

## Advancing digital inclusion and equitable access through human-centered product development frameworks

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### Abstract

Digital products and services increasingly mediate access to education, employment, healthcare, and civic life, yet large segments of the global population remain excluded from their benefits because of disability, language, income, geography, or low digital literacy. This review article examines how human-centered product development can serve as a practical mechanism for advancing digital inclusion and equitable access. Drawing on established design frameworks, including ISO 9241-210, the Microsoft Inclusive Design Toolkit, IDEO's Human-Centered Design process, the W3C Web Content Accessibility Guidelines, and IBM's Enterprise Design Thinking, the article synthesizes their core elements and identifies recurring principles that distinguish genuinely inclusive practice from design processes that merely claim to be user-centered. The discussion situates these frameworks within the broader conceptual landscape of inclusion, accessibility, and equity, and considers evidence from organizational practice that illustrates both the promise and the limits of current approaches. Persistent barriers, including resource constraints, fragmented accountability, and the tendency to treat accessibility as a compliance checkbox rather than a design value, are examined alongside strategies for embedding inclusion more durably across the product lifecycle. The article concludes by proposing directions for future research, including longitudinal evaluation of inclusive design outcomes and the development of shared metrics for equitable access across digital industries.

**Keywords:** Digital Inclusion; Equitable Access; Human-Centered Design; Inclusive Design; Accessibility; Product Development; Design Equity

### 1. Introduction

Digital interfaces now constitute the principal medium through which individuals seek employment, conduct financial transactions, access healthcare information, and engage with public institutions. This transformation, already underway for more than a decade, accelerated markedly in the early 2020s, compressing into a few years a transition that might otherwise have unfolded over a much longer period. For a substantial proportion of the global population, this shift has extended access to opportunity in ways that earlier generations could scarcely have anticipated. For a significant minority, however, the same transformation has reinforced existing patterns of exclusion, converting what were once

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situational obstacles, such as a missed bus or a closed government office, into a more durable and structural barrier between those who can use a digital product and those who cannot.

The determinants of this barrier are seldom singular. Some individuals lack reliable connectivity or affordable devices; others encounter interfaces that presuppose a level of literacy, linguistic fluency, or sensory and motor capability they do not possess; still others disengage not because a given service is technically unavailable to them, but because its design assumes circumstances that do not correspond to their own. Digital inclusion, understood in this light, cannot be reduced to a question of connectivity alone[1]. A household with a functioning smartphone and an active data plan may remain effectively excluded from a service if that service was never evaluated with users who have low vision, limited proficiency in its primary language, or no prior familiarity with formal financial systems.

The consequences of this exclusion are far from abstract. Increasingly, exclusion from digital products entails exclusion from labor markets that recruit predominantly online, from health systems that triage care through patient portals, and from educational resources that have migrated substantially to digital platforms. Because the populations most susceptible to exclusion, including older adults, people with disabilities, rural communities, and low-income households, already contend with other forms of structural disadvantage, poorly designed digital products do not merely fail to assist them; they compound disadvantage that originates elsewhere in their lives. Equitable access to digital products is therefore not a peripheral concern for designers and product teams, but a matter directly implicated in broader questions of social and economic participation[2].

Human-centered design represents one of the more credible responses available to this problem, insofar as it proceeds from the premise that products should be shaped around the people who use them rather than around organizational convenience or technical expedience[3]. The label, however, is frequently applied with insufficient rigor. Many organizations describe their processes as user-centered while engaging only a narrow and relatively privileged segment of their user base, often a segment that closely resembles the design team itself. A process may be iterative, well documented, and genuinely responsive to feedback while nonetheless excluding the very populations that digital inclusion efforts are intended to serve[4]. It is this disjunction, between human-centered design as a declared institutional value and human-centered design as a disciplined, consistently applied practice, that occupies the remainder of this article.

This article examines that disjunction in two complementary ways. It first asks what a human-centered product development framework would need to incorporate, both structurally and culturally, to function as a genuine mechanism for digital inclusion and equitable access, rather than as a retrospective label attached to processes that were never designed with marginalized users in mind. It then traces this question through the conceptual literature and through documented organizational practice, beginning with the vocabulary that distinguishes inclusion, accessibility, and equity; proceeding to a comparative review of established human-centered and inclusive design frameworks; and concluding with an examination of practice-based evidence, strategic recommendations for embedding inclusion across the product development lifecycle, and directions for future research.

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## **2. Understanding Digital Inclusion, Equitable Access, and Human-Centered Product Development**

Before examining specific frameworks, it is necessary to establish a shared vocabulary. The terms digital inclusion, equitable access, and human-centered product development are often used as though they were interchangeable, but each carries distinct implications for how a design process should be evaluated[5]. This section defines each term in turn and then considers how they intersect within digital environments, where accessibility, inclusion, and equity frequently get treated as synonyms despite addressing different aspects of a design problem.

### **2.1. Digital Inclusion and Equitable Access**

Digital inclusion is often used as a shorthand for internet access, but the concept developed within policy and scholarly literature is considerably broader[6]. It typically encompasses at least three interlocking dimensions: the availability of affordable connectivity and devices, the skills needed to use digital tools effectively, and the existence of content and services that are actually relevant and usable for a given person's needs. A community can have widespread broadband coverage and still be digitally excluded if the available services are not designed in a language, format, or interaction style that residents can use[7]. This distinction matters because policy responses that focus solely on infrastructure, such as laying fiber or subsidizing devices, address only one dimension of a multidimensional problem.

Equitable access extends this idea by introducing a normative claim about fairness. Equality of access would mean offering everyone the same product under the same conditions; equity recognizes that people start from different

positions and may need different accommodations to reach a comparable outcome[8]. A single, undifferentiated digital interface may technically be available to everyone, yet produce systematically worse outcomes for users with disabilities, limited literacy, or unfamiliar technological conventions[9]. Equitable access, in this sense, asks not whether a product is technically reachable, but whether it produces comparable value for the range of people who attempt to use it. That shift, from access understood as availability to access understood as usable, equitable value, is central to how this article frames the relationship between inclusion and product design.

## **2.2. Human-Centered Product Development**

Human-centered product development refers to an approach in which the needs, behaviors, and constraints of intended users actively shape decisions throughout a product's lifecycle, rather than being consulted only at a validation stage once a solution has already been built[10]. The approach typically involves direct engagement with users through methods such as interviews, contextual observation, and usability testing; the translation of that research into requirements and design constraints; and iterative cycles of prototyping and evaluation that allow a team to revise its assumptions before committing significant engineering resources.

What separates human-centered development from more conventional product processes is less the presence of user research, since most organizations now claim to do some form of it, than the degree to which that research is allowed to alter the direction of a product[11, 12]. A team that conducts interviews but proceeds largely unchanged by what it hears is not practicing human-centered design in any meaningful sense, regardless of the methods used. Genuine human-centered development treats user evidence as a constraint on design decisions, not as a formality to be documented and then set aside[13]. This distinction becomes particularly important when the discussion turns to inclusion, because the users most likely to be excluded from a product are often the ones least likely to be represented in a convenience sample of research participants drawn from an organization's existing customer base.

## **2.3. Inclusion, Accessibility, and Equity in Digital Environments**

The terms inclusion, accessibility, and equity are related but not interchangeable, and conflating them tends to produce design processes that satisfy the letter of one concept while neglecting the others. Accessibility, in its most established sense, refers to whether a product can be perceived, operated, and understood by people with disabilities, typically assessed against technical standards such as the Web Content Accessibility Guidelines[14]. It is the most measurable of the three concepts, which is part of why it is often treated as a compliance exercise rather than a design philosophy.

Inclusion is a broader practice concerned with whether the design process itself incorporates a representative range of human difference, encompassing age, language, culture, income, and technological familiarity in addition to disability. A product can meet formal accessibility standards while still being designed through a process that never engaged anyone outside a narrow demographic, producing an interface that is technically accessible but practically unwelcoming or confusing for the populations it was meant to serve[15,16].

Equity, finally, concerns outcomes rather than process: whether the eventual product narrows or widens existing disparities in who benefits from it. A digital service can be accessible and built through an inclusive process and still produce inequitable outcomes if, for example, it requires resources such as time, devices, data, or trust in institutions that are unevenly distributed across the population it serves[17]. Treating these three concepts as a layered set of considerations, rather than as synonyms, gives product teams a more precise vocabulary for diagnosing where a design process is succeeding and where it is not.

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## **3. Conceptual Foundations of Human-Centered Digital Inclusion**

If the previous section established what these terms mean, this section asks where they come from conceptually: what theoretical and methodological commitments underlie human-centered design, and how inclusive design and equity-oriented thinking extend or challenge those commitments. Understanding these foundations matters because the frameworks examined in Section 4 do not emerge from a single coherent tradition; they draw, often only implicitly, on the principles discussed here, and recognizing those origins helps explain why the frameworks differ in scope and emphasis.

### **3.1. Principles of Human-Centered Design**

The conceptual basis for human-centered design has been formalized most explicitly in international standards such as ISO 9241-210, which frames the approach around a small set of recurring commitments[18]. Design should be grounded in an explicit understanding of users, their tasks, and the environments in which they operate, rather than relying on

internal assumptions about who the user is. Users should be involved throughout development, not only at the beginning or end[19]. The process should be iterative, with design solutions evaluated against real user behavior and revised accordingly, and it should be carried out by teams with a range of skills and perspectives rather than by designers working in isolation from engineering, research, and domain expertise. Finally, the process should address the whole user experience, including how a product is discovered, learned, and abandoned, rather than narrowly optimizing a single interaction.

These commitments are easy to state and considerably harder to sustain under organizational pressure. Context-of-use research is often the first activity cut when timelines tighten, because its value is diffuse and its absence is not immediately visible in a working prototype. Iteration is frequently treated as a single round of feedback rather than a sustained discipline[20]. The principles nonetheless provide a useful baseline against which more specialized inclusive and equity-oriented frameworks can be understood, since most of them retain this core structure of context, requirements, design, and evaluation, while adding specific commitments aimed at populations that conventional user research tends to miss.

### **3.2. Inclusive Design and Accessibility Perspectives**

Inclusive design adds a more pointed argument to this baseline: exclusion is rarely accidental, and a process that does not actively work to identify who it is leaving out will, by default, reproduce the assumptions and limitations of the people building the product. This argument is captured concisely in widely adopted toolkits that frame inclusive design around recognizing exclusion as it occurs, learning directly from people whose experiences differ from the design team's own, and treating a solution built for someone with a specific constraint as a source of insight that often benefits a much larger population. The well-known observation that curb cuts built for wheelchair users also benefit parents with strollers and travelers with luggage is frequently invoked to illustrate this last point, though the underlying argument extends well beyond physical infrastructure into digital interface design[21,22].

Accessibility perspectives contribute a complementary but distinct emphasis: where inclusive design is largely concerned with the process by which a product is conceived, accessibility frameworks such as the Web Content Accessibility Guidelines specify testable properties of the finished product[23]. Content should be perceivable through more than one sense, interface elements should be operable through more than one input method, instructions and feedback should be understandable, and the underlying code should be robust enough to work reliably with assistive technologies[24]. These criteria give accessibility a precision that inclusion, as a broader cultural commitment within an organization, does not always have on its own. Used together, the two perspectives address different failure modes: a process can be genuinely inclusive yet still ship inaccessible code, just as accessible code can emerge from a process that never meaningfully engaged the populations it claims to serve.

### **3.3. Equity as a Design Principle**

Equity occupies a less settled position within design literature than either human-centered design or accessibility, in part because it requires product teams to reason about outcomes that extend beyond the immediate interaction with a single product. A design choice that appears neutral at the level of an individual user, such as requiring a government-issued identification number to complete onboarding, can have starkly different consequences depending on how evenly that document is distributed across the population a service is meant to reach[25]. Treating equity as a design principle means asking, at each significant decision point, whether a choice is likely to widen or narrow the gap in outcomes between users who are already well served by digital products and those who are not.

This framing distinguishes equity from a more generic commitment to fairness or universal design. Universal design aims, where feasible, to create a single solution that works for the broadest possible range of users without need for adaptation[26]. Equity-oriented design accepts that a single solution will not always be possible or even desirable, and that differentiated paths, such as alternate verification methods, offline fallback options, or simplified language variants, may be necessary to produce comparable outcomes across a diverse user base[27]. Incorporating equity as an explicit design principle, rather than treating it as an implicit byproduct of good usability practice, pushes product teams toward design decisions and trade-off conversations that purely user-experience-oriented frameworks do not reliably surface on their own.

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## **4. Human-Centered Frameworks for Digital Inclusion and Equitable Access**

Having established the conceptual vocabulary for discussing inclusion, accessibility, and equity, it is useful to examine how these ideas have been operationalized in frameworks that organizations actually use[28]. The five frameworks reviewed in this section were selected because each has wide adoption beyond a single company or sector, because

together they span standards bodies, design consultancies, and large technology firms, and because each makes an explicit, citable claim about how human-centered or inclusive practice should be structured. The intent is not to rank these frameworks against one another, but to identify where their core elements converge and where the convergence breaks down, since those points of divergence often mark where digital inclusion work is most fragile in practice.

#### 4.1. Core Elements of Inclusive Product Development Frameworks

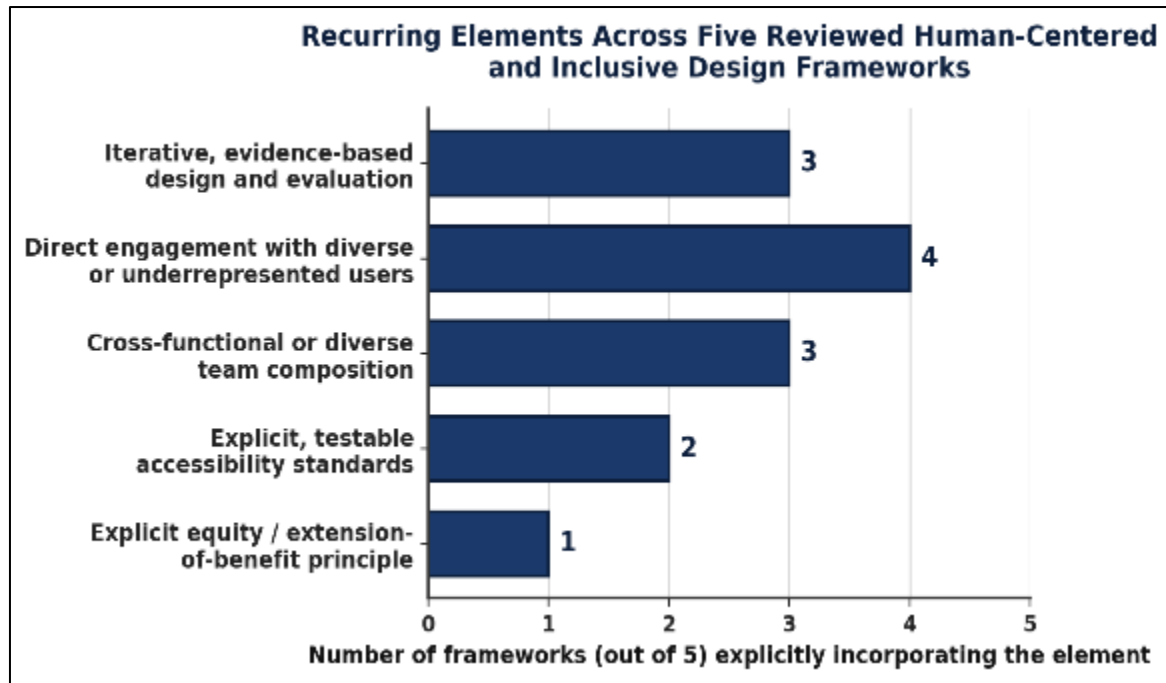
Table 1 summarizes five frameworks that are widely referenced in human-centered and inclusive product development: the ISO 9241-210 standard for human-centered design, the Microsoft Inclusive Design Toolkit, IDEO's Human-Centered Design process, the W3C Web Content Accessibility Guidelines, and IBM's Enterprise Design Thinking. Each originated in a different institutional context, an international standards body, a technology company's design practice, an innovation consultancy, a global web standards consortium, and an enterprise software organization, respectively, yet each addresses some version of the same underlying question: how should a product development process be structured so that it reliably serves the people who will use the resulting product.

**Table 1** Core elements of five widely used human-centered and inclusive design frameworks[29].

| Framework                                                   | Originating Organization                             | Key Principles / Elements                                                                                                       | Primary Process Emphasis                                           |
|-------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| ISO 9241-210 (Human-Centred Design for Interactive Systems) | International Organization for Standardization (ISO) | Understanding context of use; specifying user requirements; producing design solutions; evaluating designs against requirements | Iterative, multidisciplinary design–evaluation cycle               |
| Inclusive Design Toolkit                                    | Microsoft                                            | Recognize exclusion; learn from diversity; solve for one, extend to many                                                        | Designing from the margins outward to benefit a broader population |
| Human-Centered Design (HCD) Process                         | IDEO / IDEO.org                                      | Inspiration, ideation, and implementation; balancing desirability, feasibility, and viability                                   | Empathy-driven research with rapid, iterative prototyping          |
| Web Content Accessibility Guidelines (WCAG)                 | World Wide Web Consortium (W3C)                      | Perceivable, operable, understandable, robust (POUR)                                                                            | Testable conformance criteria applied to finished digital content  |
| Enterprise Design Thinking                                  | IBM                                                  | Focus on user outcomes; diverse, empowered teams; restless reinvention                                                          | Continuous Observe–Reflect–Make loop embedded in product teams     |

Read together, the five frameworks share a recognizable family resemblance, but the table also makes their differences legible. ISO 9241-210 and IBM's Enterprise Design Thinking are primarily process standards: they describe how a team should organize its work, with comparatively little to say about which specific populations require additional accommodation. The Microsoft Inclusive Design Toolkit and the Web Content Accessibility Guidelines move in the opposite direction, anchoring their guidance explicitly in disability and exclusion, though one does so through cultural principles aimed at design teams and the other through testable technical criteria aimed at finished products[30,31]. IDEO's framework sits closer to the process end of this spectrum, with its desirability-feasibility-viability lens functioning as a general-purpose filter for evaluating any product concept rather than a tool aimed specifically at marginalized users.

This unevenness is not so much a flaw as a reflection of the different problems each framework was built to solve. It does, however, create a practical risk for organizations that adopt only one of these frameworks and assume it covers the full scope of inclusive product development. A team following IBM's Enterprise Design Thinking faithfully, for instance, could still ship a product that fails basic accessibility conformance, because nothing in that framework's three principles addresses technical accessibility directly. The chart below makes this unevenness more concrete by counting how many of the five frameworks explicitly incorporate each of several recurring elements identified through this review.



**Figure 1** Recurring elements across the five frameworks summarized in Table 1, based on a qualitative reading of each framework's published principles [32].

The pattern in Figure 1 reinforces the point made above. Direct engagement with diverse or underrepresented users appears, in some form, in four of the five frameworks, and iterative, evidence-based design and cross-functional team composition each appear in three. Explicit, testable accessibility standards and an explicit principle for extending benefit equitably across a population are far less common, appearing in only two frameworks and one framework respectively. In practice, this means that an organization assembling its design practice from general-purpose human-centered or inclusive design guidance is likely to inherit reasonably strong habits around user engagement and iteration, but is unlikely to inherit explicit accessibility conformance or an equity lens unless it deliberately adds one. The implication for product teams is straightforward, even if it is not always acted on: adopting a human-centered framework, by itself, does not guarantee an inclusive or equitable outcome. Inclusion and equity need to be named as explicit design requirements, with their own success criteria, rather than assumed to follow automatically from a generally user-centered process[33].

#### 4.2. User Engagement and Co-Creation in Design Processes

User engagement, in conventional product practice, often means recruiting a handful of participants for usability testing late in a development cycle, after most significant decisions have already been made. Co-creation describes a different relationship, in which the people who will use a product participate in defining the problem and shaping potential solutions, not only in evaluating a design that has already been substantially finalized. The distinction matters for digital inclusion because usability testing conducted late in a process tends to surface surface-level friction, such as confusing labels or unclear navigation, while co-creation conducted earlier is more likely to surface structural mismatches between a product's underlying assumptions and the lived circumstances of the people it is meant to serve.

Effective co-creation with populations that are typically underrepresented in product research requires deliberate effort that goes beyond standard recruitment practices[34]. Convenience samples drawn from an organization's existing customer base, social media following, or professional network tend to reproduce whatever demographic biases already shaped who became a customer in the first place. Reaching users with disabilities, limited digital literacy, or language barriers other than the team's working language typically requires partnerships with community organizations, disability advocacy groups, or local intermediaries who have already built trust with the relevant population[35]. This additional effort is frequently the first casualty of compressed timelines, which helps explain why co-creation remains more often endorsed in principle than practiced consistently in commercial product development.

### 4.3. Embedding Inclusion Across the Product Development Lifecycle

A recurring weakness across organizations that genuinely intend to build inclusive products is treating inclusion as an activity confined to a single phase, typically either early-stage user research or late-stage accessibility testing, rather than as a consideration that should inform decisions at every stage of the lifecycle[36]. Inclusion that is concentrated entirely in early research can be diluted or abandoned as a product moves through engineering trade-offs, scope cuts, and launch deadlines, none of which are typically owned by the research function that surfaced the original insight. Inclusion that is concentrated entirely in late-stage accessibility testing arrives too late to influence architectural decisions, such as how content is structured or how a workflow is sequenced, that are expensive to revise once implementation is underway[37,38].

Embedding inclusion across the full lifecycle instead means attaching specific, checkable inclusion and accessibility criteria to each stage of development: discovery research that deliberately includes underrepresented user segments, design reviews that evaluate concepts against accessibility and equity considerations alongside usability, engineering practices that treat accessibility conformance as a quality gate comparable to performance or security testing, and post-launch monitoring that tracks usage and outcomes across different user segments rather than relying solely on aggregate adoption metrics. None of these practices is individually complex. What tends to be difficult is sustaining them once the original motivation for inclusion work, whether a leadership mandate, a compliance deadline, or a public commitment, loses urgency, which is a recurring theme in the discussion of organizational barriers that follows in the next section.

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## 5. Insights From Practice

The preceding sections establish what inclusive, human-centered product development should look like in principle. This section turns to evidence from organizational practice, examining both documented examples of human-centered approaches producing genuinely inclusive outcomes and the barriers, at the level of individual design decisions and broader organizational structure, that continue to limit how consistently those outcomes are achieved.

### 5.1. Human-Centered Approaches in Practice

Despite the gap between principle and practice discussed throughout this article, there is a substantial body of documented experience showing what happens when human-centered approaches are applied with genuine attention to underrepresented users. The OXO Good Grips kitchen tool line is frequently cited as an early example from physical product design: tools developed initially to accommodate users with arthritis produced ergonomic grips that proved more comfortable for the general population as well, illustrating the same extend-to-many logic that later inclusive design toolkits would formalize for digital contexts[39]. In digital settings, closed captioning, developed primarily to serve deaf and hard-of-hearing users, has become a default feature for a much larger population watching video in sound-off environments such as public transit or open offices. Voice interfaces and screen-reader-compatible navigation, designed to serve users with visual impairments, have likewise proven valuable for users operating devices hands-free or in low-literacy contexts where text-heavy interfaces create friction.

These examples share a common structure: each began with a deliberate decision to engage a specific, often underserved user group, and each produced benefits that extended well beyond that original group once the resulting design pattern was generalized. That pattern offers a useful counter to the common organizational objection that designing for accessibility or inclusion serves only a small minority of users and is therefore not worth the additional investment. The evidence from practice suggests the opposite: design decisions made in service of a narrowly defined, underserved group frequently turn out to improve the experience for a much broader population, even when that broader population was never the primary design target[40].

### 5.2. Persistent Barriers to Digital Inclusion

Even where organizations are motivated to build inclusively, several barriers recur across sectors and geographies. Connectivity and device cost remain real constraints in many regions, but they are no longer the only, or even the primary, barrier in markets where mobile penetration is otherwise high; a smartphone owner can still be excluded by a data-intensive application that assumes a stable, low-cost connection the user does not have. Language coverage is another persistent gap: localization efforts frequently stop after a handful of major languages, leaving substantial populations to interact with products in a second or third language, which measurably increases cognitive load and error rates even among otherwise fluent users[41].

Design defaults present a more subtle barrier. Many interfaces assume a baseline level of digital literacy, prior exposure to similar products, and comfort with abstract interaction patterns, such as swipe gestures, icon-only navigation, or multi-step authentication flows, that is unevenly distributed across age groups, education levels, and prior technology exposure[42]. Because these assumptions are rarely stated explicitly, they are difficult for a design team to recognize and correct without deliberately testing with users who do not share them.

A further barrier concerns the populations that research methods themselves struggle to reach. Disability status, in particular, is often underreported in product research, both because disclosure carries social stigma and because standard recruitment screens rarely ask about it in ways that capture the relevant range of conditions[43]. The result is that even organizations committed to inclusive design frequently lack reliable data on whether their products serve disabled users adequately, since the population least likely to be represented in research is often the population most affected by exclusionary design choices.

### **5.3. Organizational and Structural Challenges**

Beyond barriers rooted in user research and design practice, organizations face structural challenges that make sustained inclusion work difficult regardless of individual designers' intentions. Accountability for inclusion and accessibility is frequently distributed across multiple teams, including design, engineering, legal, and compliance, without a single owner empowered to make trade-off decisions when inclusion goals conflict with delivery timelines[44]. In the absence of clear ownership, accessibility and inclusion work tends to default to whichever team has the least authority to resist de-prioritization, which in practice is often a dedicated accessibility or research function operating without direct influence over product roadmaps.

Resourcing presents a related challenge. Inclusive research methods, such as recruiting diverse participants, partnering with community organizations, and conducting accessibility audits with assistive technology users, generally cost more in time and budget than convenience-sample usability testing, and the return on that investment is harder to quantify in the short product cycles against which most teams are measured. Organizations that treat inclusion as a compliance obligation, satisfied by a one-time accessibility audit before launch, tend to underinvest relative to organizations that treat it as an ongoing design commitment tied to product quality[45].

Finally, incentive structures within many organizations reward shipped features and measurable engagement metrics more directly than they reward inclusive outcomes, which are often diffuse, delayed, and difficult to attribute to a specific design decision. A designer who successfully advocates for an accessible but more expensive interaction pattern rarely receives the same visible credit as a designer who ships a high-engagement feature on schedule. Until organizational measurement and incentive systems account for equitable access as a core quality dimension rather than a secondary concern, structural pressure will continue to push even well-intentioned teams toward narrower, faster, less inclusive design choices[46].

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## **6. Advancing Digital Inclusion Through Human-Centered Product Development**

Building on the gaps identified in Section 5, this section outlines what advancing digital inclusion through human-centered product development requires in practice: how inclusion should be positioned within design strategy, how research and engagement practices need to adapt to reach underrepresented users, how design decisions should account for diverse contexts of use, and what organizational infrastructure is needed to sustain these commitments beyond any single product cycle.

### **6.1. Embedding Inclusion in Design Strategy**

Addressing the structural challenges identified in the previous section begins with how inclusion is positioned within an organization's design strategy. Treating inclusion as a downstream quality check, something verified after a product is largely built, all but guarantees that it will be treated as optional when timelines tighten[47]. A more durable approach positions inclusion alongside performance, security, and usability as a non-negotiable design requirement, stated explicitly in product strategy documents and design briefs rather than left implicit in a general commitment to user-centeredness.

This repositioning has practical consequences for how design strategy is written and reviewed. Product requirements that specify target user segments should name the full range of users a product is meant to serve, including users with disabilities, users in low-connectivity environments, and users with limited digital literacy, rather than defaulting to an unstated general user who tends, in practice, to resemble the design team. Design reviews should include accessibility and equity criteria as standing agenda items, evaluated with the same rigor as visual design or technical feasibility,



rather than treated as a separate review that happens later or not at all. Strategic documents that name these commitments explicitly give designers and product managers a basis for resisting pressure to cut inclusion-related work under deadline pressure, since the commitment is documented as a requirement rather than left to individual advocacy[48].

## 6.2. Inclusive Research and User Engagement

Operationalizing inclusive research requires moving beyond convenience sampling as the default recruitment method[49]. This means building, in advance of any specific product initiative, ongoing relationships with community organizations, disability advocacy groups, and intermediaries serving populations that an organization's existing customer base underrepresents. Standing relationships of this kind reduce both the cost and the lead time associated with recruiting historically underrepresented participants for a given study, which removes one of the most common practical excuses for skipping inclusive research under time pressure.

Research methods themselves also benefit from deliberate adaptation[50]. Standard usability testing protocols, developed largely around typical-use scenarios, often need modification to surface meaningful findings from participants using assistive technology, operating in a second language, or navigating a product with limited prior digital experience[51]. This can include allowing additional time, offering multiple modes of participation such as phone-based as well as screen-based testing, and training researchers to distinguish between friction caused by a participant's unfamiliarity with a product category and friction caused by a genuine design flaw the broader user base would also encounter, since conflating the two leads teams to dismiss valid findings as unrepresentative.

Finally, inclusive research benefits from being continuous rather than episodic. A single round of research conducted at a product's outset captures user needs at one point in time and can become outdated as a product evolves, as user populations shift, or as new accessibility standards and assistive technologies emerge. Embedding lightweight, recurring touchpoints with diverse users throughout a product's life, rather than treating research as a discrete project phase, keeps inclusion responsive to how a product is actually used rather than how it was assumed to be used at launch[52].

## 6.3. Designing for Diverse User Needs and Contexts

Designing for diverse contexts requires product teams to account for variation not only in user ability but in the material conditions under which a product is used, including intermittent connectivity, older or lower-specification devices, shared device access within a household, and data costs that make heavy media consumption impractical for some users. Technical decisions that appear neutral from the perspective of a well-resourced engineering team, such as defaulting to high-resolution images or requiring a persistent connection for core functionality, can quietly exclude users operating under different constraints[53].

Addressing this requires building flexibility into a product's core architecture rather than treating accommodation as an optional add-on. Offline-capable functionality, lightweight interface modes, and graceful degradation under poor connectivity allow a single product to serve a wider range of contexts without requiring entirely separate versions for different markets. Similarly, designing for cognitive and linguistic diversity through plain-language content, consistent navigation patterns, and multiple input modalities reduces the burden placed on users who do not share the assumptions embedded in a product's default design, without requiring a fundamentally different product for each user segment.

This kind of context-aware design depends on the research and strategy commitments discussed earlier in this section; a team cannot design for constraints it has not deliberately investigated. It also depends on resisting the temptation to treat such accommodations as features reserved for a lite or secondary version of a product, since segregating accessibility and low-resource support into a separate product tier often results in that version receiving less investment and falling further behind the primary offering over time.

## 6.4. Building Sustainable Frameworks for Equitable Access

Individual practices, including inclusive research, flexible design, and accessibility conformance, are more likely to persist when they are supported by organizational structures designed to sustain them rather than depending on the ongoing advocacy of individual designers or researchers[54]. Sustainable frameworks for equitable access typically combine clear ownership, with a named function accountable for inclusion outcomes across the product portfolio; measurable standards, such as accessibility conformance targets and disaggregated usage metrics that reveal whether different user segments experience comparable outcomes; and governance mechanisms that give those standards

enforcement weight, such as launch gates that require a documented accessibility and inclusion review before a product or major feature ships.

Equally important is ensuring that these frameworks remain adaptable rather than becoming static compliance checklists. User populations, assistive technologies, and accessibility standards all continue to evolve, and a framework calibrated to a single point in time risks becoming outdated even as organizations continue to treat conformance with it as evidence of inclusive practice[55]. Periodic review of inclusion frameworks against current research and emerging user needs helps prevent this kind of drift.

Building this kind of sustainable infrastructure is a longer and less visible undertaking than shipping any individual inclusive feature, which is precisely why it is so often deprioritized. The frameworks reviewed earlier in this article each represent an attempt, from a different institutional vantage point, to solve exactly this sustainability problem. Their continued evolution, and the gaps in equity and accessibility coverage that the comparison in Section 4 made visible, suggest that no single existing framework yet offers a complete answer, which is also where this article's discussion of future research begins.

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## 7. Future Research Directions

Several open questions emerge from this review that merit dedicated empirical attention beyond the conceptual synthesis offered here. First, there is a notable absence of longitudinal research examining whether human-centered and inclusive design interventions produce durable improvements in equitable access over time, as opposed to short-term gains that erode once initial investment or leadership attention moves elsewhere. Most published evidence on inclusive design outcomes, including the practice examples discussed in Section 5, describes outcomes at or shortly after launch; far less is known about whether accessibility and inclusion gains are sustained through subsequent product iterations, redesigns, or organizational changes such as leadership turnover or restructuring.

Second, the field would benefit from shared, comparable metrics for equitable access across organizations and industries. Accessibility conformance against technical standards such as the Web Content Accessibility Guidelines is reasonably well measured, but broader equity outcomes, namely whether a product narrows or widens disparities in usage and benefit across different user segments, are rarely measured in a standardized way[56,57]. This makes it difficult to compare inclusion outcomes across organizations or to build a cumulative evidence base for which design practices most reliably improve equity rather than merely usability.

Third, more research is needed on how organizational structure, rather than design methodology alone, affects inclusion outcomes. The structural and resourcing barriers identified in Section 5.3 suggest that even well-designed frameworks may underperform when adopted by organizations lacking clear ownership, adequate resourcing, or aligned incentives. Comparative research examining how inclusion outcomes vary across organizations using similar design frameworks but different governance structures could help clarify how much of the variation in inclusive design outcomes is attributable to methodology versus organizational context[58].

Fourth, as generative and conversational artificial intelligence systems become embedded in digital products, research is needed on how human-centered and inclusive design principles translate to interfaces that are less visually structured and more dependent on natural language interaction. Existing accessibility standards were developed primarily for graphical and document-based interfaces, and their applicability to conversational and adaptive interfaces, which may behave differently for different users by design, remains underexamined. This raises new equity questions about whether such systems perform comparably across the same dimensions of user diversity discussed throughout this article.

Finally, there is room for research that more directly involves the populations these frameworks are meant to serve in evaluating the frameworks themselves, rather than relying primarily on organizational or designer-reported assessments of what counts as inclusive practice[59]. Participatory evaluation research, in which disabled users, non-native-language speakers, or low-connectivity users assess existing frameworks against their own lived experience, could surface gaps that the largely institution-authored frameworks reviewed in this article are unlikely to identify on their own.

## 8. Conclusion

This article set out to examine the distance between human-centered design as a stated organizational value and human-centered design as a practiced discipline capable of advancing digital inclusion and equitable access. The review of five widely used frameworks in Section 4 showed that while most converge on iterative, evidence-based practice and some form of direct user engagement, far fewer build in explicit accessibility conformance or an equity-oriented commitment to extending benefit across underserved populations. That gap matters because it means an organization can adopt human-centered methodology in good faith and still produce products that exclude the very users digital inclusion efforts are meant to reach.

The evidence from practice examined in Section 5 reinforces a point that recurs throughout the inclusive design literature: when organizations do engage seriously with underrepresented users, the resulting design improvements frequently extend well beyond the originally targeted group, which undercuts the common objection that inclusive design serves only a narrow minority at disproportionate cost. At the same time, the persistent barriers and structural challenges documented in the same section make clear that good intentions and sound methodology are not sufficient on their own. Inclusion needs to be embedded in design strategy, sustained through adequately resourced and continuous research practices, and supported by organizational structures, including clear ownership, measurable standards, and enforceable governance, that do not depend on the ongoing advocacy of individual designers.

Advancing digital inclusion through human-centered product development is therefore less a matter of selecting the right framework than of building the organizational conditions under which any sound framework can be applied consistently and sustained over time. The frameworks reviewed in this article offer a credible starting vocabulary for that work, but, as the discussion of future research directions suggests, the field still lacks the longitudinal evidence, shared measurement standards, and structural research needed to know with confidence which combinations of methodology and organizational design most reliably translate human-centered intention into equitable outcomes.

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