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Undisciplined design: risks, challenges, limitations and strategies for navigating through chaos

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ABSTRACT: Undisciplined Design (UD) is an emerging approach suited for experiment-driven innovation and creative processes, allowing fluid disciplinary engagement in engineering design. However, its openness and adaptability also introduce challenges, particularly when integration, evaluation, and risk mitigation mechanisms are absent. This paper examines the Google Glass project through the lens of boundary objects, identifying two key dangers in UD: overconfidence in technological inevitability and unintended consequences. The analysis highlights the need for structured checkpoints to manage epistemic uncertainty while preserving UD's exploratory potential. To address these challenges, we propose incorporating participatory design methods to facilitate cross-disciplinary negotiation and present a decision-making checklist to guide UD projects in product design and innovation.

KEYWORDS: undisciplined design, Google Glass, multi- / cross- / trans-disciplinary processes, teamwork, collaborative design

1. Introduction

Undisciplined Design (UD) has emerged as a practice/approach since the 2010s that embraces the strengths of cross-boundary collaboration and flexible knowledge transformation (Marshall & Bleecker, 2010; Bremner & Rodgers, 2013; Celaschi et al., 2013; Ings, 2019). While multi-, inter-, and trans-disciplinary design have advanced problem-solving by forming new frameworks and uncovering new opportunities (Gibbons et al., 1994; Lawrence, 2010), little research has examined the risks associated with *experimental* product development in that pilot ideas might result in unforeseen situations. Questions arise regarding how UD functions in cross-disciplinary experimental projects, how teams prepare for such collaborations, and which projects benefit most—or face challenges—from UD practices. This paper examines these questions, identifying critical risks and proposing strategies to navigate UD's complexity in product design and innovation.

In this paper, we argue that UD is inherently unstable, as the tension between epistemological translation and exploratory freedom can disrupt collaboration and compromise outcomes. We first review existing literature relevant to UD, identifying risks related to inadequate integration, evaluation gaps, and weakened communication in cross-disciplinary teams. Using boundary objects as an analytical lens, we re-examine the Google Glass case, highlighting failures in recognizing its experimental nature and engaging user-developer cooperation. Our analysis identifies two key dangers in UD practices: overconfidence in technological inevitability and unintended consequences. To address these challenges, we propose integrating participatory design approaches (Schuler & Namioka, 1993) and present a structured checklist to align experimental projects with social relevance. We conclude with insights for future UD research and practice.

1.1. Contributions of this paper

This paper reflects UD's evolving methodologies and challenges in integrating and processing multiple disciplines. The main contributions of this paper are:

Contextualizing UD within broader design theories and clarifying its role in cross-disciplinary
Analyzing UD's strengths and weaknesses through the Google Glass case study.
Proposing a structured checklist to guide UD project development and decision-making.

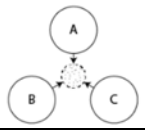
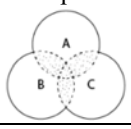
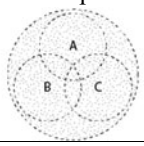
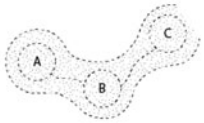
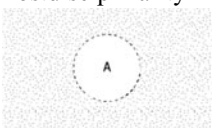
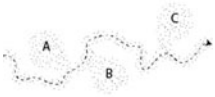
2. From disciplinarity to Undisciplined Design

Since the 2010s, UD has been added to the literature in design studies, complementing and connecting existing approaches. Considering the trajectory and interconnection among approaches, we summarize and compare some existing approaches and analyze the concept of UD within the context.

2.1. Various disciplinary design approaches

In modern design practices, knowledge production keeps evolving, resulting in dominant and emerging approaches. In Table 1, we compare established and emerging approaches, including illustrations, definitions, ways of knowledge production, and their highlights. The pattern in each illustration indicates

Table 1. Collaborative design approaches, definitions, and highlights.

Approach/ Illustration	Definition	Knowledge production	Highlights
Disciplinarity 	Researchers within the same discipline collaborate on topics within their field (Darbellay, 2016; Rodgers & Bremner, 2013).	Generate knowledge within individual disciplines.	Specialization
Multidisciplinarity 	Disciplines work alongside each other without integrating their methods or theories (Piaget, 1972).	Apply established knowledge from each field independently without feedback (Celaschi et al., 2013; Darbellay, 2016).	Problem-solving; lower scale
Interdisciplinarity 	Disciplines integrate knowledge to form new practice across individual disciplines (Piaget, 1972).	Bridging disciplines or integrating diverse expertise (Ings, 2019; Rodgers & Bremner, 2013).	Problem-solving; mid-scale
Transdisciplinarity 	Disciplines work together for inquiry-driven project tackling societal challenges larger than individual disciplines (Darbellay, 2016; Rodgers & Bremner, 2013).	Forming an overarching knowledge union beyond disciplines (Ings, 2019).	Exploratory; inquiry-driven; larger scale
Alterplinarity 	Disciplines adopted fluidly by project-based endeavor, aiming at turning expertise from different fields into real-world applications (Bremner & Rodgers, 2013).	Exploring the unknown crossing space/time and disciplinary boundaries (Rodgers & Bremner, 2013).	Exploratory; experimental; fluid with time; goal-oriented
Postdisciplinarity 	Disciplines focusing on reconstructing knowledge organization, boundaries, and production (Darbellay, 2016; Ings, 2019).	Reconceptualizing knowledge and the structure of knowledge production (Ings, 2019).	Exploratory; experimental; reconstructing disciplines
The undisciplined 	Disciplines engaging in experiment-driven explorations to create new ways of knowing (Celaschi et al., 2013).	Experimenting unprecedented processes and engage with encountered knowledge (Marshall & Bleecker, 2010).	Experimental; thinking process; creative practice

the coverage of knowledge production, and the dotted lines refer to the openness and spread through disciplinary boundaries in each type of collaboration. The comparison table is by no means exhaustive; nonetheless, it provides a helpful overview of key aspects of these approaches.

Among the cross-disciplinary approaches (Table 1), multidisciplinarity and interdisciplinarity aim at smaller-scale problem-solving by reaching a convergent goal, and transdisciplinarity is driven by more extensive inquiries and often involves a specific and complex social focus, which requires disciplines to expand their expertise to explore possible solutions or interpretations (Darbellay, 2016). In addition to its exploratory nature, alterplinarity highlights its experimental endeavor, that it embraces new disciplines on the way to exploring a specific goal outside the known disciplines (Rodgers & Bremner, 2013). Postdisciplinarity focuses on exploring and reshaping knowledge by deconstructing and redefining disciplines with new values, methods, and practices (Darbellay, 2016).

It is noteworthy that although Rodgers and Bremner (2013) categorize alterplinarity as "undisciplined," we deem the distinction between its project-based, goal-oriented trajectory and the focus of "undisciplined/undisciplinarity" on thinking process and creative practice (Marshall & Bleecker, 2010; Celaschi et al., 2013; Ings, 2019) crucial for the evaluation of UD. Therefore, we separate them as two different approaches in Table 1. In that regard, this paper adopts the vision that the undisciplined approach is driven by experimental exploration toward an unknown goal, which involves exploring new disciplinary paths, epistemological shifts of disciplines, and unexpected outcomes (Marshall & Bleecker, 2010; Celaschi et al., 2013). Although both approaches search for new paths and knowledge in innovative production, alterplinarity's project-based nature makes it relatively bound by the practices, whereas the open-ended experiment in the undisciplined approach tends to challenge and redefine the journey on the go and involves a more fluid knowledge transformation.

From a broader sense, the level of cross-disciplinary interaction in collaboration increases from disciplinarity to the undisciplined. The knowledge integration and exchange context also becomes more extensive, open, and subject to their interaction. These approaches tackle issues ranging from existing and known problems to more prominent, complex societal challenges to experimenting with future possibilities. The latter three emerging approaches have distinct intentions and practices regarding adopting and reevaluating disciplines and knowledge production systems, respectively, making them highly relevant to understanding the concept of UD.

2.2. Undisciplined-related discourses

Although "Undisciplined Design" has yet to be a formal terminology in design studies, scholars have attempted to draw from their fields and form discourses around the concept. On the topic of "Undisciplinarity," Marshall and Bleecker (2010) argue that conventional knowledge production is not well suited to creating more habitable worlds. As a result, they propose "undisciplinary" as a practice and approach to "creating and circulating culture that can go its own way, without worrying about working outside of what histories-of-disciplines say is 'proper' work" (Marshall & Bleecker, 2010, p. 221). Rodgers and Bremner (2013) also advocate for an *undisciplined and irresponsible* attitude in creative practices, emphasizing that creative practitioners have a responsibility to be "irresponsible" in their work (p. 152). They associate undisciplined practices with "unknowing" in process and production, particularly in architecture, arguing that such an approach enables practitioners to make connections that generate new methods and uncover alternative dimensions of creative research, practice, and thought (Rodgers & Bremner, 2013, p. 152). Celaschi et al. (2013) associate the business concept of disruption with an undisciplined attitude and propose in design education to teach disobeying technical-functional, socio-economical, and aesthetical rules. They argue it is important to "educate the designer towards an attitude in questioning rules, methods, procedures and boundaries and in deliberately controvert to explore them" (Celaschi et al., 2013, p. 8). An undisciplined attitude and practice equipped with critical thinking encourages practitioners to operate between, across, or bypass conventions deliberately. Ings (2019) refers to undisciplined design thinking as "research that functions beyond the conventions and constraints of established academic specialties" (p. 48) and considers undisciplined thinking part of postdisciplinarity manner and practice, which "may be aligned with certain professional contexts where knowledge is generated and applied across and between ways of knowing" (p. 63). In his examples of design projects (e.g., Tatiana's *Saints of Paradox*), UD thinking is a nonlinear, iterative approach that fosters serendipitous knowledge encounters, embraces fluid methodologies, and enables flexible transformations and adaptability in evolving research (Ings, 2019). Among the discourses, a shared

notion is that UD thinking and practices involve an epistemological shift, which requires us to overview the existing disciplines and the knowledge and boundaries thereof.

2.3. Undisciplined Design in creative practices and relevant frameworks

It is important to recognize that although some scholars tend to see UD as a remedy to old forms of knowledge production and to solve the problems in conventional cross-disciplinary practices (Marshall & Bleecker, 2010), we do not see UD functioning as an alternative solution in design practice to address existing problems, nor is it necessarily lacking in disciplinary expertise and a sense of boundaries. Instead, we view it as an evolving approach that radically harnesses disciplinary flexibility and creativity in innovation. As shown in Table 1, UD shares significant qualities with other emerging approaches (i.e., alterplinarity and postdisciplinarity) in that they question established norms and advocate for a broader understanding of rigor, moving beyond strict adherence to traditional methods. UD also embodies the strengths of all other cross-disciplinary approaches regarding collaboration and openness in its creative development. Likewise, as discussed later, UD faces many challenges that other approaches encounter during project development. Nonetheless, UD is critical and noteworthy among emerging approaches because its experiment-driven nature, combined with boundary-breaking and discipline-"trespassing" development, creates additional uncertainties and raises its susceptibility to mismanagement, scope creep, and unforeseen risks. Most importantly, since UD embodies experiment-driven innovation with unknown processes and expertise (Rodgers & Bremner, 2013), its creation can be more disruptive in a societal context without proper precautions.

Effective cross-boundary engagement is essential since UD continuously negotiates rather than rigidly defines disciplinary structures. To navigate this, we use *boundary objects* as an analytical framework to examine how UD enables knowledge translation, transformation, and integration while preserving epistemic flexibility. As Carlile (2002) identifies, boundary objects help structure interactions at syntactic, semantic, and pragmatic levels, ensuring that diverse perspectives do not remain isolated but interact meaningfully. Boundary objects are vital in UD, bridging differences as knowledge is transferred and reshaped through negotiation. Bowker and Star (2000) highlight the necessity of boundary objects for stability and adaptability, ensuring continuity across disciplines while remaining flexible. In this regard, boundary objects are active information repositories, shaping how UD practitioners navigate epistemic uncertainty.

By framing UD through boundary objects, we highlight its function as an iterative and evolving process rather than a methodological alternative to existing approaches. Brubaker et al. (2023) extend this discussion by demonstrating how different objects structure collaborative workflows through routinizing interaction, translating information, and motivating negotiation. Bechky (2003) further illustrates how these objects surface tacit knowledge, making implicit disciplinary assumptions explicit as an essential function in UD, where disciplinary overlaps remain dynamic and contingent. This reinforces that UD does not seek to dissolve disciplinary expertise but rather to leverage its adaptability for innovation. However, the openness also increases susceptibility to fragmentation, misalignment, and the dilution of epistemic rigor. As we move forward in our discussion, we consider how UD can sustain its exploratory nature while ensuring coherence in knowledge production and project execution.

2.4. Uncharted territories of Undisciplined Design

Despite its potential for limitless knowledge production and social good (Marshall & Bleecker, 2010; Ings, 2019), UD shares vulnerabilities with other cross-disciplinary collaborations, presenting gaps researchers must navigate. These gaps enable flexible knowledge translation but make production unpredictable and subjective. UD's open-ended nature also risks epistemic misalignment and communication breakdowns, potentially leading to chaos. Below, we highlight three key gaps that may compromise collaboration.

First, UD lacks an integration method to blend diverse disciplines into a cohesive framework structurally. Carlile's (2002) work on syntactic boundaries stresses the need for a shared vocabulary, yet UD resists fixed terminology, raising questions about whether existing structures can accommodate emerging knowledge. Brubaker et al. (2023) emphasize how routinization and boundary objects stabilize collaboration, but UD's fluid nature prevents the establishment of consistent routines, making integration situational rather than systematic. This challenge extends to the ways UD approaches learning itself. Marshall and Bleecker (2010) suggest that new practice idioms promote an "undisciplinary" mindset, but openness alone does not resolve how knowledge is synthesized or prioritized. Bechky (2003) highlights

the importance of making tacit knowledge explicit for interdisciplinary collaboration, yet UD lacks mechanisms for recontextualizing insights across domains. These perspectives raise critical questions: How can UD practitioners determine what knowledge to recognize and integrate? How might UD balance fluidity with structured synthesis without undermining its experimental nature?

Second, UD lacks an evaluation approach to assess project development and translated knowledge across interpretative frameworks. Carlile's (2002) semantic boundaries highlight the challenge of transferring knowledge between disciplines, as differences in meaning and context obstruct shared understanding. Brubaker et al. (2023) further emphasize the role of boundary objects in translating information across knowledge groups. However, UD's fluid structure makes it challenging to ensure that translated knowledge is meaningfully received and applied. Without established mechanisms to validate or integrate new insights, UD risks producing knowledge that remains unrecognized by existing experts, leading to gaps in decision-making and unintended consequences. This raises a critical challenge: How can UD ensure its contributions are recognized and applied if translated knowledge goes unnoticed? UD must establish structures that foster innovation and sustain cross-disciplinary collaboration.

Third, UD's lack of structure and assessment weakens communication and hinders effective knowledge agreement. Pragmatic boundaries emphasize that effective collaboration requires negotiation to resolve disciplinary tensions beyond shared vocabulary and translation (Carlile, 2002). However, UD's dynamism leaves these negotiations open-ended, preventing knowledge from integrating meaningfully. Brubaker et al. (2023) identify "motivating negotiation" as a key role of boundary objects, with activity objects identifying contradictions between group interests and epistemic objects stimulating joint interests and generating new knowledge. The sequence from translating to motivating then culminates in a co-design solution. However, UD risks fragmentation without structured processes to anchor these discussions. GrØnbæk et al. (1993) further highlight that unclear users and unmotivated participants hinder sustained collaboration in large-scale projects where user involvement is uncertain. UD's effectiveness weakens when negotiated knowledge lacks clear mechanisms for action, leading to information loss or misinterpretation. The challenge is to balance flexibility with structured negotiation to ensure interdisciplinary exchanges yield tangible outcomes.

These three gaps create a self-reinforcing cycle in which the absence of structured integration, evaluation, and communication prevents UD from effectively evolving. Without a clear process for synthesizing knowledge, projects lack continuity, progress remains unmeasured without systematic assessment, and new insights risk being lost or dismissed without structured negotiation. This recursive pattern limits UD's ability to translate experimentation into sustained interdisciplinary practice, causing ideas to circulate without solidifying into actionable frameworks.

3. Case study: Google Glass

Google Glass project is an innovative effort initiated by the Google Moonshot in 2010 (Bilton, 2015; Weidner, 2024). It was set as a luxury product, utilizing augmented reality (AR) to overlay real-time digital information in the wearer's view and voice control and camera capture functions. The product was launched as wearable smart glasses in 2014 and soon removed from the market in 2015 as it gained criticism shortly and harshly regarding its price, privacy, and safety concerns (Weidner, 2024). Despite the two Enterprise Editions launched in 2017 and 2019 (Weidner, 2024), the product was discontinued in 2023 without clear reasons.

This paper categorizes Google Glass as a UD case because the project's experimental nature led it to cross-disciplinary collaboration and exploratory path that requires various expertise. In hindsight, the project was indeed groundbreaking and thus inspired followers (e.g., Ray-Ban Meta Smart Glasses), yet it also raised unprecedented and serious societal concerns. Given that, we examine the results of Google Glass through boundary objects and the aforementioned gaps in UD. Through this exploration, we aim to draw insights from its historical lessons and contribute to the ongoing evolution of UD practice.

3.1. Unrecognition of its experimental nature and entailments

Undisciplined processes require a deep understanding of possibilities and a shared language to drive new developments through expert insights from each field (Marshall & Bleecker, 2010). However, Google Glass seems to fail to recognize the project's experimental nature fully and span the pragmatic boundaries to transform knowledge among working groups (Brubaker et al., 2023). The Google Glass project prioritized engineering, design, and marketing in pushing innovation, aesthetics, and hype, yet the

product ultimately neglected user expectations and social norms around privacy, cost, and perception (Klein et al., 2020; Noble & Roberts, 2016). In this case, they failed to see the unalignment between groups and utilize activity and epistemic objects to form a common ground. Moreover, the lack of knowledge transformation further blinds them regarding incorporating essential professionals such as ethicists, social scientists, and policy experts into the design process. The absence of such integration left the product vulnerable and innovation stagnant, as strategic input could have mitigated these issues. For instance, engineering and design teams could have balanced ethics and aesthetics to prevent public discomfort caused by users' gaze, while design and marketing teams should have considered the cultural implications of launching a luxury product from a White male-dominated tech industry (Noble & Roberts, 2016; Bilton, 2015). Similarly, marketing and engineering teams could have addressed public acceptance and privacy concerns surrounding AR in daily life (Yoon, 2018).

Transforming local understandings is essential for effective knowledge exchange within organizations (Bechky, 2003). The poor public acceptance and bans in private venues highlighted communication failures between executives, cross-disciplinary teams, and customers, and Google's poor response to criticism further damaged its reception (Nieva, 2016). Overall, Google Glass's cross-disciplinary teams struggled to integrate interdisciplinary expertise under a shared epistemological framework and translate ideas into actionable outcomes (Klein et al., 2020; Yoon, 2018). Not recognizing the project's experimental nature and pragmatic boundaries makes the Google Glass case more susceptible to biases within existing disciplines and conventional structure.

3.2. The absence of prospective users created more uncertainties

Undisciplined thinking in design is expected to adapt to emerging opportunities, exploring innovative solutions to complex and uncertain challenges (Ings, 2019). However, many undisciplined practices stay in creative and artistic expression (e.g., HeHe's *Nuage Vert project* and Tatiana's *Saints of Paradox*) (Rodgers & Bremner, 2013; Ings, 2019) without the need to consider potential users. Nonetheless, when the "new thing" in UD production involves users and societal impacts, it urges more consideration of the implications. In this regard, the development process of Google Glass seems to be further impaired by poorly defined users in the early stage, plus a lack of analytical frameworks and a shared vision of the product. These absences left Google Glass in limbo, with neither customers nor creators having a clear vision of its purpose (Yoon, 2018). Furthermore, the lack of standardized evaluation metrics left no clear benchmarks for success and led to poorly considered decisions on features and market positioning (Yoon, 2018). This situation further complicates UD's flexible structure, as the translated knowledge is inadequately evaluated, and there are no prospective users to test the knowledge. Although Google Glass eventually tested the product through a selective Glass Explorers program for $1,500 (Bilton, 2015), insufficient guidance on application compatibility and coherence (Price, 2023; Wadhwa, 2014) led to poor coordination, alienated developers, and stalled product development (Nieva, 2016). As GrØnbæk et al. (1993) argue, full user participation becomes challenging in the product focus when the development team is well-identified but user organizations are unclear.

In hindsight, Google Glass could not align internal and external stakeholders, leading to conflicting priorities. As a result, Google Glass faced systemic communication failures across teams, management, and customers, disrupting development, launch, and public acceptance. For example, the mismatched objectives between *a revolutionary prototype* from the engineering and design teams and *a high-end luxury product* from the marketing team and executives resulted in the release of an unfinished product (Bilton, 2015; Klein et al., 2020), which worsened the consumer disappointments over hardware failures, biased language processing, and poor battery life (Eveleth, 2018; Martinez-Millana, 2016; Srivastava, 2022; Weidner, 2024). In that regard, GrØnbæk et al. (1993) point out that identifying prospective users for future-oriented design is difficult, and management might be reluctant to do so to prevent competitors and remain flexible in product development. However, without prospective users to balance the negotiations between cross-disciplinary teams, frameworks, and shared vision, the uncertainties in UD processes become more challenging to navigate and manage, resulting in inconsistent and conflicting products.

4. The risk and complexities of Undisciplined Design

At the center of UD is an unpredictable space where disciplinary boundaries shift and knowledge emerges through experimentation. While this openness enables exploration, it also introduces risks that,

if unaddressed, can undermine project outcomes. This section identifies the dangers, challenges and opportunities, limitations, and considerations in UD practice.

4.1. Dangers

The first danger is overconfidence in technological inevitability. Overconfidence in technological inevitability assumes innovation will naturally find its purpose without structured user engagement (Toyama, 2015). Google Glass was developed assuming an AR wearable would naturally integrate into users' everyday lives once it is created (Bilton, 2015), which illustrates this danger; developed without explicit user integration and entered the market prematurely, failing to address social, ethical, and usability concerns (Nieva, 2016; Yoon, 2018). Participatory design literature warns that side-lining users in experimental projects leads to fragmented development and public rejection (Schuler & Namioka, 1993; GrØnbæk et al., 1993).

The second danger is unintended consequences. Which further complicates UD's open-ended nature. Tenner's (1997) concept of "revenge effects" describes how innovations produce outcomes that contradict their original intent. Google Glass, designed to streamline access to information, instead heightened privacy concerns and social discomfort. These risks highlight the challenge of balancing UD's exploratory process with mechanisms for guiding decision-making. Without strategies to address misalignment and anticipate consequences, UD risks producing fragmented and impractical outcomes.

4.2. Challenges and opportunities

As the Google Glass case shows, the challenge in exploratory projects is not just cross-disciplinary misalignment but the absence of mechanisms to guide innovation while managing risks. Unlike structured product development, with well-defined goals and methods, innovation-driven projects require additional frameworks to balance exploration with strategic foresight. The Google Glass team failed not only due to poor project coordination but also because they did not recognize the entailment of developing an experimental product. Moreover, it is crucial to understand that UD does not function as a standard project methodology but as an approach that allows fluidity in knowledge creation while maintaining structured checkpoints. Without those checkpoints, experimental projects risk losing direction or generating unintended consequences. Brubaker et al. (2023) argue that boundary objects facilitate cross-disciplinary interaction. However, in projects like Google Glass, the absence of a shared epistemic framework meant that teams failed to define what knowledge was necessary for success. Similarly, Carlile (2002) highlights that knowledge integration requires translation and transformation, which is another step missing in Google Glass's development.

Exploratory projects must ensure that the results do not overthrow public trust and shared values. The bans on Google Glass in private venues show a lack of consideration for its social and cultural implications. In that regard, participatory design may help reduce the uncertainties during UD processes by ensuring that stakeholder contributions shape decision-making at the proper stages of development (Schuler & Namioka, 1993). As scholars suggest, employing prospective users at the outset and introducing participatory design could shape the project focus and development processes, making the output relevant and acceptable (GrØnbæk et al., 1993; Grudin, 1993). Grudin (1993) further stresses that participatory approaches fail when feedback mains disconnected from implementation, as seen in Google's Glass Explorers program, where user input led to no meaningful improvements. Without clear pathways for generating and integrating emerging knowledge, projects like Google Glass remain disconnected from the realities of their application.

Overall, the challenge in UD is not only a lack of integration but also the design of a process for iterative discovery that accounts for unpredictability. This requires structured approaches for managing uncertainty, aligning expectations across teams, and embedding participatory processes to ensure that internal and external stakeholders contribute meaningfully to innovation. By incorporating participatory design approaches, UD can facilitate shared ownership of knowledge, ensuring that evolving insights are recognized and acted upon throughout the development process.

4.3. Limitations and considerations

As Marshall and Bleecker (2010) argue, not everyone is suitable for undisciplinary practice, as it needs deep and broad insights from a profound understanding of the situated discipline, boundaries, evaluation

criteria, and limits. While UD intentionally moves away from rigid frameworks to encourage flexibility and interdisciplinary engagement, it requires an acute awareness of situatedness—the specific contexts, systems, and frameworks within which design operates (Weisberg & Markman, 2009). Effective innovation relies on an informed understanding of existing structures, ensuring interventions remain meaningful and contextually relevant. Without this grounding, UD risks producing results that lack practical applicability or fail to engage with systemic constraints.

In the same vein, UD is not suitable for all contexts and requires certain conditions to succeed. Although UD's adaptability makes it more effective in social innovation projects, it needs a more proactive and precautious structure for experimentation when the planned results are set to be pioneering and disruptive. In that regard, participatory design methodologies might help UD engage diverse actors to address complex social issues and innovations (Schuler & Namioka, 1993). Involving users in the design process benefits UD's nonlinear approach and balances the negotiations regarding cross-disciplinary boundaries, as a thriving innovation requires public interest and social acceptance. Moreover, UD's openness must be carefully harnessed in industries that demand regulatory precision. In high-stakes engineering design industries (e.g., automotive, biomedical, and chemical engineering), adherence to standardized protocols is necessary for safety and compliance. The failure of Google Glass in healthcare (Gillette & Raja, 2024) illustrates this tension; while UD's methods promote inclusivity and adaptive innovation, they lack the structured rigor necessary for regulated environments.

As mentioned, UD is yet to be a method but an evolving approach to design thinking and creative practices. It needs structured mechanisms to navigate variations and prevent projects from inconsistencies in implementation across different regions. Addressing these limitations requires balancing UD's experimental nature with strategic structure, ensuring that while it remains open to new possibilities, it also aligns with contextual demands and industry requirements. Recognizing these constraints does not diminish UD's potential but highlights the importance of tailoring its methods to specific design ecosystems.

4.4. Strategies for navigating chaos: a decision-making checklist

Given UD's exploratory nature, fluidity, and challenges, we draw from new product development (NPD) (Riek, 2001), contextual inquiry in system design (Holtzblatt & Jones, 1993), and obstacles to user involvement (Grudin, 1993) to propose a checklist (Table 2) for practitioners engaged in innovation project development. Unlike traditional frameworks that prioritize commercialization and competition, this checklist focuses on knowledge transformation, project evaluation, and user involvement across different stages of development to manage cross-disciplinary uncertainties while maintaining UD's experimental nature.

Table 2. Undisciplined Design project development checklist.

Stages	Checklist items
Defining	- Identify the experimental aspects and the social inquiries or issues of the project. - Define the prospective product and its relation to existing society and market contexts. - Establish project priorities (e.g., performance, timeline, cost) and ensure alignment with planning. - Identify prospective users, key assumptions, and their needs.
Planning	- Outline key project assumptions and create a validation plan. - Identify necessary disciplinary knowledge and establish a framework for knowledge negotiation. - Define a structured process for integrating new knowledge and expertise as needed. - Engage prospective users early and define their roles in the project. - Establish measurable goals for epistemological alignment and resolving misalignments between teams. - Assess potential risks and unintended consequences, developing mitigation strategies. - Design a feedback collection mechanism to translate user input into actionable improvements.

(*Continued*)

Table 2. Continued.

Stages	Checklist items
Development	- Test key value assumptions with user-developer through iterative prototyping. - Identify boundary-spanning objects facilitating knowledge integration. - Evaluate knowledge translation effectiveness between development teams and user-developer cooperation. - Assess unintended consequences and refine mitigation strategies. - Identify early adopters, define acceptance criteria, and validate with prospective users. - Analyze diverse use environments and incorporate findings into product design.
Scale-up validation	- Validate interest from key decision-makers using prototypes. - Test product usability across environments to ensure alignment with risk prevention strategies. - Establish post-launch monitoring plans for continued evaluation and adaptation.

This checklist guides practitioners through UD's complexities while ensuring flexibility, coherence, and accountability in developing experimental products. It emphasizes epistemological alignment, participatory design, and ongoing collaboration across teams and users to assess progress and refine practices. Given UD's iterative nature, continuous reassessment is highly encouraged to foster resilience and shared responsibility, allowing practitioners to adjust as needed.

5. Conclusion

As an emerging approach in cross-disciplinary collaboration, Undisciplined Design critically engages with existing disciplines and society, offering significant potential for innovation and experimentation. However, its fluidity and loose structure present challenges in maintaining project coherence and accountability. While UD resists rigid methodologies, applying strategic frameworks does not contradict its ethos; rather, it ensures that projects remain responsible and socially aware. UD practitioners and stakeholders must recognize their role in shaping technologies and processes that could disrupt existing systems and should be accountable for their social impact.

To further strengthen UD's methodology, we propose an inquiry into actor-network theory (ANT) to map UD projects' experimental development across actants through a non-human-centric lens (Latour, 2005; Moser, 2014). Analyzing UD projects through ANT helps understand how new knowledge is generated, negotiated, and stabilized across disciplines, offering insights into structuring collaboration without restricting UD's openness. Future research should explore how UD can incorporate adaptive structures to balance experimentation with responsibility, ensuring that its contributions are both innovative and ethically sound.

Finally, we invite researchers and practitioners across disciplines to contribute to UD's ongoing evolution, sharing insights from real-world projects to refine its processes within complex innovation ecosystems. By engaging in these discussions, UD can evolve into a scalable and accountable design approach, nurturing responsible and transformative innovation.

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