing Joint Communication and Sensing (JCAS) Capabilities • AI Transparency and Auditability • Intent Translation and Provisioning • **Shared Digital Environments/Real-time Digital Twins**
Environmental and Home Quality	• **Smart Grids/6G-enabled grid balancing** • **Smart Home Sensors/Energy-neutral sensors** • **Environmental Monitoring** • **Sensing-aided connectivity**
Work-Life Integration	• **Ubiquitous connectivity** (e.g. via TN/NTN convergence) • **AR-driven remote support**

Leisure and enriching cultural experiences	• Enhancing Joint Communication and Sensing (JCAS) Capabilities • Sustainable AI/ML-based Control • AI-as-a-Service (AIaaS) • Machine Learning Operations (MLOps) • Human-machine Intent Interface Design • **XR/AR/holographic experiences**
Personal fulfilment	• Monitoring and Telemetry Framework • **AI-enabled edge services** • XR/AR-based learning technology • Human-machine Intent Interface Design

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KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Intuitive, user-friendly systems and services that reduce complexity, enhance usability, and improve accessibility for all users, measured by Network Safe Actions Auto Ratio (example from Safe-6G). Continuous, high-fidelity monitoring via in-body or wearable medical sensors, aims at early detection and personalized care solutions (example from AMBIENT-6G)	Business (e.g. industry R&D teams)	Service Availability, Agency and Control, Physical and Mental Health	Assess if the technical speeds and data are translating into a satisfying human experience, or actionable information. (Dimension 1)
Rationale: Low quality, complex, and unreliable tools add to stress, add to mental strain, and decrease agency. Early detection equally supports anticipation of harm, and thus allows actions to take place before they are most critical.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Reduction in caregiver stress, via continuous monitoring to show reduced anxiety and improved response to	Healthcare providers,	Agency and Control, Physical and	Learn where breaking points are in health care chains and identify if the

emergencies, in trials (Example from 6G-Path) Perception of enhanced autonomy for elderly, children and in general (women especially), via survey (example from HEXA-X-II). The ability of users (e.g., PPDR personnel) to use tools while keeping a focus on the final goals (saving lives and preventing harms) (example from FIDAL)	technology developers	Mental Health	technology is actually easing those points. Is more training needing or does the technology need different features. (Dimension 2)
Rationale: Reducing strain is a direct improvement to the worker's long-term health. Being able to do one's main activity (provide care) without being hindered by technology fosters a sense of empowerment.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Number of prevented traffic accidents, simulated or assessed by expert (from Target-X, ENVELOPE, VERGE) Reduced patient travel enabled by precision healthcare and telepresence, simulated (example from Hexa-X-II)	Healthcare providers	Physical and Mental Health, work-Life Balance	Learn if a system increased their capacity and what kinds of investments are needed to see results. (Dimension 3)
Rationale: Preventing accidents removes the physical and mental strain of high-risk work environments. Travel affects a person's and community's time and energy, especially for those in more vulnerable situations. Together both demonstrate a reduced burden of care.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Citizen and Expert Panel to allow residents to evaluate technology adoption and distributions strategies directly [20]. Trust in public institutions, as assessed via survey of stakeholders after explanation of how a service would use the new technology [14].	Government & public sector, Communities	Service Availability, Trust	To address communication activities around a technology, to identify if external oversight is needed to foster trust, to request increased transparency. (Dimension 4)
Rationale: These indicators involve direct democratic oversight, where residents and specialists deliberate on how a technology should be rolled out.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Select Social Progress Index (SPI) indictors that support assessing the readiness of society to benefit from the technology [21] [22]. Equity-Adjusted Net Health/Economic Benefit via, distributional Cost-Effectiveness Analysis [23] [11].	Businesses, Government	Economic prosperity, Institutional Trust, Social Cohesion	Deciding where to fund, subsidize, or tax broadband or training centres before deploying new technology Determining how much upskilling is needed

			before the tech can be safely used. (Dimension 5)
Rationale: One measures societal readiness (the context the technology enters), and the other measures equitable outcomes (the actual impact of the technology). Combined they help assess how the technology might be able to support social growth as well as the elements in society that might need to shift to encourage that growth.			

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BUILDING KNOWLEDGE AND SKILLS FOR AND BY 6G

1. Key Value Definition

Pillar: Societal

KV: Building Knowledge and Skills

Explanation of KV:

Building knowledge and skills is a cornerstone of European social policy, representing a fundamental commitment to human capital as the driver of a prosperous, fair, and resilient society. It is key to a beneficial 6G-enabled economy.

This value is defined as the process of equipping individuals with the understanding, competencies, values, and attitudes necessary to foster economic competitiveness, social solidarity, and active democratic participation. This principle is formally enshrined within the European Pillar of Social Rights and the European Skills Agenda, which explicitly prioritises general education, professional training, and lifelong learning as essential rights for all citizens. This includes a workforce adept at leveraging new, including 6G, technologies to drive economic and social stability [1]. It also includes citizens that possess the digital literacy, general skills, and resilience to transform disruptive technologies into tools for personal and collective advancement and equip vulnerable groups to meet their own social needs [2] [3] [4].

This foundation extends far beyond mere technical proficiency. Rather, this includes four interdependent dimensions: technical, aesthetics (e.g. creativity), ethical (e.g. responsibility) and political (e.g. citizenship and democracy) [4]. It encompasses a proactive approach to cultivating the competencies necessary for technological innovation, especially that around 6G, including technical skills like cybersecurity but also soft skills like critical thinking, creativity, and complex problem-solving [1]. Developing these skills is essential for individuals to understand how knowledge is produced, how insights are shared across diverse teams or with diverse publics, and how innovation occurs, particularly important as 6G incorporates emergent technologies like AI [5]. By empowering citizens with these competencies, they are enabled to become active co-creators of a future that is both sustainable and equitable, capable of navigating complexity and contributing meaningfully to societal progress. This holistic approach ensures that human development remains at the heart of Europe's social and economic model.

2. Sub-Objectives

- **Promoting digital literacy and skills among all citizens**: This is foundational knowledge and competencies, motivation, and resilience required for individuals to actively generate social value from 6G. Without it, individuals cannot access essential online services, engage in the 6G-enabled digital economy, make well-informed decisions on the use of 6G-enabled products/services towards their wellbeing, or understand how knowledge is produced and shared in the digital age [2] [3] [6]. Nor can then contribute to or inform the shape of 6G innovation. It is more than a technical checklist [7].
- **Empower people to make informed decisions in digital contexts.** A spectrum of 6G skills required for effective civic participation [8]. Education and media literacy focused on critical thinking and ethical awareness shapes active citizens capable of participating in public debate, combating disinformation, and to make informed decisions to improve their well-being [9].

- **Developing a skilled workforce**: A skilled workforce is the direct output of effective knowledge and skill building. Successful 6G innovation and implementation requires multi-disciplinary teams that cover competencies beyond pure technical expertise, such as ethics, data science, and public communication [10]. Such diverse and complementary skills ensure there are individuals capable of creating, applying, and benefiting from 6G. Workforces will need skills in electronic engineering and software engineering [11], as well as socio-technical skills, such as empathy and social responsibility [7]. Upskilling as a vital non-technical enabler, particularly around communication and engagement with the public [12] [13]. This potentially requires revamped academic curricula and industry-academia partnerships to bridge existing gaps, as well as continuous learning [1].
- **Fostering innovation and creativity**: In order to have the possibility of using 6G to create (or support) new innovative services, new forms of collaboration between disciplines will be needed in order to improve long term innovation and impact [14]. Innovation and creativity are engines of new knowledge production, research, and insight generation, and are crucial for the use of 6G technologies to foster prosperity and competitiveness. As automation, multi-sensory experiences, and AI become more deeply integrated into 6G, human-centric skills such as creativity and emotional intelligence will become invaluable [1]. The necessary knowledge sharing for this requires a culture of trust and alignment of values between partners [15].

Relevance to 6G: The successful development and deployment of 6G will depend heavily on the availability of a skilled workforce and a digitally literate population. Without adequate investment in education and training, there is a risk that the potential benefits of 6G will not be fully realized, and that existing inequalities will be exacerbated. The SNS JU emphasizes the need for advanced skills in areas such as AI, cybersecurity, and network management to support the deployment of 6G.

3. Stakeholders and Pain Points (What's at stake for who?)

Stakeholder	Their potential pain-points the KV could help illuminate
Citizens	Lack of relevant skills and motivation for 6G-related jobs; difficulty in adapting to new technologies/fear of overload; exclusion from the digital economy due to lack of digital literacy; lack of understanding of 6G in order to shape industry choices; lack of educational resources to become active citizens; fear of stigma for needing support in using digital tools.
Engineers/6G technologists	Disciplinary and work force silos, lack of funding or structure to support the essential cross-disciplinary outreach and public engagement needed for technology acceptance.
Educational institutions	Difficulty in updating curricula to keep pace with technological advancements, lack of resources to provide adequate training, challenges in reaching diverse learners. Limited capacity to provide digital literacy training, difficulty in reaching marginalized communities. Constant need to upskills educators to keep up with 6G innovation, finding and retaining qualified staff.
Businesses	Shortage of qualified workers, difficulty in finding employees with the necessary skills, need to invest in employee training and development, uncertain or low return on investment.
Governments and public sector	Challenges in developing effective education and training policies, need to invest in infrastructure and resources, difficulty in measuring the impact of training programs, developing knowledge standards in a multi-disciplinary space, regulation is often behind the technology, finding the funds to support digital mandates. The need for improved local skills to support digital sovereignty.

Research Organisations	Lack of funding for long-term research, difficulty in accessing relevant data and resources, challenges in translating research findings into practical applications, and the need to collaborate across disciplines and institutions.

4. Impact

How Can Stakeholders Benefit (from engaging this value)?

Positive impacts are the benefits experienced if the potential of 6G is engaged or 6G is able to be used to its fullest. Negative impacts are the opposite: what happens if the potential of 6G is not reached? Or, e.g. what happens if too much priority is given to technology skills at the expense of soft skills or the motivational dimensions of learning?

Stakeholder	Positive and Negative Impacts
Citizens	Enhanced employability, increased earning potential, greater ability to participate in the digital economy or meet one's own social needs, improved quality of life, independence, and ability for civic engagement. Negative impacts: widening skills gap with reduced earnings and career prospects, individuals lacking the necessary expertise to participate in a 6G-enabled economy, chronic cognitive overload and anxiety.
Engineers/6G technologists	New career opportunities, leading a digital revolution, becoming an essential knowledge worker, ability to merge technical skills with human creativity. Negative impact: new ethical accountabilities, new public responsibilities, constant threat of skill obsolescence and demand for continuous learning, increasingly complex working environments.
Educational institutions	Increased reach, relevance, and cutting-edge nature of their programs, increased ability to engage cross-domain research and education, improved student outcomes, and enhanced reputation. Negative impact: finding and retaining qualified staff, increased costs for cross-disciplinary activities, new educational models required.
Businesses	Competitive advantage, access to a larger pool of qualified workers, increased productivity and innovation, and enhanced competitiveness. Negative impact: Increased unemployment and social exclusion for those without digital literacy, increased staff education burdens and costs, increased operational complexity.
Governments and public sector	A more skilled and adaptable workforce, tools to bridge digital divides, increased economic growth, reduced social inequality. Negative impact: regulatory lag, tensions between national initiatives and local priorities. Failure to build skills creates a sovereignty risk.
Research Organisations	Increased funding opportunities, access to cutting-edge resources and data, enhanced collaboration across disciplines and institutions, and greater impact of their research findings on real-world applications. Negative impact: increased cost, increased public communication needs, increased need for physical infrastructure to support knowledge.

What Actions or Decisions Will Result?

e.g. who makes decisions around this objective? What kind of decisions?

Stakeholder	Who would use the results of assessments within this value frame? How?

Citizens	To make informed decisions about their education and career paths, and to identify opportunities for lifelong learning. To better assess if a technology will provide them benefits.
Engineers/6G technologists	To make informed decisions about when to offer public trainings or when to seek their own job training, when to shift design due to specific literacy capabilities of stakeholders, better assess how to reduce mental fatigue for 6G users, how to engage the practicalities of human-in-the-loop.
Educational institutions	To design curricula and training programs that align with the skills needs of the 6G era.
Businesses	To inform their hiring and training strategies, and to identify areas where investment in employee development is needed.
Governments and public sector	To develop policies that promote digital literacy, support workforce development, and ensure equitable access to education and training. To prioritize projects that promote skills development and address the digital divide.
Research Organisations	To identify key knowledge gaps, prioritize research areas, and secure funding for projects that advance 6G-related knowledge and skills. To evaluate the impact of their research and communicate their findings to broader audiences, including policymakers, industry stakeholders, and the general public.

5. Implications for Technology and Use Case/PoC

Use Cases/PoCs

Objective	How might it affect use cases?
Promoting digital literacy and skills among all citizens	Recognizes that simply having access is not enough; use cases must actively facilitate the development of meaningful digital competencies across diverse demographics, addressing barriers like confidence, relevance, and language, particularly where digital literacy is limited. Use cases could focus on how they can improve learning opportunities for marginalised communities. *Key Question: How can training and education in 6G or via 6G improve the impact and reach of 6G technologies?*
Empower people to make informed decisions in digital contexts	Goes beyond mere benefits of connectivity to address how knowledge about 6G actively can impact 6G deserts or be catalyst for a more just society. *Key Question: How can training and skills in 6G or via 6G empower people to make their lives better?*
Developing a skilled workforce	Focus on how 6G actively facilitates the acquisition and application of complex skills by workers, making learning more effective, accessible, and responsive to individual needs and industry shifts. They could emphasize engagement, practical experience, and adaptability. They could focus on identifying the future skills and knowledge needed to ensure benefits and mitigate harms. *Key Questions: How can 6G technologies improve training and education for workers and workplaces? What kind of training or education improves the benefits 6G technologies can offer workers and workplaces?*
Fostering innovation and creativity	How 6G can directly augment human cognitive processes, collaboration, and experimentation, lowering barriers to entry for creative endeavours and innovative problem-solving for a wider range of individuals. How leveraging human-centric skills (e.g. creativity, emotional intelligence)

	improves 6G impacts. Use cases could be prioritised that have a potential for social return on investment, rather than just profit or cost. *Key Question: What kinds of training and skills in 6G or via 6G can support augmenting human ingenuity and broaden access to innovation?*

Technology

What technologies are implicated most in this value? What tech features or enablers may reflect or even reinforce this problem?

Objective	Technology Enabler
Promoting digital literacy and skills among all citizens	• Extended Reality (XR), to engage engagement and skill development. • Augmented Reality (XR), to increase educational opportunities • Non-Terrestrial Networks (NTN), to ensure that students in remote regions can access virtual classrooms and labs • Integrated Sensing and Communication (ISAC) to allow students to observe events remotely • Virtual Base Stations, to provide immersive training environments • AI-as-a-Service (AIaaS) • Machine Learning Operations • Programmable Network Monitoring and Telemetry
Empower people to make informed decisions in digital contexts	• AI/AI-as-a-Service (AIaaS), that provides high-level explanations for the network's automated decision or real-time views of network activity/footprint in ways that supports decision-making. • Network Observability to allow stakeholders to make informed decisions about resource management
Developing a skilled workforce	• Immersive video, to simulate different working scenarios • Haptic Sensing, to raise the quality of training by incorporating the sense of touch. • AR and XR, to train with remote expert supervision • Programmable logic controller, networking monitoring, and telemetry functions to the edge, to allow Industry 4.0 workers to train on flexible systems. • Synergetic Orchestration Mechanisms for the Computing Continuum • Closed loop coordination for intent management • Intent-Based Orchestration and Lifecycle Management
Fostering innovation and creativity	• Mixed Reality platforms, to enable stakeholders from different locations interact together. • Network as Code and Developer Portals to allow developers without expertise to create novel applications • Machine Learning Operations • Network Digital Twins Creation Mechanisms

Some enablers are included could also negatively affect the value/objective in question. While these enablers do not inherently block skill development, without human-in-the-loop options, documentation, and training interfaces, they risk deskilling the workforce and shifting expertise to only a few system designers.

6. Key Value Indicators (KVIs)

Grounding Framework

What frameworks does the literature provide to support which KVIs matter for your objective/stakeholder/decision combination? What elements do your stakeholders say need to be covered?

(For this exemplar document, see key value, objectives, and references. Were there to be a specific use of this for a project, it is expected that additional research would be done to explain why each indicator was chosen, or how the selected indicators, as a group, are interrelated to the broader project goals. See the inclusivity sheet for a partial example.)

KVI Formulation

Exemplar KVIs: These are not intended to be standards or to be used by all projects or necessarily ones that actually get used. These exemplars offer ideal qualities that can be imitated to develop good KVIs. Each is presented as a stakeholder/objective pairing (e.g. what stakeholder is being considered or who might use it, and the objective within the value) to help narrow the focus.

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Accuracy and effectiveness of real-time language understanding and translation capabilities (example from 6G-Cloud) Increased number of educational products available as immersive services (example from ENVELOPE)	Engineers/6G technologists	Promoting digital literacy and skills among all citizens	Is the technology sufficient to meet a use case? (Dimension 1)
Rationale: Technologically, the quality, effectiveness, and number of tools out there for diverse audiences to use that are of high quality has the potential to enable improved learning and skills. While alone it is insufficient to make a claim about improved skills, it is can be a foundational element.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Perceived usefulness for teaching and learning experience (example from 6G-Path, TrialsNET) Perceived quality of virtual services for education (example from VERGE)	Citizen	Developing a skilled workforce	Decide if they want to invest in the new technology to improve their education. (Dimension 2)
Rationale: If the citizen perceives the learning experience as significantly better than traditional methods, they will more likely decide to invest resources in it, rather than stick with good enough previous tools.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Increased availability of quality education resources (example from 6G-Senses)	Research Organisations	Fostering innovation and creativity	Decide how to redirect their budget, e.g. from network-based research to social-based research.

Predicted adoption rate of educational programs made available via the 6G service (example from HEXA-X-II)			(Dimension 3)
Rationale: Since creativity requires soft skills not just technical skills, understanding the potential uptake and availability of resources, as supported by 6G technologies, would allow research organisations to better assess how to shift their own programmes and funding to support real-world applications. For example, if the data shows that citizens want the technology, but social groups are not adopting it, the organization could decide to fund more social research to better understand the situation.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
The fit between current regional education provision and future knowledge and skill profiles required for the 6G technology in question [11]. The predicted number of 6G-enabled access points available per population in target areas [16].	Educational institutions	Promoting digital literacy and skills among all citizens	whether to invest in traditional classrooms or mobile learning. How to partner with the wider region to share their network resources to balance skills and technology. (Dimension 4)
Rationale: Combining regional skill gap analysis with infrastructure density supports geospatial and redistributive decisions in such a way that enables a focus on how schools and universities can help prevent a new 6G digital divide.			

KVI	Stakeholder Impacted	Objective Aimed At	Decision it Supports
Price of connectivity compared to other commodities, like 1 kg of rice [16]. Local communities, after training, able to manage what are the most important applications for them, as assessed by local and external experts [17].	Governments and public sector	Empower people to make informed decisions in digital contexts	Decide if they regulate or finance 6G like other educational support networks? Decide on the national 6G education strategy. (Dimension 5)
Rationale: Affordability provides the opportunity to learn, while community self-management provides the evidence of agency. They provide the evidence needed for governments to decide between maintaining the status quo or investing in a transformative national 6G education strategy, and how centralised such management needs to be.			

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