6G4SOCIETY

TOWARDS A SOCIALLY ACCEPTED AND SUSTAINABLE 6G

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Operational Brief on Values, Impact, Acceptance, Sustainability in 6G

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1. Highlights

The 6G4Society initiative has focused specifically on investigating the social dimensions of the 6G technology environment. More specifically, 6G4Society examined the way 6G development interacts with societal needs, ethical considerations, and sustainability objectives, addressing the central question of how 6G development can be guided to ensure meaningful social and environmental contributions.

This Operational Brief is built upon, and draws from, the direct and participatory observational experience of 6G4Society within the SNS JU project and expert community. The cultural framework and the consolidated practices where innovation unfolds – including existing economic models, consolidated innovation practices, and governance arrangements – constitute its primary objects of observation and critical analysis.

Its purpose is to clarify what **cultural, governance and methodological conditions** are truly conducive to research and innovation practices that are sustainable under the economic, environmental, and social dimensions. It does so by providing guidance on how driving values, societal impact, social acceptance, and sustainability should be explored, identified, interpreted, and operationalised across research and innovation processes, especially in early-stage and low-TRL 6G development.

In relation to the set of 6G4Society Operational Briefs, this Operational Brief addresses a different and complementary level of action. While the Operational Briefs on Privacy, Inclusion, and Technological Sovereignty translate defined societal priorities into specific technical solutions or operational choices for industry, the present brief **elaborates on the overarching governance and methodological non-technical practices** through which such solutions and choices are conceived and shaped. Doing this, it establishes the conceptual, organisational, and cultural foundations to ensure that any vertical operational measures – such as those we propose on privacy, inclusion, and technological sovereignty – are not applied in isolation or as compliance-driven add-ons, and unfold consistently and in alignment with European policy objectives and with Responsible Research and Innovation principles.

In this sense, the present brief functions as an enabling and orientation tool, supporting industry and research actors in embedding societal values into decision-making and design processes, impact exploration and assessment practices, sustainability, and value creation strategies.

Against this backdrop, this Operational Brief elaborates on this central question:

HOW DOES A LIMITED INTEGRATION OF SOCIAL DIMENSIONS DURING INNOVATION NARROW THE INSTITUTIONAL AND OPERATIONAL FRAMING OF SUSTAINABILITY, AND TO WHAT EXTENT DOES THIS HINDER THE ACHIEVEMENT OF A TRULY HOLISTIC SUSTAINABILITY?

Risks identified relate to values alignment, awareness about societal implications, and the overall approach to sustainability.

Operational recommendations are proposed around three main topics: Values; Impact; Sustainability. They revolve around the following aspects:

- The need to make social desirability a transformative driver within the technological process;
- The need of specialised competences to manage the complex relationship between values and technology, so as to meaningfully reflect social values that count in the innovation process;
- Approaches to proactively anticipate, assess, and guide the broader societal impacts of future network technologies;
- Aspects worth to be investigated from an ethical and sociological point of view in the context of immersive communication environments;
- The need to comprehensively interpret environmental and social sustainability in research and innovation processes;
- The transition towards sustainability as an integral value and strategic driver within innovation processes.

2.Context of the Issue

The 5G Infrastructure Association described 6G as "one of the basic foundations of human societies of the future." [1], underscoring the pervasive and profound societal impact 6G is expected to trigger. The magnitude of this transformative potential is matched by significant commitments as to its role and mission in society. As elaborated in both institutional and industrial strategic documents, 6G is envisioned as a transformative technology whose ambition extends beyond technological advancement and performance metrics. 6G is considered for its potential to enable a wide range of critical services across multiple sectors, and in particular, to **enable sustainability**, as it can support major polluting sectors—such as transport, agriculture, and construction—in reducing their environmental footprint.

A major conceptual shift accompanies these goals, represented by the expressed ambition of incorporating value-oriented objectives in the design paradigm as of the onset, representing **intangible yet fundamental human and societal needs.** This evolution is explicitly elaborated in the strategic orientations of the SNS-JU, which positions future smart networks and services in support of European policy priorities, including the Green Deal, and of a sustainable and secure internet [2]. Further, the European Sustainability lighthouse project Sustain-6G concretely collects this commitment [3], with the mission of exploring 6G sustainability in a holistic way across the three environmental, economic, and social pillars. Altogether these developments signal a profound **cultural shift,** conceiving the advancement of next-generation connectivity as inseparable from the responsibility to foster societal well-being, protect fundamental rights, and support long-term planetary health.

It is within the space between the pervasive transformative potential attributed to 6G, and the desire to build a system based on social and ethics values, that the reflections of this brief develop. **Triangulating the concepts of values, impact and sustainability**, 6G4Society has explored and critically interpreted the work conducted within the SNS-JU and 6G-IA ecosystem.

The first issue relates to the dimension of values, to how it influences both high-level strategic orientations and the practice of technology development. Dealing with values is inherently complex because values—whether at the individual, corporate, or institutional level—are often implicit and rarely acknowledged in a deliberate or conscious way. This difficulty translates into **biases and limitations** in how the strategic level and the implementation level reflect social values. The result is that research and innovation (R&I) practices risk projecting a **narrow-scoped vision of possible futures** to be designed and pursued, by overlooking the diversity of societal perspectives and aspirations. This translates into missed opportunities for a more disruptive and inclusive explorations of how human and societal development might evolve.

At the level of **technology implementation,** value related considerations raise significant challenges. Despite innovation actors being increasingly expected to define and manage the value dimension within technology development processes, evidence from 6G4Society confirms that many technical experts still lack the **multidisciplinary expertise** needed to navigate the complex interplay between values and technology, and to recognise how cultural values shape innovation, especially at low TRL levels.

2. Context of the Issue

This **competence gap,** combined with challenges in identifying and engaging relevant stakeholders early on, results in value-related considerations being **addressed predominantly at later TRL stages,** and in a partial and/or **biased reflection of social values** in the innovation process. The potential for value-based design at the earliest stages of technology development, when flexibility is greatest, is therefore constrained, together with the possibility of truly steering technological development toward ethics, values, and social good considerations in technology design.

The second issue highlighted is in the way **impact** is described and addressed within the current technical R&I culture. What emerged is the tendency to act on the **assumption of a beneficial effect** of technology as concerns its impact on society, with **limited awareness of the potential negative and unintended social implications** that technologies may generate beyond their intended or sector-specific impacts. As a result, a number of social impacts – related to the creation of broader value for society or linked to the transformative impact of the digital world on individuals – are often not sufficiently taken into consideration and reflected in the R&I design or assessment processes. This affects - and compromises - in turn: the **definition and calculation of costs and benefits, of pains and gains;** the capacity of identifying in due time social values or **rights that are either at risk,** or that require a new recognition and protection; the breath and scope of KVIs and their capacity to capture longer-term impacts, beyond the project lifetime. Overall, these aspects can compromise the capacity of comprehensively scoping and addressing the **social sustainability** dimensions. More in particular, immersive communication environment has been recognised as an environment liable of profoundly **reshaping society and human experience, calling for a more responsible, anticipatory, and reflexive approach** to innovation, in line with the European Commission strategy on Web 4.0 and Virtual Worlds (the "metaverse") [4].

Important and specific dimensions have been identified in the context of 6G4Society work, through the lenses of social theory and media studies, highlighting needs and opportunities for further ethical and social research. These dimensions include: the reconfigured relationship between body, space, and environment; the blurred boundaries between reality and imagination in the virtual world; the relationship between physical and virtual social space; the perpetration of stereotypes in the virtual world; the role of mediation in immersive communication environments [5].

The third and last dimension analysed is sustainability - how it is addressed within the industrial R&I culture, as a value and as a set of practices. Overall, sustainability continues to be framed often as a **trade-off,** or as a secondary or external consideration, rather than being integrated as a core priority. It remains frequently associated with notions of **constraint, burden, or renunciation,** and is often perceived as standing in tension with objectives such as competitiveness, performance, and profitability, as well as with creativity and innovation potential. In most business contexts, sustainability **has not yet evolved into a genuine guiding principle** and still fails to contribute to shaping innovation strategic objectives in a transformative way, informing the design and development of products or business models, and ultimately stimulating a real paradigm shift. This partly derives from sustainability not being widely recognised as a **source of business value in terms of market positioning, reputation,** or product and service offerings. This scenario points to two important aspects: on a practical side, sustainability risks to remains peripheral to industrial research and innovation agendas, core business models, and decision-making processes, resulting in only a **superficial and compliance-oriented** exercise, failing to evolve into a genuine driving force and source of business value.

On a cultural side, this scenario em-bodies a disconnect from the fundamental values that should underpin responsible and future-oriented development, reflecting the **persistence of a deeply rooted cultural and value framework, in which competitiveness, profitability and performance hold a higher place in the value hierarchy.**

Final considerations regard the way in which the concepts of **social and environmental sustainability is interpreted** in the context of R&I innovation agendas and practice. Some nuances and aspects considered constitutive of these concepts are currently not taken into sufficient account and not reflected into R&I processes, for a combination of policy-related and competence-related reasons - notably: a low priority attributed to these topics within programmatic research priorities (work programmes) and **missing specialist competences** to properly interpreting and then addressing some specific aspects.

However, a proper understanding of these additional aspects remains relevant, to avoid negative social and environmental rebound effects from the digital transformation. Also, the capacity to devise concrete **co-optimisation** strategies, [6], as a way to guarantee a more **holistic alignment** between technological advancements and broader sustainability objectives, remains a critical challenge within the SNS JU community. Appropriate support mechanisms are needed to support industry in this effort, to avoid treating conflicting variables as competing interests, and to ensure that a performance-oriented culture does not overshadow broader sustainability considerations.
6G4Sociey underscores how any such limitations - on capturing social needs, understanding societal impact, incorporating values in the innovation process - may **relapse on the way sustainability is scoped and enabled,** ultimately **hampering** the possibility to realise sustainability **in a holistic way.** The way forward demands **awareness, openness to challenge assumptions,** and ultimately **dedicated guidance** and capacity-building.

VALUES
3.Operational Recommendations

R1 Guidance and multidisciplinary cooperation is needed to operationalise values in technology

Values represent enduring priorities that function both as individual guiding principles, and as shared cultural frameworks. They motivate actions, shape attitudes, and define what is deemed desirable or negative in a given group or society.
In the context of research and development, when development teams choose to prioritise certain features of 6G, they are not just making technical choices; they are transferring and reinforcing assumptions about what matters most in society. This is why workng with values has to do with taking active steering about the directions and impact of technological development in society, actively orienting societal transformation.
Addressing values throughout the innovation process allows to link technological advancements to societal legitimacy and policy objectives; it involves, for example:

- **Taking an aware stance on which values promoting and reinforcing into society:** values can act as human-centric framing (or, even better, planet-centric), to be used to guide design decisions. They can also be used as "balance needle" to weight trade-offs, assess outcomes and evaluate impacts.
- **Being responsive to societal priorities:** values are at the basis of any discussion about desired outcomes and priorities amongst different stakeholders.
- **Identifying in due time social values or rights at risk, or requiring a new recognition and protection.** We can look at values through anticipatory perspectives, trying to anticipate unintended consequences and build public trust in 6G systems.

A first, key competence concerns the ability to work with values and to operationalise them throughout the innovation process, making them operative criteria. In this social sciences can support practitioners with practical and structured guidance, to facilitate a systematic engagement with values and their integration throughout the technology development and innovation process. This is how a social science perspective on technology can contribute (see also [7] and [8]):

- **Elicitation and identification of the values that are relevant in a given technology context** – values are often abstract, multidimensional, and vary throughout contexts, cultures, different social groups, sectors. It is important to identify with awareness which are the driving principles that (often implicitly and unknowingly) orient strategic or technical decisions and define the wider purpose of a project. Such exploration, therefore, helps to uncover assumptions taken for granted, and the deeper cultural and ethical frameworks guiding technological choices. Also, will allow to choose which values should be reinforced. From these considerations will also depend how conflicting values and balance trade-offs will be managed -since advancing one value may impose costs on another.
- **Exploring stakeholder views, and managing conflicting interests.** Different stakeholders may prioritise different values. Mapping these different perspectives across stakeholders is an integral part of the work on values, to explore the different interests and priorities at stake. This may entail the recognition of conflicting interests among stakeholders, which should be acknowledged and managed. These aspects will be dealt with in more detail in the following recommendation.
- **Mastering the interplay between Value and Values.** Values are the underlying principles that drive and shape choices and decisions; they should not be confused with the concept of value, meant as the creation of a positive repercussion at different levels of society, often as a consequence of the achievement of end-goals. While the two concepts are linked, they are operationalised in different ways in innovation processes.

Identification of meaningful key value indicators (KVIs), and of trajectories and thresholds to assess the presence of those values. The design of appropriate indicators is essential for identifying impacts at the social or societal level and for assessing the extent to which specific values are supported and reinforced within society. Evidence shows considerable heterogeneity in how values are defined and assessed, leading to difficulties in comparing outcomes across studies. Most importantly, the analysis highlights how methods solely oriented toward achieving predefined targets may be inadequate for capturing and engaging with values. A different conceptualisation of assessment is needed, more related to outlining a trajectory rather than capturing a single finish line; more focused on identifying proxies to demonstrate that a quality exists, rather than establishing a precise quantity. Relevant concepts for this endeavour become, therefore, thresholds (the minimum acceptable presence of a value); momentum indicators (the speed and scale of a positive change); diffusion indicators (the spread of a value to new areas). Also, the focus could shift towards maturity models -a totally different way of showing progress. Overall, in this field, the provision of clear rationales, methodological steps, and examples are needed, to help teams navigate different options, and explore different approaches to measurement or assessment, notably less numerical or quantitative.

Understanding when and how in the innovation process (in which phase, and in which way) values exert an influence. The short answer is "always". Values influence technology development directions and objectives. Values get to orient strategic choices on what technology to prioritise, influence problem-solving approaches, the choice of what use cases to consider, whose voice to include for consultation, and design and functionality decisions. Also, they shape content development. All these levels produce social impact. A key competence lies, therefore, on the capacity to understand what to include, where and when throughout the specificities of the project context. Understanding how values may be concretely reflected into a technology, service or product, and in different phases of the process, is crucial to choose among different options, and actively steer the development process. For this reason, it is important that values are not operationalised only at the end of the project, but as of the conception phase, to become guiding principles. This is needed to not only reveal hidden biases, to build inclusive impact, and builds the necessary transparency for trust.

Integrate values into design and development processes. This attain to navigating the different ways a value can find relevance and be operationalised throughout the innovation process, as of the earliest stages of technology conception (at low TRL), through the translation into appropriate and specific requirements. The different ways to reflect a value into the innovation process may depend on considerations related to the specific socio-technical context.

R2 Whose values? The importance of questioning assumptions in technological innovation paths

In its own mission statement, the SNS JU has set objectives to ensure a human-centric and sustainable internet and to meet public policy and societal requirements alongside technical and market targets (for example in areas like security, energy efficiency, health and inclusion). This commitment, grounded on the awareness that business exerts a profound influence on society in terms of impact generated, entails the capacity to involve and meaningfully integrate external voices to shape innovation agendas and therefore the future of society.

However, despite these valuable intentions, evidence collected through observations show that stakeholder engagement practices are often addressed in ways **that limit their potential to shape the initial design and strategic direction** of activities. In practice innovation paths in the telecom sector appear as the reflection of the interests and values of a narrow set of actors, with stakeholders often consulted at advanced stages of the process, after key technical and business decisions have been made, **expressing only validation purposes.**

In this way, the main substantial and initial drivers in innovation remain **technological feasibility** and **market potential,** or the application of existing technologies. This dynamic potentially introduces biases on which foundational elements (technological or otherwise) are prioritised, and therefore on how the future is framed; for example, the persistence of a paradigm that treats hyperconnectivity as an unquestioned and intrinsic value is automatically reinforced.

For industry innovation pathways and choices may appear clear and unavoidable, as naturally reflecting their prevailing values and priorities. Similarly, society - meant as the beneficiaries and users of innovation - may tend to adapt passively to proposed technological future scenarios, without questioning (especially before negative impacts occur) the existence of alternative possibilities or unexplored options.

Although some technological paths may appear inevitable, however, they can be questioned, and interpreted as the products of specific cultural and historical contexts: each choice or step in the innovation pathway is the result of an implicit cultural framework, underpinned by a series of cultural values, often unrecognised (see also [7]).

To summarise, awareness on the relativity of innovation path is still limited; and low awareness on this translates into limitation as concerns the envisioning of our future.

It is key to question whose values are being prioritised. In order to reinforce the capacity to steer with awareness which social values are being actually promoted and reinforced in society, or left behind, it is necessary to question whether the value and values projected from industry actually correspond to social needs and priorities, including those of underrepresented or excluded groups. Also, attention should be given to recognise who holds decision-making power around the technology and how those decisions shape its development and deployment.

It is essential to break away from the entrenched assumptions that govern current technological innovation paths. Awareness on the relativity of innovation path should be reinforced within the innovation culture, broadening and strengthening the capacity of imagining future solutions that are truly tailored to actual societal needs. Research and innovation orientations, technological priorities, use-case prioritisation, and approaches to problem-solving should be shaped around different assumptions, questioning on the one hand the need for certain innovations, and understanding - on the other hand - the orientation and priorities of society. Underlying assumptions are to be examined, discussed, and, where necessary, revised.

3. Operational Recommendations

VALUES

R3 Whose are these values? Making social desirability a disruptive and operative criterion

Robust mechanisms for collecting pluralistic inputs have not yet become an integral part of industrial culture. This **limitation in capturing a fair diversity of perspectives** and visions of what constitutes a desirable future has con-sequences on two interconnected levels. First, a lack of fairness and transparency in deci-sion-making processes can negatively affect relationships among stakeholders, ultimately **undermining trust.** Second, limited exploration of alternative solutions, social visions, and col-lective needs tends to result in innovation trajectories that primarily reflect the priorities, values, and perspectives of industrial, tech-nical, and scientific actors, who represent **only a subset of society.**

As a result, strategic decisions guiding tech-nological development remain anchored in the viewpoints of a restricted group of stake-holders. This creates a **bias in the definition of priorities,** with future orientations shaped pre-dominantly by what technology is capable of delivering rather than by what society collec-tively desires or requires. Such a dynamic reinforces technology-driven and perform-ance-oriented value frameworks, privileging technical rationales (e.g., performance or fea-sibility) and economic considerations (e.g., profitability) over broader societal concerns.

Most importantly, when the diversity of socie-tal perspectives and communities is not ade-quately considered, the range of possible futures envisioned through research and inno-vation processes becomes increasingly nar-row. The capacity to explore **alternative or disruptive pathways for human and societal development** is weakened. These alternative pathways could be grounded in different pri-orities and aspirations—focusing on what is socially desirable or genuinely needed—and could support value-driven outcomes such as human well-being, equity, and sustainability.

Developing technologies that meaningfully ad-dress social values therefore requires giving voice, throughout the entire innovation life-cycle, to **values and needs that may fall out-side mainstream industrial and innovation cul-tures.**

This includes reflecting such perspectives in how technologies are imagined, funded, and deployed. Ultimately, the goal should be to promote innovation that is guided as much by societal impact as by technological potential, thereby unlocking new avenues for innovation grounded in what society deeply and genuinely needs.

Social desirability should become a key driver in defining research priorities and guiding decision-making. This requires openness to capturing the diversity of needs across society, as well as alternative visions and priorities regarding desired lifestyles and the ways in which human and societal development may evolve or be transformed—including pathways that depart from dominant or taken-for-granted assumptions. It implies the possibility of consciously selecting and prioritizing specific human values and future visions, independently of immediate or technology-driven market opportunities. Achieving this shift calls for a broader cultural change and a redefinition of the role of technology in society, moving beyond a predominantly technology-driven paradigm and recognizing that decisions made at each design phase actively shape future societies.

3. Operational Recommendations

The concept of need should be redefined. It should not be understood only in the context of technology push, where – for the purpose of market success – demand and perception of need in consumers can be induced and stimulated through the introduction of supply, even in absence of a clearly expressed social need. In a social desirability context, exploring needs means understanding the orientation and priorities of society, also independently from immediate or technology-driven market opportunities. This may lead to question the path towards certain innovations.

The perspective of who has a legitimate stake in technological innovation should be extended beyond the community of business, technical and industrial specialists and beyond final users, including those social groups or communities that may be indirectly or negatively impacted – or which perceive themselves as negatively impacted. Only in this way, social desirability and societal values can emerge as fully transformative elements within the prevailing technological paradigm.

Formal decision-making tools can support the exploration and management of plural and divergent positions – such as multi-criteria decision analysis, Delphi techniques, or the analytical hierarchy process. These tools can also complement problem-definition and vision-building approaches by helping to clarify shared goals and challenges.

Public controversies around science and technology provide a valuable entry point into understanding what matters to social groups that may be affected by technological developments, as well as the underlying values attached to social and environmental contexts beyond purely economic considerations (e.g., landscape preservation, quietness, or unspoiled nature, as highlighted in expert interviews). The analysis of controversies—ranging from public scepticism to more explicit forms of opposition—can help elicit points of tension in how different stakeholders prioritise values, as well as reveal the diverse interpretations and meanings that different social groups attribute to the same value. For this reason, controversial views should be constructively acknowledged and managed rather than dismissed.

VALUES

R4 Whose values? The importance of exploring stakeholders and their values

Stakeholder engagement remains an inherent challenge in research and innovation, as it involves navigating a plurality of variables, including divergent interests, asymmetries of power and knowledge, institutional constraints, and temporal misalignments between innovation processes and societal deliberation. These factors make engagement complex, context-dependent, and difficult to standardise. Nonetheless, the importance of stakeholder engagement is widely recognised.

What remains critical is ensuring that stakeholder engagement is **operationalised in a meaningful way.** It constitutes a core component of responsible and socially robust research and innovation, and a key condition for aligning innovation trajectories with societal values and needs. The central issue, therefore, lies not in whether engagement should be integrated, but in how to **navigate its different phases, formats, and degrees of influence** throughout the R&I process. A number of aspects that are especially important to ensure meaningful stakeholder engagement in the context of 6G will be highlighted:

Direct interaction with local communities. The involvement of local communities in decisions that affect their territories is important, for instance in relation to the placement of infrastructures or the transformation of local environments.

Transparent and accessible communication about risks, uncertainties, and potential impacts is key, allowing stakeholders to form well-grounded opinions rather than being confined to validation roles.

Participatory approaches supported by tools such as virtual reality can facilitate understanding, dialogue, and informed deliberation by making complex technological choices more tangible (e.g., the experience of the Trialsnet project).

Broadening the range of stakeholders involved is equally crucial, as it allows the elicitation of social needs, priorities, underlying values, and potential tensions across different social groups.

Co-design with stakeholders: projects should be incentivised or required to engage co-creation activities with vertical sectors (e.g., disaster responders or rural community groups) to ensure that technology addresses real-world pain points rather than theoretical needs. These activities should not be a one off at the beginning (e.g., requirements elicitation) or at the end (e.g., testing) but ongoing throughout the project in order to influence ongoing decisions.

Practices of co-creation and co-design remain areas with significant untapped potential, calling for further methodological development and the cultivation of specific competences to integrate stakeholder contributions more effectively into R&I processes.

The quadruple helix model, long applied in the context of living labs, and grounded on design thinking methods, could offer a relevant reference framework to effectively support the translation of insights from engagement into alternative development choices. It demonstrates how collaboration among academia, industry, government and civil society can foster more pluralist, inclusive and reflexive innovation processes, grounded in real societal expectations and capable of generating more legitimate and socially responsive outcomes.

Meaningful stakeholder engagement cannot be improvised. It should be understood as an articulated and multi-layered practice, rather than as a single or isolated activity. Also, it cannot be treated as an ancillary or procedural requirement. It requires dedicated competences, including facilitation skills, reflexive capacities, and the ability to translate between technical, social, and normative perspectives.

VALUES

R5 Which are my key values? Identifying and prioritising Key Values in High-Impact Technological Contexts

The identification and prioritisation of driving Key Values constitutes a crucial first step in the responsible development of technologies with high transformative potential, such as 6G. Translating these principles into actionable guidance for innovation, however, is far from straightforward.
Key values express broad normative objectives on which societies often converge upon, at a high level of abstraction—human rights charters and international declarations.However, their concrete meaning and implications emerge only when values are operationalised within specific geographical, cultural, sectoral, and technological contexts, moving beyond abstract consensus toward a grounded understanding of what sustainability, inclusion, or fairness mean in a particular innovation setting. At this stage, challenges and **frictions frequently arise.**

Different social groups and stakeholders may attribute varying interpretations, priorities, or degrees of importance to the same high-level principles, giving rise to debates or controversies. A robust value-based approach should be guided by **three overarching objectives:**

1. uncovering divergent values where different groups prioritise competing concerns;
2. preventing "ivory tower" solutions that reflect only an industry or expert perspective - and may not resonate with the values and needs of the people they aim to serve;
3. ensuring transparency regarding whose values are prioritised, and for what reasons.

The following steps can help move values from abstract principles to actionable drivers of innovation, providing a grounded basis for defining technological objectives that are both context-sensitive and socially robust (see also [8]):

Reflect on Implicit Assumptions.
The process should begin with a critical reflection on the implicit assumptions and values shaping innovation trajectories and decision-making priorities. This involves questioning whose needs and perspectives are being reflected and translated into innovation processes: are the needs and perspectives of specific user groups, of all affected parties, or primarily of who leads the development process? Who decides what is good for users? Is a given interpretation of a value the right one for a given group/environment in that context? Making these assumptions explicit is a prerequisite for inclusive and responsible innovation.

Challenge Assumptions through Stakeholder Engagement. Early engagement with a broad range of stakeholders allows existing assumptions to be challenged and enriched.
This exploration aims to understand diverse user perspectives, identify biases, uncover divergent positions, and consider alternative approaches to addressing societal challenges. Such engagement can disrupt established framings and reveal unexpected priorities or concerns, supporting more informed and balanced decision-making.

Balance universal value frameworks with context-specific priorities. Each specific context, in the pursue of its goal to maintain or improve a given condition, would face different challenges; **values will acquire therefore different relevance and priority,** in light of situational needs, risks, and constraints. Value identification in a given context should rely on a combination of top-down and bottom-up analyses. Inputs should be drawn from multiple levels, including policy priorities at international, European, and national scales; industry strategies and incentives; project-level objectives; sectoral drivers; and the concerns and expectations of affected stakeholders. Such an analysis is essential not only for guiding innovation objectives but also for mitigating risks related to societal harm, lack of adoption, or public resistance.

3. Operational Recommendations

R6

What a KVI is for and what we want KVI to do

The primary purpose of KVIs is to **shift the focus of evaluation from outputs to outcomes,** from what a project produces (such as a testbed), to the actual change experienced by stakeholders (such as increased connectivity for 10,000 previously unconnected citizens). Most importantly, KVIs should be addressed as a **strategic compass** to **monitor and guide** the design of technology toward a **human – and planet-centric** digital future. KVIs serve as **anticipatory proxies,** providing early signals during the research and innovation phase to predict long-term societal benefits that may only manifest years after a project's completion. More specifically, KVIs should be used to:

1. to know if an overlooked area is really being addressed;
2. to influence the design and testing process;
3. to affect business models and exploitation plans;
4. to assess how fit-for-context a technology is;
5. to assess if the technology needs to be paired with additional activities on different levels (improved infrastructure, policy, standards, etc.) for it to achieve its intended impact.

What a KVI is not: they are not tools to rationalise the use of existing KPIs. They are not to be measured only after a project is over, acting as validation tools. They are not marketing tools. In all of these cases, there are no decisions being made, other than to confirm and rationalize what was already being done. For a KVI to be effective, it must be decision-relevant. The following are examples of how KVIs can support specific **decision-making** processes, helping to **course correct** and **change design and paths** (see also [9]):

1. **Navigating Trade-offs:** They should be able to make tensions explicit, such as the conflict between energy efficiency and hardware costs, helping decision-makers ensure that market viability does not always compromise inclusivity or sustainability.
2. **Informing Specific Stakeholders:** Indicators should be designed to support specific actors, such as an engineer making a design change, a policymaker determining funding priorities, or a stakeholder in determining for themselves if the technology is right for them.
3. **Strategic Layering:** By layering KVIs across different dimensions, from technical capability to regional system leverage, projects can make informed decisions about where to prioritise efforts for maximum societal benefit.

The work on KVIs should therefore happen the following practices:

1. **Stakeholder Co-design:** KVIs must be co-defined with the people who will use or be impacted by the technology. This connects the framework with real-world priorities rather than just top-down policy.
2. **Multi-disciplinary Teams:** It is recommended that project teams include social scientists, economists, and environmental scientists to navigate the qualitative complexities of societal values and non-technical data.
3. **Harmonisation of Language and Process:** There is a need for a common strategic language and processes across projects to ensure that values like "fairness" or "trust" are interpreted and assessed consistently.
4. **Establishing Baselines:** Ideally, projects should establish baseline data describing the social situation they are entering so that subsequent changes can be accurately measured.This does not mean, necessarily, threshold data, but data that establishes the current situation (e.g., how many people in a region are currently not gaining value from SNS services, what structural factors are influencing SNS impacts, etc.).
5. **Supporting governing framework:** in order to express at best their capacities, KVIs require a governing framework that explicitly prioritises social and environmental **outcomes alongside financial returns.** Otherwise, the path of least resistance will favour profit-maximizing and technologically novel solutions over those that advance equity or sustainability.

3. Operational Recommendations

R7

IMPACT – Widening our understanding of the broader social impact of ICTs

Social impact is, by definition, difficult to explore, particularly within projects that run for only a few years. The way social impact is envisioned and explored, however, is critical. Depending on whether and how risks are adequately identified and considered, technology design can be differently oriented: the greater the capacity for anticipatory exploration of long-term and broader societal implications, the greater the opportunity to reflect critically on current technological choices.

Within the current innovation culture, social impact is often scoped focusing mostly on the direct, predictable, and intended effects of a solution. Second-order effects– the long-term social, cultural, and ethical impacts of technological advancements are only weakly considered and not explored systematically. This is due to the combination of two interrelated tendencies within technical R&I environments: on the one hand the tendency to act on the **assumption of a beneficial effect** of technology in terms of social impact; on the other hand, **limited awareness of potential negative implications** for individuals and society beyond intended impacts.

Capturing long-term, diffuse, or systemic impacts of emerging technologies—those that emerge gradually through evolving behaviours, institutional changes, or shifts in social norms – remains an open challenge. The exploration of broader societal implications and transformations triggered by technologies has so far remained largely confined to academic social science research, with approaches that are often difficult to translate into concrete industrial practices and operational processes. Most importantly, a comprehensive socio-technical impact-modelling framework does not currently exist.

A narrow scoping of societal impact affects and compromises, for example, the capacity of:

1. Duly calculating cost and benefits; pains and gains. Depending on what aspects of social impact a project decides to acknowledge a different perception will emerge about the value this project creates in and for society. This would influence the work on needs and goals.
2. Duly and comprehensively shaping the understanding of the relevant social sustainability dimension;
3. Devising KVIs with sufficient breath and scope to capture longer-term impacts, beyond the project lifetime;
4. Timely identifying social values at risk, or the need to recognise new social values, emerging rights, or rights in need of renewed protection.

This tendency becomes particularly critical in the sector of ICTs. ICTs do not exist solely as tangible products: they are platforms, services, and infrastructures that shape behaviours, social practices, and structural dynamics, triggering complex and interrelated dynamics at both human and societal levels. In particular, assessing 6G's potential impact (and implications) at the societal level requires awareness on the complex set of dynamics ignited at the cultural, social and individual levels (cognitive, psychological, identity-related, relational, mental health aspects), including the unintended or negative effects that may accompany smart networks and deeply immersive communication ecosystems.

To adequately address these aspects within the innovation ecosystem, it is essential to integrate competences from the social sciences and humanities (SSH) into the innovation culture and processes of the SNS JU community.

Here some suggestions and perspectives:

There is a need to strengthen shared awareness of the broader and deep societal implications of ICTs.

A new way of approaching and understanding impact should be fostered in the industrial culture. This should move beyond the immediate scope of applications of technology or performance metrics, combining the study of more immediate and intended social impacts, with a broader understanding of the complex set of dynamics that technology triggers at the human and societal level.

Broader and longer term social implications aspects should be considered early in the development process (not only assessed at the end of the process), to inform orientations and choices, enabling timely adaptive measures wherever relevant or possible. This is substantial to align technological progress with societal values and well-being.

There are inherent challenges in dealing with longer-term and broader implications of technology. They could be partially counterbalanced by a more aware work during the research process on the mechanisms through which social aspects, values and ethics can be reflected and operationalised into technology design. This may include reflexive checkpoints throughout the design cycle, including research into the mechanisms where social aspects intersect with technical architecture, and mapping social requirements onto technical specifications/design constraints.

A number of anticipatory approaches exist which can help to capture and explore the broader, systemic, and long-term transformations triggered by technologies, uncovering second-order effects and societal dynamics that conventional methods often overlook. These methods shift the focus from purely technical feasibility and performance toward social desirability, long-term societal relevance, and ethical soundness; also, they help uncovering second-order effects and societal dynamics often overlooked by conventional methods. These comprise Constructive Technology assessment methods; Value-sensitive Design; Foresight exercises, mostly based on scenario building; back casting exercises. In particular, the backcasting approach is the one that operationalises the social desirability conceptual perspective.

Tools and methods for the anticipatory exploration of possible broader societal implications of technology should be further explored in project practices. Anticipatory and ethics-by-design methodologies should be more systematically integrated into technology-oriented R&I activities. While combining diverse approaches and perspectives may initially present challenges, their integration should be pursued through an exploratory and iterative process. Over time, this can strengthen innovation culture and support its evolution in the medium term.

It is important to leverage complementary and multidisciplinary knowledge, competences and methodologies, in particular from the social sciences realm, as perspectives able to situate technology within its social context, and to bring and anticipatory perspective.

Key social impact dimensions that warrant reflection and guidance in the context of 6G include, for instance: the effects of an always-on lifestyle on well-being and quality of life; emerging forms of digital inequality arising from hyperconnectivity or heightened surveillance; the interplay between physical, virtual, and imagined spaces and its implications for social interaction and well-being; and the influence of algorithms on personal autonomy, among others.

IMPACT

R8

Multidisciplinary expertise is key to operationalise values, explore future implications, and generate positive impact

Despite the complexity of the dimensions of social values, and of social impact and implications, and the fact that they relate rather to social science and humanities competences, industry and innovation actors are increasingly expected to define, identify, manage the value and social impact dimension within technology development processes.

Experience working alongside technical teams has shown that technologists alone cannot easily work with societal value. For example, evidence collected through 6G4Society confirms that many technical experts find it difficult to recognise the way cultural values may influence innovation from its very conception, especially in low TRL levels. This translates into **limitations in the possibility to truly steer technological development** reflecting ethics, values and social good considerations into technology design. Conversely, experience from 6G4Society demonstrates the productive and complementary contribution that social sciences can bring to future network research.

While raising awareness within technical teams about **value-related mechanisms, ethics issues, or social implications** remains essential, it is not sufficient to equip technical teams with the competencies needed to analyse the complex interplay between technology, values, society, and impact. This is because these competencies cannot be easily transferred to or mastered by without a more structured social science background.

A list the **key aspects on which social sciences can provide complementary perspective and possibly guidance,** in order to set the basis for substantial social good:

Values: exploration of stakeholders' values and identification of key values; identifications of key moments where values enter, and can be integrated in, the innovation process, including in low TRL phases; shaping of design requirements.

KVIs: translate values into corresponding and context-specific indicators able to suitably capture the generation of positive value for society, notably in terms of social and sustainability impact.

Ethics: closely connected with values aspects, deals not only with ensuring compliance with regulation, but with the capacity of capturing possible ethical implications of activities, through anticipatory approaches and reflections.

Impact: Social sciences competences have been proved crucial to move beyond perspectives limited to laboratories and user experience or satisfaction, and to engage with the broader dynamics of societal transformation, in particular: scoping the areas of impact of certain use cases and solutions; elicit the way certain technology features could translate into social impacts and societal implications, capturing nuanced dimensions of the social and environmental impacts of technology; supporting in the assessment of social impacts.

Sustainability: complementing the comprehension of how technology relates to social and environmental sustainability

IMPACT

The answer lies in fostering an R&I culture where the **navigation of qualitative societal complexities** is addressed operationally through **multidisciplinary expertise and approaches** – notably seeing the contribution of social scientists, economists, and ethicists.

Projects in the 6G sector should consider integrating social science expertise in the operationalisation of their activities as of proposal conception. This is because the scale, breadth, and complexity of 6G's societal impacts make it highly likely that significant societal, ethical, and sustainability-related implications will need to be addressed. Technical teams are encouraged to actively recognise and value this multidisciplinary contribution, as it is essential for complementing technical knowledge and enabling a deeper, more informed understanding of societal impacts throughout the innovation process.

Immersive communication environments and gaming applications offer an interesting stage to demonstrate the potentialities of a multidisciplinary approach (see also [5] and [10]). In these contexts, the construction of narratives, representations, and virtual identities directly shapes users' sense of self, social roles, peer interactions, and collective imaginaries. From an acceptability perspective, it is crucial to consider which values—such as autonomy, authenticity, inclusivity, and well-being—should be protected as immersive and XR technologies become central to cultural experiences and daily communication. Key concerns requiring careful reflection include emotional manipulation, bodily surveillance, and user dependency. Insights from SSH disciplines—especially social sciences, cognitive sciences, media studies, and psychology—can provide valuable guidance in addressing these challenges.

ACCEPTANCE

R9 ACCEPTANCE – ...or Acceptability?

At the core of reflections on acceptance and sustainability is acceptability. While acceptance concerns how people perceive and respond to a technology once it enters everyday life, acceptability focuses on making a technology socially acceptable from the outset. This involves evaluating the technology against legal and ethics framework, social values, and societal expectations. While social acceptance unfolds as an evolving and negotiated process once technologies enter everyday use, acceptability, by contrast, concerns whether and under what ethical and societal conditions technological pathways should be pursued. As such, acceptability becomes critical at early stages of innovation.

Acceptability, being closely tied to the notion of values, is often operationalised through value-based design practices, which allow that relevant societal and ethical considerations are integrated early in the development of technologies and solutions. In this way, acceptability fosters:

1. by design compliance with existing regulations as well as alignment with cultural and social norms considered relevant;
4. reflection on which values—autonomy, authenticity, inclusivity, well-being—could be at risk and should be safeguarded, allowing to actuate adaptive measures as early as possible at the level of technology design. Here some considerations (see also [11]):

Focus on acceptability before acceptance. In the context of emerging technologies and low-TRL research—where specific technical requirements are still being defined—discussions on acceptability are more relevant and influential than those on acceptance. For the same reasons, acceptability is relevant in all reflections around sustainability, whenever approached as a fundamental requirement (or value) to be embedded into technology design. **Acceptability explorations should be dealt with as early as possible** in technology and solution design. In this way, values, ethical concerns, and divergent visions can surface in time to shape innovation with awareness.

R10 Social acceptance not as a goal, but as an exploration

In the business world, drawing from the traditional technology acceptance models such as TAM or UTAUT, it is frequent the tendency to identifying the exploration of social acceptance with the exploration of user experience, interpreting user satisfaction as an indication of future likelihood of adoption and business viability. This approach exposes three main, interlinked limitations:

1. It frames the exploration of acceptance solely around ensuring business viability and market success (acceptance as a goal); this undermines the attention to potential rising ethical issues or to significant social transformations that require careful management and guidance.
2. It links acceptance to the role of users, overlooking how other social groups might be impacted by or may respond to the technology.
3. It circumscribes acceptance to the context and sector of technology use [12], with limited attention to the wider impact of technology on society.

In this approach, acceptance is treated as a goal to be achieved, often by persuading people of a technology's benefits. This reflects a **"technology push"** model, in which companies create demand rather than respond to genuine societal needs. However, achieving acceptance in this way does not necessarily guarantee that the solution aligns with the values of the society that are expected to be built, meaning it **may lack true acceptability.** Moreover, this approach risks delegitimizing alternative perspectives on innovation priorities and does not ensure that the accepted trajectory represents the most socially desirable direction for technological development. As a result, important considerations that affect both **social desirability** and **social sustainability** may be overlooked.

6G4Society promotes a broader understanding of acceptance that goes beyond measuring user satisfaction, adoption likelihood, or business viability, and is not limited to persuading people of a technology's benefits. It highlights the importance of expanding the analytical perspective to include dimensions that shape the relationship between technology and society, such as values, ethical principles, potential disruptiveness, and wider social implications. Acceptance is framed as an open-ended process aimed at exploring and understanding what people value, examining social perceptions, and reflecting on whose needs are being addressed and whose may be overlooked. In summary, in relation to acceptance 6G4Society promotes the following (for a more actionable explanation on this topic see [11]):

- **Shift from goal to exploration; from outcome to process.** Social acceptance should not be seen as a goal to achieve but as an ongoing process to explore and critically examine whether the values envisioned by industry align with actual societal needs. This approach does not dismiss business objectives but broadens their perspective in terms of social value creation, enabling a comprehensive elicitation of needs and priorities across diverse social groups.
- **Broaden the scope of investigation beyond the use scenario.** Exploring social acceptance should involve a wider range of stakeholders—not just end users—and consider socio-economic and cultural contexts beyond immediate use scenarios, including the community level, and the market and socio-economic contexts.
- **Deliver actionable insights.** Results of social acceptance explorations should identify gaps between technology-driven objectives and societal priorities, uncover concerns from underrepresented groups, and reveal underlying value tensions that may influence adoption, trust, and social legitimacy.

R11 ACCEPTANCE – Embrace and constructively manage public controversies as tools to explore social desirability

Public controversies on science and innovation arise whenever different social groups prioritise different values or interests. As such, they represent valuable manifestations of where different social groups provide different interpretations of what is desirable in society and for their future, or of how the same concept (e.g., sustainability) may be filled with different meanings. Therefore, public controversies should not be seen as obstacles, but rather as important and **strategic exploratory tools** to explore and expose this diversity of priorities and values among social groups, industry, and institutions. Such controversies could prompt decision-maker or industry to question the criteria leading the way towards the future being built through nowadays choices. In this way, they would foster socially desirable directions. On this matter the following points are highlighted (see also [11]).

1

Open up to alternative or controversial voices to tune towards social desirability. Conflicting or divergent voices should be acknowledged, embraced, managed, as they can act as valuable indicators for better accessing and understanding relevant social needs. They can help in:

- Eliciting possible points of tensions in the way different stakeholders or social groups prioritise values, marking where different interests and priorities may collide or diverge from those of decision-makers (industry or institutions).
- Clarify different interpretations and meanings that different social groups attribute to a same value.
- Identify key social groups possibly impacted by technologies, and the underlying values that people attach to their social and environmental context beyond economic considerations (e.g., landscape preservation, quietness, or unspoiled nature – as also noted in an expert interview).
- Highlighting which values are perceived as neglected or violated, offering important insights into societal priorities.

2

Misinterpretation and misunderstanding of scientific facts should not be dismissed, even when they lead to controversies. They remain interpretatively relevant, as they can indicate gaps in communication or trust within the stakeholder system. What matters here is not the substantive accuracy of the opinion itself, but what it reveals about relationships, expectations, and trust dynamics among stakeholders.

3

The cause of controversies cannot be reduced to lack of knowledge or information. There is a widespread assumption within scientific and technical communities that public scepticism or disagreement with science stems primarily from a lack of knowledge or understanding, and that improved information transfer alone would be sufficient to increase public support for science. Such an assumption – known as "deficit model of science communication"– has been widely challenged by extensive research in the field of Science and Technology Studies (STS). The principal [13] limitation of this position is that of overlooking the role of other forms of knowledge (e.g., cultural or experiential understanding), as well as of values, trust, and context, in shaping attitudes toward science. Critics to the deficit model have eventually highlighted the need to understand science communication beyond a one-way, simple transmission of scientific facts from experts to a passive public; they showed instead that public opinion is more complex than the deficit model suggests and that the model's premise that knowledge directly leads to positive attitudes toward science is flawed [14].

4

Controversies around science and technology expose gaps in the governance process and decision-making mechanism. If public controversies around a certain innovation surface in public and media spaces, it is most probably because the diversity of public perspectives has not been sufficiently represented in the decisional process, and certain social groups do not feel represented by innovation visions and expectations. This is why stakeholder engagement should be approached not merely as a project activity, but as a governance and management approach that informs and supports decision-making.

R12

Ensure a comprehensive and contextual interpretation of environmental and social sustainability in research and innovation processes.

Currently, the way in which the concept of social sustainability and environmental sustainability are interpreted in the context of R&I innovation agendas and practice shows a gap in incorporating nuances and aspects that are instead constitutive of the concepts. The analyses conducted in the context of 6G4Society, in particular, highlight the following aspects as:

As concerns social sustainability: aspects considered relevant to correctly scope the concept, and currently not fully addressed are: mental and physical health and wellbeing; cultural identity and diversity; sense of belonging; feeling of being safe in a community and of being part of the community; intergenerational justice; equity in the way assets, resources and benefits are distributed; autonomy; social cohesion; cultural heritage; freedom, the right to disconnect; landscape preservation; quietness; unspoiled nature.

As concerns environmental sustainability: the concept of environmental sustainability is explored predominantly in terms of energy efficiency. Other important aspects appearing less addressed within the activities of SNS-JU projects, are: greenhouse gas (GHG) emissions, circularity, and electromagnetic field (EMF) exposure, but also circularity, and impact on biodiversity.

Some argue that these aspects are overlooked because they are considered less relevant, linkable, or actionable within the scope of 6G research projects; while this position is highly relevant and worth-exploring, it can also be argued that this perceived lack of relevance may actually stem from:

1. **a lower priority attributed** to these topics in programmatic research priorities (work programmes)
2. **a difficulty in establishing meaningful links** with current R&I priorities, targets and project operations
3. **missing specialist competences** to properly address these aspects. In all cases, it becomes crucial to make sure that these receive the due attention and are effectively addressed, to avoid potential negative social and environmental rebound effects.

Values such as those listed above may be linkable to, and operationalised in, different aspects of project operations - technical requirements, ethics requirements, objectives, or expected impact - and in different moments. Therefore, it is crucial to build a nuanced understanding of how these different environmental and social sustainability aspects - currently more or less weakly addressed - may relate, more or less directly, to the specific activities and operation areas of SNS JU project community, including in low TRL projects. By way of example, consider the following scenarios:
circularity may be oper-ationalised through eco-design principles, through sustainable materials, or adopting modular, scalable, and reconfigurable architectures [6]. Besides this, circularity can be realised also, and most prominently, through circular business models. Landscape and cultural heritage become relevant during the phases of deployment of a telecommunication infrastructure. Cultural identity may be operationalised in choices related to language, or other types of contextualisations. Diversity may be reflected in the way a use case addresses needs of under-represented social groups. To summarise:

There is a need to explore and verify whether or to which extent the values and aspects less represented can relate to the current context of future network technologies, under which respects and focus. Concrete examples and contextual explanations are needed to better scope specific meanings and nuances of environmental and social sustainability values in the context of SNS-JU project operations. This would help clarify the connection between these values, projects technical operations, and long-term, systemic social impacts; these connections would then orient projects towards effectively translating and integrating these aspects into project design.

The contribution of specific multidisciplinary competences should be encouraged. For example, specific competences on GHG, circularity, biodiversity should be required as concerns environmental sustainability, to be able to integrate such aspects holistically within the wider picture. Similarly, the visions and narratives advanced by industry as concerns future social scenarios, or the approaches proposed to address social challenges should be analysed in light of social sciences competences. This would make it possible to highlight ethical or social issues related to specific technological solutions and requirements, requiring attention for their potential wider societal implications. This is valuable also for works at low-TRL or on enabling technologies.

R13

SUSTAINABILITY – Sustainability as core strategic asset. Overcoming the trade-off logic

Within the SNS-JU community, the willingness has been manifested to overcome a trade-off logic, towards a **co-optimisation approach**, with a case-by-case assessment of the relationship and "blend" between different sustainability pillars, as a way to address sustainability dimensions holistically. This marks a positive, substantial shift of intention, in a more general framework where sustainability remains an operative. Across the broader global industrial landscape, sustainability has long continued to occupy a **peripheral** position within research and innovation agendas, mostly aimed at managing corporate reputation [15]. Only **recently it has started been looked at as astrategic asset**—a constitutive element of value creation, market positioning, and long-term competitiveness. However, in most cases, sustainability **has yet to evolve into an inherent and core guiding principle** capable of shaping innovation strategies, transforming core business models, or influencing decision-making processes and product design in a substantive way [16]. While some sectors have begun to move in this direction, such instances remain the exception rather than the rule, with consequent risks for the long-term resilience of social and ecological systems.

More commonly, sustainability is still framed as a **trade-off:** a source of burden, renunciation, or constraint, perceived as being in tension with performance, profitability, and competitiveness.

This framing reinforces, and is the consequence of, approaches that address sustainability in a largely **non-substantial** and **compliance-oriented** manner, treating it as a **secondary** or **external** requirement rather than an **integral driver** of innovation.

The persistence of sustainability at the margins of industrial research and innovation agendas calls for a **critical examination of its underlying cultural causes.** Currently, industrial and consumer imaginaries reinforce each other:

the priority values of do-minant industrial and economic cultures shape social norms, collective imaginaries, and expectations within broader society, while these societal expectations in turn sustain and legitimise prevailing industrial priorities.

Since the value framework underpinning the dominant industrial operation culture is characterised by principles such as, e.g., expectations of perpetual growth, short-term profit maximisation, efficiency also at the expenses of resilience, or consumption-driven expansion, and since these principles are engrained in the business models - that is, in the way the value is conveyed towards users and consumers - it is normal that tensions have emerged towards sustainability. There is a de facto misalignment between the value framework underpinning the dominant industrial operation culture, and the fundamental values necessary for responsible and future-oriented development. The values underpinning sustainability - such as circularity; reuse, refurbishment; frugality -finish to come at odds with the current framework of industrial operations. For example, when considering "frugality", this conflicts with the dominant competitiveness marketing discourse, that is mostly built on "having more" functionalities. As a result, the way sustainability can generate meaningful value for society—including economic value— remains difficult to define, within the current framework. This highlights the need to rethink what is considered "value" in business, expanding it to include social, environmental, and long-term considerations. Here some considerations:

1

Position Sustainability as a Core Driver of Competitiveness and Value Creation. There is growing evidence that a change of paradigm is increasingly necessary for sustainability to be recognised and valorised as a driver of competitiveness and generation of value. Sustainability should be embraced as a strategic asset that drives innovation and strengthens market positioning. Organisations should integrate sustainability as a non-negotiable baseline principle, guiding the conception, design, production, and management of activities, products, and systems. This requires overcoming the prevailing "trade-off" culture, reframing sustainability as an enabler rather than a constraint [17].

2

Embed Sustainability Across Operations and Decision-Making. Sustainability principles should permeate all phases of the value chain, from early R&I decision-making to end-of-life considerations, ensuring that environmental and social impacts are accounted for systematically rather than treated as externalities.

3

Projects need an agreed process for explicitly identifying and documenting tensions between values, performance, and cost, to a) ensure sustainability is not always sacrificed for market viability; and b) to ensure transparency in the trade-offs made; and c) to support projects in making the trade-offs in the first place.

4

A cultural reorientation about what value is necessary. Current market and business models often assess "success" through paradigms prioritising growth, accumulation, and possession, which inherently conflict with sustainability values. From this stance, sustainability is addressed in a mitigation-oriented and compensatory stance. Instead, the times are ripe for organisations to embrace sustainability and its core principles. To do this, further work is needed towards valorising and making emerge the financial value and possibility of economic return linked to components of the sustainability value framework such as frugality; reuse; non-ownership; reduction; modularity of user experience. The cultural and economic dimensions are closely interconnected; changes at the economic and operational level are inseparable from shifts at the cultural level, with the underlying value system of the business model representing the pivotal point of transformation.

R14

Circularity as core and founding aspect of sustainability

Sustainability increasingly needs to be understood through the lens of circularity, which constitutes a **backbone and foundational principle** for sustainability. While certain initiatives—such as focusing on emissions reduction—treat only the symptoms of environmental challenges, circularity addresses the root causes of the triple environmental (crisis-climate change, pollution, biodiversity loss) by lessening both our material use and waste to support a healthy planet [18].
To date, circularity and eco-design principles remain **only minimally adopted** within the SNS JU project community, as does engagement with holistic and systemic environmental strategies, which are essential for tackling long-term challenges such as climate change and resource sustainability. This gap presents significant opportunities for both research and practical action, while also highlighting challenges: it is necessary to assess the extent to which materials, product architectures, or sustainability measures may conflict with critical requirements such as performance or reliability [6].

The second and most important level where circularity can be achieved - more closely related to the level of cultural change - is that of **business modelling. Viable circular business models**, indeed, would provide the framework in which **environmental and financial objectives can co-exist without colliding,** under a unified system of driving values (and realizing deep cultural transformation in the way of living and perceiving the generation of value). Differently, trying to implement circular practices along the value chain without rethinking underlying business models entails a high risk of sustainability being deprioritised or "loose out". **Circular business models** are underpinned by two core values: **shareability** and **durability** (which together realise the more overarching value of "sufficiency").

These values are most effectively realised in models based on products-as-a-service, rather than traditional ownership-based sales. In these models, the business focus shifts from producing more physical goods to maximising the utility and value derived from each product through extended longevity and shared use.

In such models, therefore, a single product serves multiple users, reducing material consumption and environmental impact. Simultaneously, producers are incentivised to invest in durable, high-quality solutions, as responsibility for the product's performance and maintenance remains with them.
This alignment ensures that the product is designed to last longer, benefiting both sustainability objectives and the business model's economic viability.

Circular economy should be seen as an essential and core component of environmental sustainability frameworks, as it acts on the causes of the environmental crises.

Circularity should be integrated by design across all phases of the value-chain - not be considered as a single phase at the bottom phase of the value chain. For instance, the end-of-life stage of products should be incorporated as early as possible into research and innovation decision-making processes, reflecting a broader respect for resources, ecosystems, and the needs of future generations. This requires a more holistic and systematic analysis and quantification of the impact of circularity-based choices (e.g., at the level of material) impact on other outcomes (e.g., reliability, performance...), in order to outline suitable co-optimisation strategies in the context of circularity by design.

Circularity should act as value and driver in the designing of alternative business models. The exploration of circular business models should be incentivised, as a way to operationalise circularity. In this way, the specific set of values underpinning sustainability and circularity (e.g., sufficiency) will concur in creating also business value. Indeed, this calls for efforts to model the impact of this trajectories and shifts in terms of corporate costs, in the short, medium and longer term.

Digital product passport Data Dictionaries. Telecommunications industry actors should proactively implement Digital Product Passport (DPP)–compliant data structures within OSS/BSS systems, integrating circularity directly into core operational processes. This requires the adoption of standardised data dictionaries capable of tracking component–level provenance, material composition, repairability, and dismantling instructions from the earliest stages of procurement. Embedding such data across the lifecycle enables effective circular resource management and traceability. This approach directly supports compliance with the Critical Raw Materials Act (CRMA) targets and strengthens the industry's capacity to meet sustainability and resilience objectives in a systemic and verifiable manner.

R15 SUSTAINABILITY AND ACCEPTANCE – Reconfiguring narratives putting sustainability at the core of the value proposition

The fact that sustainability is still not treated as a strategic asset by the corporate world, emerges in the way sustainability is **narrated. Compelling and transformative narratives about sustainable facts or goals remain scarce.** And since through proper narratives it is possible to build positive perceptions of facts, the absence of these narratives further limits the capacity of sustainability to be understood and mobilised as a source of strategic and business value.

Such a position on narratives is not to be understood as supporting reputation, like it has been used for all what concerns greenwashing practices. Instead, it is meant as a way to reconfigure the **construction and perception of overall value offered.** What is argued is that consumer awareness towards sustainability has changed and there is now readiness and space for users and consumers to positively receive different form of offers.

In this framework, with sustainability as a core positioning asset, the presence of less performant features resulting from sustainability–driven choices would not necessarily assume a negative value, nor would be perceived as minus, or a lack, because they are counterbalanced by the overarching creation of sustainability value. In the case of systems enabling a modulable quality of user experience (e.g., project EXIGENCE), reducing the quality of definition to improve energy efficiency, the value of the offer will not be associated to a lowest definition quality, but to the capacity of providing the best possible offer while taking care of CO2 consumption.

As long as "success" is assessed through indicators built around a different paradigm (newer, bigger, having more, possessing more), a world based on the values of sustainability risks being perceived as less performant and consequently less competitive. Instead, this changing global readiness around sustainability priorities creates an opportunity to rethink prevailing narratives.

It is important to build new business-consum-ers relationship based on narratives where foundational aspects of sustainability (e.g., reparability; refurbishment; frugality) are not associated with a sense of renunciation, but become fundamental values within a deeply transformed **narrative around sustainability. In this framework, the values underpinning sus-tainability and circularity** (e.g., reparability; re-furbishment; frugality) should find core space and be pushed through in narratives/advertise-ment/selling strategies, creating a differ-ent baseline and formula for what is considered a **comprehensive value offer**. In this formula the "selling" of possible "negative" changes (e.g., loss in terms of performance; lower quality of experience) should not be approached and la-belled as a minus or a lack, but acquire a differ-ent meaning- e.g., integrity, opportunity, sensi-bility. This needs to be **shown, made evident, made available, and narrated** in a positive way.

1

Growing public awareness and societal readiness towards sustainability, makes it a powerful source of innovation and differentiation, rather than as a constraint.

2

Sustainability is underpinned by a different value system that should be positively reinforced through appropriate narratives. Concepts such as circularity; reuse, refurbishment; frugality, sufficiency should be decoupled by a narrative of deprivation, and associated with positive narrations. In this way it is possible to entail a shift on how the generation of value is perceived at the market level. It deals with a changed perception of the relationship between economic and environmental sustainability value, and with a different logic through constructing market value - engrained on a more distributed, long-term and holistic logic.

3

Customer acceptance and market adoption dynamics should be further investigated as concerns the creation of sustainability-centred market value; in particular the impact of choices that lower performances (in terms of traditional metrics) should be explored, and possibly reconsidered in the framework of a different logic in the creation of competitive value.

3. Operational Recommendations

It is important to build new business–consumers relationship based on narratives where foundational aspects of sustainability (e.g., reparability; refurbishment; frugality) are not associated with a sense of renunciation, but become fundamental values within a deeply transformed **narrative around sustainability. In this framework, the values underpinning sustainability and circularity** (e.g., reparability; refurbishment; frugality) should find core space and be pushed through in narratives/advertisement/selling strategies, creating a differ-ent baseline and formula for what is considered a **comprehensive value offer**. In this formula the "selling" of possible "negative" changes (e.g., loss in terms of performance; lower quality of experience) should not be approached and labelled as a minus or a lack, but acquire a different meaning-e.g., integrity, opportunity, sensibility. This needs to be **shown, made evident, made available, and narrated** in a positive way.

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3. Operational Recommendations

4. Evidence and analysis

The project's findings at the basis of these policy briefs are based on the analysis of multiple sources and the triangulation of quantitative (surveys), qualitative (interviews and workshops), and desk-research methods. Sources have been analysed through the analytical lens of Responsible Research and Innovation (RRI) and Science and Technology Studies, and comprise scientific literature, participatory workshops, surveys and interviews with R&I practitioners from SNS JU projects, a citizen survey, consultations with policymakers and experts on topics such as social acceptance, 6G, green ICT, smart cities, and sustainability. Other key sources to understand approaches and methods applied by industry in matters of social needs, social values, social acceptance and KVIs, have been: a two-round **survey** to explore the SNS-JU projects' community [19]; the direct engagement within the **SNS JU community working groups** (e.g., SNS-JU Sustainability Task Force); the constructive face-to-face exchanges and collaborative work conducted for two **EuCNC** events; the active participation in technology-focused SNS-JU projects. Combined, these sources and methods offer a complementary view across diverse stakeholders of how societal values and needs are currently represented and operationalised in 6G research and innovation. Here a synthesis of the main findings.

The way social and societal impact of ICTs are generally conceived and approached is important to the cause of sustainability. It emerged how the **impact of ICTs** is rarely addressed beyond the description of direct and intended effects of technologies, and is mostly viewed as inherently positive. A particularly interesting context where social implications should be further and more broadly investigated - and with anticipatory approach - is that of **immersive communication.** In this context, the relationship between human, technologies, media and the environment will be subverted, calling for specific reflections. The identification of sensitive ethics and sociological aspects in **immersive communication** is rooted on interpretative categories and knowledge proper of social theory and media studies, and especially on the notion that communication environments not only determine how contents are produced and conveyed, but they also structure the way audiences perceive and interact with these contents, influencing the relational affordances of society. These aspects are further explained in chapter 3 of 6G4-Society D1.1 [5].

A narrow awareness and vision on possible societal implications may undermine the substance of sustainability actions - **compromising especially the social sustainability** dimension. This narrow framing of impact reflects a more general issue pertaining the **perspective** used to define innovation outlooks and targets.

The analysis of project documents and the collection of expert views through interviews and direct interactions in EuCNC, confirmed a general framework already well elaborated upon by the RRI theory. Innovation **paths appear still shaped by a narrow set of actors and values,** with limited importance attributed to the point of view of non-specialists in defining the trajectories of future technologies, and ultimately, of the future of humanity.

This leads to reproducing a vision of the future that reflects **assumptions, visions and priorities** proper of industrial actors. In this cultural and value context, technology tends to be considered as the solution to most of the problems (**techno-solutionism**), universal connectivity is mostly framed as inherently beneficial, and **societal progress** tends to be treated as a by-product of technological advancement. Innovation is frequently associated with technological advancement, with the concept of innovation mostly associated to that of technological advancement. Such a vision of the role of technology in society relapses also in the way **social acceptance** is conceived: acceptance is mostly treated as a goal to be achieved, typically through persuading people of the benefits of technology, and reflecting a traditional "technology push" model - where companies create demand rather than respond to real societal needs.

Considering that innovation choices shape the boundaries and affordances of future human civilisation, the dominance of a partial perspective raises concerns about the ability to genuinely **capture the diverse needs of society** and to remain responsive to its evolving needs and values.
Shifting from a more strategic level, to the practical and operational one, the work of 6G4Society across SNS-JU projects, combined with insights collected at EuCNC 2025, highlighted that values **represent a terrain of both ambition and challenges for technology projects' practitioners**. Teams have shown difficulty in translating the value dimension into practical management (e.g., understanding what constitutes a social value, which values to identify, where to look for them, how to derive them), with some using user experience as a more accessible – though not appropriate – proxy for societal values. Regarding Key Value Indicators (KVIs), most projects reported significant difficulties engaging with this concept, especially in low-TRL, technology-focused environments. More broadly, regardless of the TRL level, **KVIs are still not being used as a guiding tool for design.**
Finally, **insights regarding sustainability** are derived from active contributions to the analytical work conducted within the SNS-JU Sustainability Task Force, complemented by interviews with national and European policymakers. These findings are further enriched by direct and participatory observations gained through involvement in project consortia activities. A key analytical perspective relates to **how the discourse on environmental and social sustainability is framed.**
Environmental sustainability is mostly framed around the **need to mitigate negative effects,** leading to treat the relation between economic and environmental sustainability as a continuous **trade-off.** Social sustainability, instead, is often framed around a **generic positive assumption** that technologies can solve social problems. This, combined with a still low awareness on the societal implications of ICTs, may lead to overlook important nuances and categories of values, relevant to define social sustainability in the context of future networks and connectivity.

5. Sources and Resources

This operational brief synthesises findings from 6G4-Society Deliverables D1.1, Societal aspects in 6G Technology: concerns, acceptance models and sustainability indicators [5] and D1.2, Towards a socially accepted and sustainable 6G – Policy Brief. [20]

In addition, this work draws from the following project outputs: D3.2, Social Acceptance of 6G Technology [11]; D3.3, Key Sustainability Indicators for 6G Technology [9]; 6G4Society SNS Survey Report 2024-2025 [19]; 6G4Society Insight Report #1 [7]; 6G4Society Insight Report #2 [8].

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