Beyond Adoption: Rethinking Technology Acceptance through a Social Acceptance Framework for 6G

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***Abstract*—Technologies like 6G are not merely adopted; they are negotiated, contested, and legitimized through complex social processes. Yet dominant models in ICT research, such as TAM, UTAUT, and public acceptance surveys, reduce acceptance to individual attitudes or behavioral intentions. To address this limitation, we introduce the Social Acceptance of Technology (SAT) framework, which draws from energy transition studies. SAT conceptualizes acceptance as a multi-level phenomenon shaped by institutions, values, and governance. Applied to 6G, the framework helps identify how acceptance unfolds across innovation agendas, deployment practices, and institutional change. Rather than replacing existing approaches, SAT situates them within a broader context – offering a more integrated perspective for understanding and guiding responsible technology development.**

Keywords— Social Acceptance of Technology; 6G; Technology Acceptance; Public Acceptance ; Socio-technical Systems

I. INTRODUCTION

As digital infrastructures grow increasingly complex, ubiquitous, and consequential, the question of how societies accept, resist, or negotiate emerging technologies has become central to both policy and design. Nowhere is this more evident than in the development of 6G, the forthcoming generation of wireless communication systems. Yet, as the recent controversies surrounding 5G deployments made clear, technological capability does not guarantee social legitimacy. Understanding how, why, and under what conditions new technologies are accepted is no longer a secondary concern – it is a foundational one. The real question is not whether society will accept 6G – but on what terms, through which processes, and with whose values encoded into the infrastructure.

This paper challenges the prevailing frameworks through which technology acceptance is commonly understood. Models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) [1,2] have long shaped the field of information and communication technology (ICT) research. These models aim to predict technology use based on factors like perceived usefulness, ease of use, social influence, or facilitating conditions. While they offer useful insights into individual-level adoption and user behavior, their analytical scope is limited. They tend to treat acceptance as a static, individual psychological state, captured at a given moment in time, often through surveys or controlled settings. In doing so, they abstract technology from the complex social, political, and institutional environments in which it is embedded.

Equally limited is the concept of **public acceptance** [3,4,5], often used as a proxy for the societal legitimacy of technologies. Typically measured through surveys, focus groups, or public opinion polls, public acceptance is framed as an aggregate of individual attitudes or preferences. While useful for gauging sentiment, this approach offers a narrow and potentially misleading view. It reduces complex social dynamics to individual psychology and treats resistance or criticism as noise rather than signal. As [6] and others have warned, the conflation of public acceptance with social acceptance leads to conceptual confusion and flawed decision-making.

To build a more robust understanding, this paper turns to a body of literature where the concept of social acceptance has undergone significant conceptual development – namely, in the field of energy transitions. In studies of wind power, nuclear energy, and infrastructure change, scholars have challenged the notion that acceptance can be treated as a static outcome or reduced to psychological factors. Instead, they emphasize that acceptance is part of a complex, evolving, and often contested process, shaped by institutional dynamics, public engagement, and broader questions of legitimacy [6,7].

II. SOCIAL ACCEPTANCE OF TECHNOLOGY FRAMEWORK

A. Conceptual foundations

To address the limitations of existing models such as TAM, UTAUT, and public acceptance approaches, this paper advocates for a shift toward a Social Acceptance of Technology (SAT) perspective [8]. This Acceptance framework draws on insights from social studies, ethics of technology, and innovation studies, in line with recent discussions of the concepts [9]. Rather than treating acceptance as a binary outcome – accepted or rejected – the SAT

framework conceptualizes acceptance as a **bundle of dynamic, multi-level processes** involving diverse stakeholders, competing values, and institutional arrangements. It begins from the recognition that technologies are not neutral tools introduced into a passive society, but elements of contested socio-technical systems shaped by power, history, and culture.

This work builds on two complementary conceptual approaches to understanding technology acceptance. The influential model proposed by [10], which distinguishes between socio-political, market, and community acceptance, offers a valuable lens through which to identify the key stakeholder groups involved in shaping and negotiating technological implementation. This tripartite structure remains useful for mapping how different actors participate in or influence acceptance processes across various arenas.

Building on this, the multi-level framework introduced by [9] offers a more refined understanding of how acceptance unfolds across levels of analysis – systemic, societal, and individual. While [10]'s categories remain essential for stakeholder identification, the funnel metaphor proposed by [9] adds conceptual depth by linking these actors to levels of aggregation and clarifying the shifting objects of acceptance, from broad socio-institutional structures to specific tools and practices.

Such a layered perspective is particularly suited to the analysis of complex and anticipatory technologies like 6G, where issues of legitimacy, governance, and normative alignment are as significant as user experience or commercial success. By highlighting institutional dynamics and the evolving nature of desirability, the funnel framework helps distinguish between acceptance and acceptability, and offers greater precision in assessing how and why technologies are embraced – or contested – within society. Taken together these two approaches support a more integrated and analytically robust understanding of the social processes that shape technological adoption.

B. Technology Acceptance models: Scope and limitations

While widely used in ICT research, traditional models of technology acceptance such as the **Technology Acceptance Model (TAM)** and the **Unified Theory of Acceptance and Use of Technology (UTAUT)** offer a narrow perspective on how technologies become integrated into society. These models are primarily concerned with individual user behavior and adoption intentions, often assessed through quantifiable variables like perceived usefulness, ease of use, and social influence. Their emphasis on user psychology and decision-making has made them valuable in design-oriented fields and interface development.

However, this individual-level focus comes at the cost of overlooking broader social, institutional, and political dimensions. These models tend to isolate the user from the environments in which technologies are introduced, treating acceptance as a one-time decision rather than a process shaped by governance, public trust, cultural norms, or historical context. As a result, they offer little insight into how technologies are contested, negotiated, or reconfigured as they move through different phases of implementation.

The limitations of this approach become especially apparent in large-scale, infrastructure-heavy technologies such as 5G and 6G, where **acceptance involves multiple stakeholders beyond the end user**. Questions about electromagnetic exposure, data sovereignty, environmental impact, or democratic participation cannot be addressed within frameworks that measure only individual perceptions or behavioral intentions. Acceptance in these cases unfolds within systems of regulation, power, and value conflict – not simply in moments of user interaction.

Similarly, public acceptance approaches often rely on aggregated attitudes gathered through polls or focus groups. While useful for gauging sentiment, such approaches risk oversimplifying complex controversies and **reinforcing the assumption that public opinion is a sufficient proxy for social legitimacy**. As pointed out by [7], this reductionist view can obscure underlying tensions mask opposition, and misrepresent the dynamic nature of public engagement with technology.

What these models collectively lack is not only a sense of scale, power, or institutional depth, but a recognition that technologies are not simply adopted or rejected – they are embedded in ongoing negotiations over legitimacy, governance, and competing visions of the future. Social Acceptance, in this view, is not a fixed psychological response or snapshot of public opinion, but a dynamic, multi-level process shaped by institutions, values, and power relations, involving different social groups and a plurality of stakeholders, far beyond technology users. The following section introduces a framework that responds to these shortcomings by conceptualizing acceptance as a socio-technical process that evolves across actors, phases, and systems.

C. A layered approach

The Social Acceptance of Technology (SAT) framework offers a way to analyze how ICT innovations – such as 5G and 6G – are shaped, implemented, and received across multiple levels of society. It incorporates public acceptance and user experience as meaningful elements, but places them within a wider structure that accounts for institutional change, societal values, and governance arrangements.

Rather than viewing technologies as fixed products awaiting uptake, SAT understands them as part of ongoing innovation processes. In this context, acceptance refers not only to how individuals react to new tools, but to how society as a whole negotiates the conditions, consequences, and implications of technological change.

The framework distinguishes four interconnected objects of acceptance:

1. Conditions for innovation.

   This includes the early decisions that shape the trajectory of a technology, such as funding priorities, spectrum allocation, and international standard-setting processes.

2. Conditions for implementation.

   At this stage, acceptance relates to the requirements for deployment – such as dense infrastructure, cybersecurity protocols, or new models of data governance.

3. Consequences of implementation.

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Technological systems produce effects that extend beyond their intended functions. These may involve changes to everyday life, energy consumption, or risks to privacy. Acceptance here also includes critical responses, not only support.

4. Institutional change.

As technologies develop, they often bring shifts in market structures, regulatory approaches, and political control. Acceptance in this sense involves evaluating how institutional arrangements are being reconfigured.

This layered view of acceptance allows for a more detailed analysis of where tensions arise and how different actors relate to the same technology in different ways. It shows how acceptance evolves alongside the implementation process, and how individual attitudes, public opinion, and institutional trust intersect with broader debates over legitimacy and direction.

Considering the distinct levels and objects of acceptance within the SAT framework leads to a more comprehensive grasp of how technologies like 6G are formed – not merely as technical entities, but as integral aspects of our social and political existence. (end part 3)

D. 6G development as a case-study for social acceptance

The development of 6G presents a clear case for applying a multi-level, process-oriented framework for understanding technology acceptance. Currently in the research and conception phase, this technological innovation aims to reshape communication, sensing, and computational capacity. As such, 6G is not just a technological upgrade – it is a transformation of how societies interact with data, connectivity, and governance. The SAT framework provides the tools to unpack how acceptance unfolds in this anticipatory space, across various actors, levels, and phases of development.

At the **systemic level**, 6G is already being framed through geopolitical and industrial policy debates. The EU, China, South Korea, and the United States are investing heavily in shaping global standards and intellectual property portfolios. For instance, initiatives such as the EU flagship projects (e.g. Hexa-X) and China's 6G vision white papers [11,12] illustrate how acceptance at this stage requires high-level institutional commitments including political alignment, strategic funding, and the reconfiguration of spectrum governance. These foundational moves are not simply technical – they encode visions about sovereignty, competitiveness, and values like sustainability, privacy and openness. Stakeholders at this level include governments, international agencies and institutions (e.g., ITU, European Commission), industrial associations, public-private partnerships, standardization bodies [13,14], and telecom giants, whose choices will determine the conditions under which 6G will be developed and deployed [15].

The **societal level** brings attention to how these high-level decisions translate into public concerns and community-based responses. Lessons from the rollout of 5G have made this clear: in several European countries, protests against antenna installations, especially in residential or rural areas, have reflected public unease with electromagnetic fields, surveillance, and the lack of local consultation. These controversies were often dismissed as misinformation, yet they revealed underlying distrust in institutions, opaque decision-making processes, and unresolved tensions about who gets to shape digital infrastructure. If 6G intensifies spatial densification or integrates ubiquitous sensing, similar resistance is likely, unless governance models evolve to include public participation, transparency, and local agency.

This level also involves civil society actors raising ethical concerns about surveillance, algorithmic decision-making, or the environmental impact of advanced ICT systems. The energy consumption of 6G – expected to exceed that of 5G due to more frequent data exchanges, edge computing, and always-on connectivity – may face criticisms from environmental organizations, particularly if not matched by appropriate sustainability frameworks.

At the **individual level**, the familiar terrain of technology adoption becomes relevant, especially as 6G aims to create new user experiences through holographic communication, tactile internet, and immersive education and health services. Whether users find these applications meaningful or disruptive depends on factors like digital literacy, accessibility, cost, and relevance to everyday needs. While Public Acceptance, along with models such as TAM and UTAUT can provide useful indications of how individuals or communities can adopt, reject, or respond to new technologies, these insights must be situated within broader societal expectations and values. For example, users might appreciate personalized health monitoring via 6G-enabled wearables, but still express discomfort with centralized data control or third-party data sharing. Similarly, immersive education tools might be welcomed in some communities but seen as reinforcing educational inequalities in others.

Across all levels, the SAT framework emphasizes the objects of acceptance that cut across technical and institutional boundaries. One example is data governance: who controls, stores, and benefits from the massive data flows generated by 6G? Another is energy infrastructure: how are energy demands balanced with environmental commitments? A third is institutional legitimacy: what forms of public engagement, ethical review, or value alignment are used to guide deployment?

In recent stakeholder dialogues – such as the 6G4Society project [16], the TrialsNet initiative [17], and various 6G-IA working groups – these themes have emerged as central to the long-term viability of 6G. Industry actors are increasingly aware that market success cannot be decoupled from societal trust. Similarly, policy institutions at the EU level are pushing for a value-based approach to 6G, calling for Key Value Indicators (KVIs) that reflect sustainability, privacy, inclusion, and resilience. These efforts signal a shift away from narrow performance metrics and toward a broader set of criteria through which acceptance can be assessed and earned.

In this context, the SAT framework allows researchers, policymakers, and technology developers to anticipate where resistance may arise, what forms of participation are necessary, and how legitimacy is co-constructed. It encourages a reframing of the central question: From "How do we ensure the public adopts 6G?" to "What forms of acceptance are required – from which actors and at which stages – to make 6G socially legitimate and sustainable?".

III. CONCLUSION

This article has proposed a broader and more process-oriented framework for understanding the acceptance of emerging technologies, particularly in the context of ICT innovation. By drawing from social studies, ethics of innovation, and innovation studies, the Social Acceptance of Technology (SAT) framework moves beyond narrow behavioral models and aggregated public opinion metrics. It treats acceptance not as a fixed outcome, but as a set of interrelated processes involving diverse actors, evolving institutional arrangements, and contested values.

In the context of 6G, the SAT framework offers a promising approach for capturing the multiple levels and objects of acceptance – from the institutional conditions that shape innovation, to the societal debates that emerge during deployment, to the individual experiential responses that follow. Rather than excluding approaches such as TAM, UTAUT, or public acceptance, SAT incorporates them within a broader analytical landscape – highlighting how user attitudes, public sentiments, and social legitimacy are interrelated and shaped by wider institutional and normative dynamics.

Recognizing acceptance as a dynamic and multi-level phenomenon enables more reflective, responsive, and responsible technology development. Furthermore, this approach extends beyond 6G, offering valuable insights for future innovations that will similarly challenge how societies define progress, manage risk, and negotiate change.

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