Design For Inclusion 6

Stefania Camplone
Claudia Porfirione *Editors*

Design for All and the Future of the Planet

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The book series “Design for Inclusion” publishes studies aimed at untangling the complex relationships between design and society, especially with regard to human diversity and inclusion. The series cover the classical fields of industrial design, such as product design, interior design, service design and communication design, with a special focus on their interactions with other disciplines, such as the physical and social sciences. In particular, the series reports on the latest developments, both theoretical and practical, concerning different approaches to “Design for Inclusion”: Universal Design, Inclusive Design, and Design for All. It shares insights into their multiple, interdisciplinary relationships with both the human sciences and the transversal frameworks and approaches typical of Human-Centered Design (HCD) and Design for Sustainability. “Design for Inclusion” addresses a very broad readership, including designers, engineers, architects, social scientists and stakeholders, who deal with any of the topics mentioned above and their various implications. It publishes volumes fostering scientific advances, as well as books devoted to supporting education and professional training. These include monographs, edited books and conference proceeding. Outstanding PhD theses on emerging topics, if properly reworked, may also be considered for publication. This book series is published with the support of EIDD—Design for All Europe.

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User Integration Funnel: A Theoretical Model for User Research Practices

Annapaola Vacanti

Abstract

The paper introduces the User Integration Funnel, a theoretical model for enhancing user participation in the design process, within the framework of Human-Centered Design (HCD) and Human-Technology Interaction (HTI). As the integration of data into design becomes increasingly prevalent, the model responds to the challenges of balancing quantitative insights from big data with the nuanced, contextual understanding provided by thick data. This dual approach emphasizes inclusivity and adaptability, fostering designs that not only function effectively but also resonate with diverse user experiences. The model conceptualizes user engagement through three concentric levels: sporadic involvement, sustained observation, and active collaboration. Each level explores a distinct interaction type, knowledge accessibility, and output, ranging from user opinions to behavioral insights and co-created ideas. These levels align with mixed-method research paradigms, blending qualitative and quantitative methods to address the complexities of HTI projects. According to a systemic perspective, users are situated within interconnected human, technological, and ecological networks. HCD theory must acknowledge practical challenges, such as power dynamics, resource constraints, and varying levels of user literacy, advocating for progressive engagement to ensure meaningful participation. While the framework promotes inclusive, adaptive technologies, it raises critical questions about the implications of hyper-adaptivity. By minimizing friction and resistance in human experiences, design risks undermining the critical thinking, creativity, and resilience that emerge from overcoming challenges. It is thus urgent for designers to balance the benefits of seamless interaction with the preservation of human autonomy, creativity, and growth, through a holistic, humane approach to the co-evolution of humans and technology.

Keywords

User research · Human technology interaction · Co-design · User participation · Humane technology

1 Human—Technology Interaction and Designing with Data

Since the dawn of humanity, artificial solutions have played a critical role in reducing effort, simplifying tasks, and enabling achievements beyond physical and cognitive limitations. Collectively referred to as *technology*, these

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artifacts have evolved into complex, interconnected, and often autonomous systems, bridging the physical and digital realms. The design discipline, broadly defined by Buchanan as the conception and planning of the artificial (Buchanan, 1992), is pivotal in determining the purpose, functionality, and usability of these non-natural artifacts.

In today's era, our tools not only assist us but also collect and record behavioral data, generating an immense volume of information that transforms human lives into data streams, a phenomenon known as *datafication* (Cukier & Mayer-Schoenberger, 2014). This trend generates valuable insights but also raises concerns about prioritizing technological interests over human needs (Galimberti, 2023). As technological advancement accelerates, humanity's relationship with technology is shifting from coexistence to *co-evolution*, marking the dawn of a *hybrid age* characterized by ubiquitous, intelligent, and social technologies (Khanna & Khanna, 2013).

However, not all individuals can harness the full potential of available technology. The *Technology Quotient* (TQ) (Nosta, 2017) quantifies an individual's ability to adapt and integrate technology, yet global technological literacy remains alarmingly low. Reports from the OECD (2016) reveal that in 33 industrialized countries, only 5% of the population possesses advanced technological skills, with the majority struggling to complete moderately complex tasks. This discrepancy underscores a profound gap between the competencies of average users and the so-called technological elite, including engineers and designers (Nielsen, 2016). The reliance on vast computational capabilities and global databases fosters a quasi-mystical faith in data and algorithms (Davis, 2015), often sidelining critical human oversight (Anderson, 2008). Data-driven processes frequently reflect inherent biases in their design and datasets, emphasizing the need for human critique in interpreting information meaningfully. Human - Technology Interaction (HTI) thus stands as an iterative discipline that hybridizes technical knowledge with humanistic insights, gathered by involving users in the design process.

In the context of data, the growing reliance on big data marks a profound transformation in design. Characterized by an abundance of data, this trend enables unprecedented optimization but often sacrifices inclusivity by marginalizing minorities and reinforcing biases (Criado Perez, 2019). Conversely, *thick* data (Wang, 2016), derived from qualitative methods from small datasets, provides nuanced insights into user contexts and emotions, complementing the breadth of big data. The integration of both approaches creates a holistic understanding essential for inclusive and human-centered design.

For example, while big data offers scalable insights into user behavior through algorithms and statistical models, it often lacks the depth required to understand unique user needs or cultural contexts. *Thick* data, collected through interviews, focus groups, and ethnographic methods, fills this gap by capturing emotional and social dimensions. Together, these methodologies enable designers to balance scale with depth, fostering innovative and inclusive solutions (Fig. 1).

Additionally, emerging frameworks such as *data-informed design* (King et al., 2017) and *data-enabled design* (Bogers et al., 2016) offer structured approaches for integrating data into the design process. These methodologies empha-

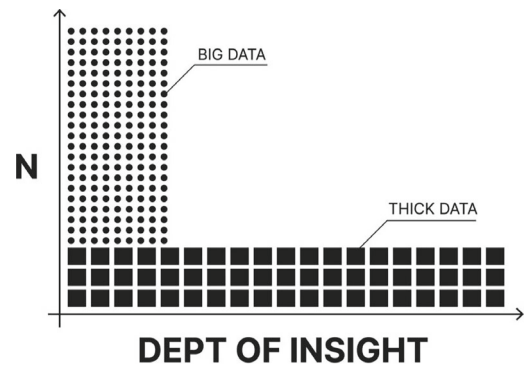

Fig. 1 A comparison between big data and thick data. Where thick data loses in scale, big data loses in resolution (credits of the author, 2024)

size collaboration between designers, users, and data scientists, promoting iterative cycles of prototyping and testing. The hybridization of big and *thick* data has also led to frameworks like *big-thick blending* (Bornakke & Due, 2018), which calibrates and contextualizes large-scale data insights with qualitative observations to add depth and understanding.

As the role of data in design evolves, designers must adopt new competencies to navigate the challenges of a data-driven world. They assume roles as translators, team leaders, and analysts, bridging gaps between technical and human-centered perspectives as categorized by Lu et al. (2021). For instance:

1. Designers as *translators* facilitate communication between disciplines, requiring technical literacy and strong interpersonal skills;
2. Designers as *empathizers* leverage their ability to interpret user needs, even in the context of large datasets;
3. Designers as *team leaders* guide projects by combining data insights with intuitive decision-making;
4. Designers as *analysts* assess data for meaningful patterns, ensuring designs remain relevant and user-focused.

These roles highlight the growing complexity and interdisciplinarity of the design profession. As translators, designers bridge technical and human dimensions, fostering collaboration among diverse stakeholders and aligning technical frameworks with cultural and social contexts. As empathizers, they humanize data-driven processes, addressing big data's limitations by integrating qualitative insights to create trustful, user-centered solutions. Team leaders balance data-driven rigor with creative intuition, mediating conflicts and aligning multidisciplinary goals. As analysts, designers critically evaluate data, identifying biases and contextualizing findings to ensure designs are not only functional but also equitable and inclusive.

Hybrid methodologies that balance quantitative insights with qualitative depth are vital for addressing the growing complexity of user needs. By integrating these approaches, designers can ensure that data serves as a tool for understanding, rather than dictating, human experiences. This paper aims to contribute to this dialogue by introducing the User Integration Funnel, a theoretical model that enhances user participation in design processes. Through its framework, the model demonstrates how different levels of interaction, knowledge accessibility, and collaboration can foster inclusivity and enable human-centered technological innovation.

2 User Participation Theory

The role of the designer lies in applying his/her expertise proactively to the existing, producing either incremental or even disruptive innovations (Giacomin, 2014). This creative synthesis activity is rooted in interpreting the complex factors driving societal change, aiming to deliver solutions that address people's needs, expectations, and desires, potentially even proposing new lifestyles (Tosi, 2018). Within this framework, Human-Centered Design (HCD) has emerged as a distinct approach, prioritizing people over the creative and aesthetic processes of designers or the technical specifications of the artifacts themselves. Originating in the 1970s under the term User-Centered Design (UCD), it was redefined as HCD and later expanded in *Humanity Centered Design* by Norman (2023), emphasizing the focus on people rather than their roles as end-users.

The HCD approach finds parallels in ergonomics, sharing its concern for human well-being while also extending into areas such as HTI and User Experience (UX). These fields focus on optimizing the global experience of interacting with an artifact, delving into the desires and expectations of users. The HCD process focuses on increased effectiveness, efficiency, and user satisfaction while mitigating potential adverse effects on health, safety, and performance. This iterative and multidisciplinary approach ensures that the user needs guide design, involving users throughout

the process and focusing on the entire user experience.

However, the practice of HCD is not without challenges. Designers and organizations may underestimate its value, failing to account for systemic issues or creating artifacts that are inflexible and narrowly tailored. Such shortcomings are exemplified by the *Five Fundamental Fallacies* (Pheasant & Haslegrave, 2005), which include misconceptions such as designing for the average user or over-relying on personal intuition. Rubin and Chisnell (2008) stress the iterative nature of HCD as an empirical process, grounded in understanding human diversity to adapt designs to behaviors rather than expecting users to conform to pre-existing solutions. As technology becomes more intelligent and context-sensitive, especially in domains such as IoT and assistive robotics, emotional and psychological factors increasingly shape user acceptance, demanding nuanced approaches to design that balance usability with personal and contextual adaptability.

The question of how to effectively engage users in the design process has sparked critical debates. While user involvement is fundamental to HCD, it can inadvertently constrain innovation if users are unable to articulate future needs or rely on familiar concepts (Van Kleef et al., 2005). The dynamic between user insights and designer expertise necessitates a spectrum of methods for capturing explicit, observable, and latent user knowledge (Sanders, 2005). These include interviews, ethnographic studies, and co-design workshops, each offering distinct advantages and challenges depending on the phase and focus of the design process. The interplay between these methods highlights the need for flexibility and adaptability in how designers approach user research.

Central to HCD is the acknowledgment of users as carriers of domain-specific knowledge, with designers acting as facilitators who translate this knowledge into actionable insights. This shift in roles reflects broader disciplinary trends, where participatory and co-design approaches encourage users to become active contributors. These methodologies, rooted in the Scandinavian tradition of democratizing design, aim to empower users by leveraging their tacit knowledge while fostering mutual learning between stakeholders (Spinuzzi, 2005). Co-design, in particular, emphasizes creating shared design languages and tools, enabling collaborative ideation and prototyping that transcend traditional hierarchies.

Despite the strengths of HCD, contemporary design challenges demand a broader perspective that accounts for the systemic and ecological implications of design decisions. Designers must move beyond user-centricity to consider the complex interplay of human and non-human actors within interactive systems (Norman, 2023; Slavin, 2016). This systemic approach requires balancing empathy for individual users with an awareness of the broader socio-environmental context, acknowledging that design interventions often have ripple effects extending far beyond the immediate user base.

The convergence of various design disciplines toward shared reflections on the human-technology relationship underscores the evolving nature of design as a field. From ergonomics to UX, interaction design to data-driven methodologies, these domains increasingly intersect in their focus on creating meaningful, inclusive, and context-aware experiences. The proliferation of Living Laboratories exemplifies this interdisciplinary synthesis, merging HCD principles with data-driven insights to foster open, participatory innovation. By situating research within real-life contexts, Living Labs bridge the gap between controlled experimentation and the chaotic realities of everyday life, yielding insights that inform more robust and adaptable design solutions.

The trajectory of HCD reflects a shift from addressing individual needs to navigating the complexities of interconnected systems. As Van Mensvoort (2022) suggests, the future of design lies in embracing a humane approach—one that prioritizes compassion, inclusivity, and the co-evolution of humans and technology within a shared ecological framework. This holistic perspective challenges designers to redefine their role, not as isolated problem-solvers but as facil-

itators of collective innovation within a diverse and dynamic world. The synthesis of these reflections forms the foundation for advancing the discipline, fostering a more integrated and responsive design practice.

The User Integration Funnel.

User research practices constitute a vast and diverse toolbox available to researchers and designers to inform their work and make effective, informed choices. Data collection activities are increasingly becoming an integral part of the design process, both in academia and industry, making it essential for designers to engage with their users (Rohrer, 2014). Various methods allow for leveraging users' knowledge on a given topic at different levels, either by listening to them, observing their behaviors, or enabling them to propose (or co-create) innovative solutions (Westerlund, 2007). In this perspective, users are considered key actors in placing their daily life ecosystems at the center of the ideation, experimentation, and evaluation of technological artifacts. However, existing methods often face challenges that risk undermining, or at least diminishing, the reliability of their outcomes. Quantitative approaches have the advantage of enabling the collection of large datasets at relatively low costs, which can also be made accessible through open access for the scientific community. The study of such aggregated data offers a precise understanding of observable behaviors (Veeckman & Van Der Graaf, 2015). However, in the context of HTI, quantitative methods fall short in at least two aspects identified by Romero Herrera (2017): exploring the appropriation of technology and the adoption of new practices by users within their life contexts, and involving users in the ideation and evaluation phases of artifacts.

Qualitative methods seem preferable in addressing these gaps, although they also present challenges. For instance, co-design or usability testing activities often require users to replace mature technologies with unstable or incomplete solutions, which significantly impacts their assessment of the potential adoption of such products (Ogonowski et al., 2013). Researchers must also account for the cognitive effort and time commitment required from participants, who may easily lose motivation and interest, leading to feelings of burden, annoyance, or boredom (Rek et al., 2013).

Creswell and Clark (2011) coined the term *Mixed Methods Research* (MMR) to describe an approach that integrates both quantitative and qualitative methods to address research questions at various stages of the process. This integration can occur through three different approaches:

1. Connecting: a qualitative data source builds upon or follows a quantitative one (or vice versa);
2. Merging: data are collected using both quantitative and qualitative methods and then compared or interrelated;
3. Embedding: a qualitative dataset is embedded within a quantitative one (or vice versa) to explain one dataset's findings through the other.

These three MMR approaches illustrate the flexibility and adaptability of combining qualitative and quantitative data to address complex research questions. The connecting approach allows researchers to build on the strengths of one method to enrich or validate findings from the other, ensuring a comprehensive understanding of the subject. The merging approach fosters a more integrative perspective by comparing and interrelating datasets, revealing patterns or insights that may not emerge from a single method. Finally, the embedding approach is particularly valuable in providing deeper context to quantitative findings or validating qualitative observations through measurable data.

Designing technological solutions that are inclusive, acceptable, and humane in the sense proposed by Van Mensvoort (2022) requires leveraging human values and insights while empowering users to improve their conditions and enabling interactions that feel natural and resonate with their senses.

A visual metaphor of a funnel viewed from above illustrates three levels of user integration in the design process (Fig. 2), inspired by the

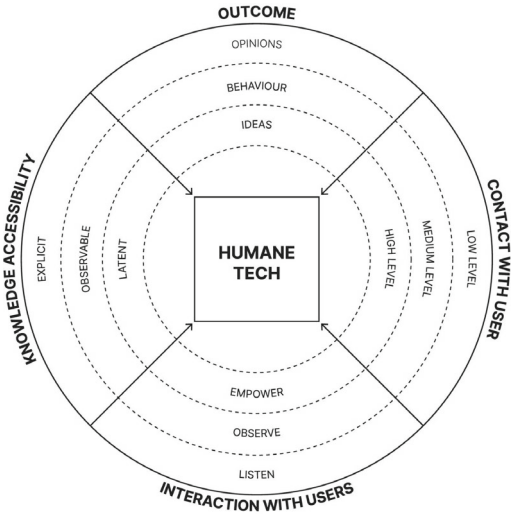

Fig. 2 The visual representation of the User Integration Funnel (credits of the author, 2024)

model for sustainable innovation in Living Labs (Romero Herrera, 2017).

The four quadrants of the diagram represent different types of interaction with users, the accessibility level of the knowledge sought, the degree of contact between researchers and users, and the outputs generated. The type of interaction defines various roles for users as contributors to design research.

- The outer ring represents sporadic involvement, where users share their opinions through activities guided by the designer.
- The middle ring indicates a more interactive role, where users act and interact within the study context, while their behaviors are observed and interpreted by the designer.
- The inner ring signifies active collaboration, where users are enabled to propose their ideas and evaluate solutions.

The level of knowledge accessibility reflects the type of user expertise being engaged:

- The outer ring pertains to explicit knowledge, which users articulate verbally.
- The middle ring relates to users' actions and observable skills in using a system.
- The inner ring involves users' creative abilities, which are latent and require activation through collaboration with designers.

The degree of contact describes the interaction intensity between users and designers:

- The outer ring represents brief engagements, such as interviews or similar activities.
- The middle ring involves sustained collaboration over time, requiring direct interaction during the observation period.
- The inner ring represents deep collaboration, fostering a close working relationship.

Outputs vary based on these parameters:

- The outer ring produces explicit opinions expressed by users.
- The middle ring generates an understanding of users' observed behaviors.
- The inner ring yields new ideas and insights applicable to the project.

The first level of integration is characterized by merging different data collection techniques. Quantitative data from surveys, self-reported diaries, or other methods are combined with qualitative data from interviews and focus groups. The second level uses connected data, linking information gathered through both methods to capture everyday practices empathetically and objectively. The third level involves connecting collaborative activity results with qualitative (e.g., self-reports, interviews) and quantitative methods (e.g., sensor recordings) to enrich the data. These data can provoke further reflections and insights among users.

An ideal innovation process encompasses all integration levels to address HTI project complexity comprehensively. Realistically, the appropriate integration level for each project depends on factors such as its scope and objectives, available resources, technical capabilities, timelines, and the expertise and availability of the designers, researchers, and users involved.

The funnel also incorporates a systemic perspective, recognizing the interconnectedness of human, technological, and ecological systems. By situating users within broader frameworks, the model aligns with the Gaia hypothesis, which envisions the Earth as a self-regulating system where humans are one of many interdependent components (Lovelock, 2000). This systemic thinking is essential for addressing the complex challenges of contemporary design, including sustainability, inclusivity, and ethical responsibility.

It is relevant to note that factors such as power dynamics, resource constraints, and varying levels of user literacy can pose barriers to effective collaboration (Holmes, 2020). Designers must navigate these obstacles by fostering trust, ensuring accessibility, and adapting their methodologies to the unique characteristics of their user base. By promoting progressive engagement, the funnel provides a pathway for overcoming these challenges, ensuring that user participation remains meaningful and impactful.

3 Conclusions and Openings

The discussions presented in this paper reflect on the complex interplay between humans and technology, exploring how design methodologies can mediate this relationship. The integration of user participation into the design process, organized through the User Integration Funnel, requires a balanced approach that leverages both data-driven insights and empathetic understanding. While the framework offers pathways to more inclusive and adaptive technologies, it also raises broader questions about the implications of designing for seamless interaction.

The contemporary design landscape increasingly prioritizes accessibility, inclusivity, and personalization, striving to create technologies that respond flexibly and intuitively to human needs. However, this trend toward hyper-adaptivity prompts critical reflection on the consequences of removing friction from human experiences. By shaping a world that offers less resistance and anticipates our desires, we risk creating environments that diminish the very challenges that foster critical thinking, creativity, and resilience (Vacanti, 2024). The act of overcoming obstacles, of engaging with complexity, is not merely a source of difficulty—it is a fundamental aspect of human development.

This reflection highlights a key tension in the designer's role. On the one hand, designers are tasked with improving usability, reducing cognitive load, and enhancing the quality of life through technology. On the other, they bear a responsibility to question whether total optimization serves human agency. Can we, as designers, strike a balance between enabling ease and preserving the capacity for struggle, learning, and growth?

Moreover, as technologies increasingly interconnect, the role of the designer must expand to consider the broader ecosystems in which these artifacts operate. Designing for human-technology interaction is no longer about creating isolated tools but about shaping systems where human and non-human actors coexist and co-evolve. This requires not only technical proficiency but also ethical and systemic awareness.

In conclusion, the design of inclusive, adaptive technologies must go hand in hand with a deeper consideration of their societal and psychological impacts. As we push the boundaries of personalization and seamless interaction, we must remain vigilant about preserving the essential human qualities of autonomy, creativity, and critical thought.

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