Insolvent

How to Reorient Computing for Just Sustainability

By: Christoph Becker

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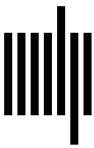

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LEVERAGE POINTS FOR CHANGE

FROM INSOLVENT COMPUTING TO JUST SUSTAINABILITY DESIGN

To critique a particular normative regime is not to reject or condemn it; rather, by analyzing its regulatory and productive dimensions, one only deprives it of innocence and neutrality so as to craft, perhaps, a different future.
—Mahmood (2015)

So how do you change paradigms? . . . you keep pointing at the anomalies and failures in the old paradigm, you keep speaking louder and with assurance from the new one, you insert people with the new paradigm in places of public visibility and power. You don't waste time with reactionaries; rather you work with active change agents and with the vast middle ground of people who are open-minded.
—D. H. Meadows (1999, 18)

Just sustainability really is a perfect storm: the immense complexity of interacting spheres of human artifacts, societies, and the rest of nature meets the social complexity of designing in wicked problem situations with asymmetrically vulnerable stakeholders. Its characteristics mean that the computing field urgently needs to restructure the way it conceptualizes systems design to address its insolvency. Restructuring reorganizes the elements of a system so that it becomes more capable of fulfilling its obligations. Part II reorganized the narrative of what happens in systems design for sustainability and justice so that systems design research, education, and practice can improve. The conceptual restructuring of

theories and methods completed in part II provides a basis for *reorienting* systems design. With the help of our critical friends, I separated computer science from its dominant myths and offered an alternative set of foundational principles. This might entail a sense of loss. In his book on "life after capitalism," Jackson writes that the role of myths is "to furnish us with a sense of meaning and to provide a sense of continuity in our lives. That need is a perennial one. The loss of a sustaining myth undermines our sense of meaning and threatens our collective wellbeing. Developing new myths, better stories and clearer visions is as essential as understanding the dynamics of collapse. Perhaps more so" (T. Jackson 2021, 56). In displacing the rationalist myths of systems design, the critical turn in computing elevates robust counternarratives:[1]

Software is never neutral: Recognize that computer science is not merely the systematic application of abstract value-neutral scientific methods to the real world. Values, ethics, and politics are not separate issues to be treated as "additional considerations" in computing. They are constitutive of the foundations of what computing has become. As a socially entangled discipline, it can no longer see itself as purely technical but must recognize its sociotechnical nature. The foundations of computing must include those social and humanistic perspectives that help us understand that nature. This shift addresses the myth of value-neutral technology (VNT).

People are more-than-rational: Reevaluate the role of rational decision-making and place much more attention on the difference between prescriptive approaches to decision-making and descriptive studies of practice. Critical reflection is the link between these two. This shift addresses the myth of rational decision-making.

Problems are framings: Because framings are inevitably made from partial perspectives, we must recognize the inability of computational thought to construct valid problem framings *on its own*. To address the myth of objective problems, we prioritize dialectical problem framing.

Design must be critically systemic: As a consequence, in systems design, rationalist computational methods must be placed within reflective methodologies using critically systemic frameworks. This methodological shift addresses problemism in systems design.

The concept *just sustainability design* (JSD) encapsulates the orientation away from a problem-solving paradigm to a critically systemic engagement with wicked problem situations. I introduced it in the Introduction to describe a systems design paradigm that aims to address the challenges of just sustainability (dispersal; uncertainty/ambiguity; fragmentation; power imbalance and asymmetric vulnerability; incommensurability). To do so, JSD needs to fulfill at least the following criteria:

1. *Constructive and critical*: Critique is an essential element of change. To reorient systems design toward sustainability and justice, critique must also examine the norms themselves that govern how computational systems are designed today. In doing so, JSD must be critical without abandoning the generative aspects of engineering and design. The idea of critical friendship is central to achieving this.
2. *Systemic*: Because the social, the technical, and the natural are entangled with political, cultural, and economic dimensions, JSD must take a systemic perspective—a perspective that prioritizes the consideration of wholes and their relationships over the isolated analysis of individual components and their properties. The boundaries of meaningful "wholes" rarely align with organizational and technical boundaries, so the commitment to systemic thought implies the acknowledgement that technology design always designs sociotechnical rather than purely technical systems.
3. *Dialectic*: The climate crisis has brought to the forefront central challenges for epistemology and collective action that sustainability and justice advocates have long grappled with, including the incommensurability of conflicting worldviews, the inevitable selectivity of each, and the need to nevertheless find common grounds for collective action. Just sustainability design—and in fact any systems design for the twenty-first century that tackles relevant social issues—must transcend the monological forms of reasoning expressed by traditional science-driven approaches to "solving social problems" through deductive means alone, in favor of a pluralist dialectics of design in which multiple worldviews can meaningfully engage.
4. *Diachronic*: The delayed temporal nature, and the path-dependent nature of design decisions and ecosystems, require a diachronic design

perspective— that is, a perspective aware of temporal scales and dynamics—studying its phenomenon as it evolves over time (Merriam-Webster 2020a). JSD must account for the historical profile of the processes that led to the system design, the life cycle of the system itself, the downstream and long-term impacts and consequences, and the temporal dynamics of design itself, rather than taking an atemporal focus on the "now" of design.

5. *Contingent*: The universalist approaches touted by science-driven methodologies are in fact neither universal nor appropriate to the case. Their "unmarked" worldview is partial, resting on unspoken assumptions that are Western and colonial rather than truly global. Far from being "independent of culture," as some would like sustainability to be, universalist approaches express an unacknowledged ideology built on a colonial and racist legacy. Just sustainability design must be aware of its contingency and the partiality of its perspective and equipped to reflect on its already given context, boundaries, and assumptions. I use contingency rather than situatedness or located accountability (Suchman 2002) to emphasize the importance of attending to the set of assumptions that are implicitly mobilized to justify systems design choices. But contingency also means that rather than being declared complete and optimal, JSD must be thought of as a proudly incomplete project, fashioned to learn and evolve.
6. *Legitimate*: The orientation toward sustainability and justice highlights the asymmetry of distant effects of design choices. Because full participation of those affected in design is not possible, JSD must grapple seriously with the question of justification. Rather than seeking a technical optimization or abandoning the generative orientation of design and engineering, the approach must aim to prioritize questions of legitimacy when systems design choices are to be justified based on their potential effects on those not involved in design.
7. *Reasonable, rather than rationalist*: In justifying critically and systemically the choices made in systems design with regards to their uncertain and distant effects, JSD cannot rely solely on rationalist modes of deduction. They would lead us right back into the traps of universalist frameworks of an ideological nature. Instead, it must be built on reasonable arguments. This is important, and it applies both to the

level of argumentation needed to develop and justify methodological commitments and principles and to the discursive level of reasoning through systems design choices. This does not preclude the application of scientific and rationalist frameworks for those issues and contexts to which they are appropriate in situations in which that is legitimate.

8. *Replicable, rather than repeatable*: Because of its emphasis on contingency and legitimacy, JSD will not produce one absolute method for design that can supposedly be repeated to yield optimal outcomes. Instead, it asks for replicability across different contexts, building and growing our understanding of how it can work in heterogeneous ways across diverse contexts.

These principles have led me to conduct research that critically evaluates proposed systems designs for sustainability and/or justice and the processes by which they come about (McCord and Becker 2019), develops design tools that support the collaborative exploration of distant effects in systems design among heterogenous stakeholders (Penzenstadler et al. 2018; Becker et al. 2016), studies the macro-cognitive systems of judgment and decision-making in systems design (Fagerholm et al. 2019), examines genuine participation vs pseudoparticipation in and by design (Palacin et al. 2020), and develops systems design methods that embody the criteria listed above (Duboc, McCord, et al. 2020). In my academic organizing, the just sustainability design framework has motivated the facilitation of conversations about the role of human values in computing (Becker, Engels, et al. 2019), the collective social responsibility of computing professionals and academics (Becker, Light, et al. 2020; Saxena et al. 2020), the ethical tensions in requirements engineering work (Becker, Betz, et al. 2020), and the leverage points available to our societies to abolish the conditions that allow Big Tech to have such excessive power (Barendregt et al. 2021).

I think of just sustainability design as a region and a mindset, rather than a fixed point, theory, or singular method. Its scope is defined by the principles above (critical and constructive, systemic, dialectic, diachronic, contingent, reasonable, legitimate, and replicable). Its origin lies in its aim to transcend the monological forms of reasoning expressed by traditional science-driven approaches to "solving social problems" through deductive means alone in favor of a dialectics of design in which multiple worldviews can meaningfully engage. I do not offer a comprehensive

design framework here, but a roadmap that can be used to chart diverse paths across this region. I offer principles and high-level goals, chart tentative pathways and their challenges, and explore leverage points for change. One can argue that this framework amounts to a paradigm shift, and it would be naïve to assume that presenting eight principles is enough to make that happen. Rather, we will need to shift perspectives: from a focus on the narratives and assumptions of systems design to considering the social structures and forces that constitute and shape systems design practice. But change can start anywhere.

LEVERAGE POINTS FOR CHANGE

I am far from the first to suggest the need to reorient computing, or design, away from rationalist, modernist, patriarchal, capitalist foundations (Winograd and Flores 1986; Escobar 2018; Knowles 2013; Costanza-Chock 2020; Benjamin 2019). Many have recognized that such a reorientation is an indispensable step toward bringing human activity into harmony with the rest of nature (Hickel 2020; Midgley 2000; Kimmerer 2013; Escobar 2018). As Escobar (2018) writes, "the practice of transformation really takes place in the process of enacting other worlds/practices" (99). In this third part, I show how I enact this reorientation in my practice to illustrate the opportunities, difficulties, and consequences of this book's argument and to provide starting points and suggestions for others interested in enacting similar transformations.

The concept of *leverage points* (D. H. Meadows 1999) proposes that in a complex system, we can understand and evaluate possible interventions by considering how they address the structural dynamics of the system's organization. Some interventions may be easy to implement but have only localized or fleeting impact, because the dynamic behavior of the system is bound to erase any positive change over time. For example, pouring water on a hot stove will not permanently cool it down while it's on, but might well lead to steam burns and electrical shorts. Other interventions carry leverage: they shift the structure of the system's elements such that the newly changed system begins to exhibit new behaviors or initiate processes that lead to large-scale change. Disconnecting the stove from electricity might be an example. (I will leave it to you to draw parallels to geo-engineering.) Typically, interventions with small leverage are

easier to implement, but the relationship between leverage and difficulty is not simple. By analyzing a system, we can evaluate which interventions may be most promising: feasible, yet powerful.

Meadow's classification of leverage points is built atop an understanding of the existing system from the viewpoint of system dynamics, so I will not reproduce it here in full. In ascending order of their power, Meadows proposed twelve intervention points. The weaker six are specific to system dynamics. They provide highly visible points of intervention such as tax percentages or efficiency measures, and they are often targeted by managers and policy makers. But they rarely shift the behavioral patterns of the system that produces them because these patterns emerge from the deeper structure of the system's organization. The highest leverage points within this group are the strength of balancing and reinforcing feedback loops, whose influence is often underestimated. The second half of Meadows's leverage points can be interpreted outside of system dynamics. In ascending order of power, these are:

- The structure of *information flows* determines who, and which part of the system, has access to what kinds of information.
- The *rules* of the system include incentives, punishments, and constraints.
- The power to add, change, evolve, or *self-organize* the structure of the system implies the ability to change any of the prior aspects, such as information flows.
- The *goals* of the system determine what behavior it will strive for.
- The *mindset* or paradigm out of which the system arises will shape its goals, structure, rules, delays, and parameters.
- The power to *transcend paradigms* involves difficult shifts in mindset. (adapted from D. H. Meadows 1999, 3)

The first three refer to the *design* of structural conditions that regulate how the system is coordinated; the final and strongest three, to its underlying *intent*: that is, "the norms, values and goals embodied within the system of interest" or "the emergent direction to which a system of interest is oriented" (Abson et al. 2017, 32–33). Within the world of just sustainability design, these leverage points might direct designers to act on the following:

Information flows: Researchers make publicly visible the sustainability debt of a large information system so that it can be evaluated by other stakeholders.

Rules: Lawmakers extend the legal frameworks of "extended producer responsibilities" mentioned in chapter 1 to increase the extent to which IT companies are liable for the environmental degradation and health implications caused by designed obsolescence.

Self-organization: Local communities organize to form permanent groups that evaluate a given system's sustainability debt or work to persuade lawmakers to extend the responsibilities of producers, ban facial recognition technology, or regulate consumer data collection.

Goals: A start-up constitutes itself as a cooperative designed not to maximize shareholder return but to best serve its constituents.

Mindset: Increasing numbers of aspiring computing professionals commit to, organize as, and practice systems design in a manner committed to principles of design justice, data feminism, autonomous design, or just sustainability design.

Beyond one paradigm: Powerful narratives of change sometimes hit home across diverse constituents. From a critically systemic view, this reminds us all of the need for epistemic pluralism. We want to build "a world where many worlds fit," as the Zapatista slogan at the heart of Escobar's (2018) work on *pluriversal design* suggests.

This list illustrates the range of possible interventions that can move computing design from insolvency to just sustainability. It further illustrates that some leverage points have the power to cause interventions on other leverage points. Each of these interventions implicitly assumes a system boundary. The system in *goals* is the social organization of the start-up. The system in *information flows* includes the object of evaluation, the researchers, and others for whom this information serves as input for some decisions (perhaps the *rules* regulators). Reflecting on these boundaries is crucial for evaluating possible interventions.

Meadows cautioned that her list is "not a recipe for finding leverage points. Rather it's an invitation to think more broadly about system change" (D. H. Meadows 1999). Some leverage points relate to mindsets and paradigms, and I make no secret of the fact that this book argues for a shift in mindset. I harbor few illusions about the ease of doing so. But smaller change can trigger larger shifts. We really do need to *act locally* where we can, while *thinking globally* and keeping larger contexts in mind.

MY LEVERAGE POINTS

The *leverage points* concept suggests that the analysis of complex systems can help us to identify interventions that exert leverage beyond localized change, but the chapters in part III do not provide a comprehensive account and assessment of all the actions we may take to shift our practices of designing systems to be more sustainable and just. That is likely a good subject for a separate book beyond my own ability. Instead, I discuss how I have reoriented my own work, reflecting on the margins of maneuver that I see for myself, I survey some initiatives for change, and I consider some proposals worth exploring.

As an academic, I am asked to describe, measure, and evaluate my impact in terms of teaching, research, and "service," that is the organizing, coordinating, and administrative work that helps keep everything else running at my university and in my research communities. Since these are distinct categories of work in my employment contract, it makes sense to look for leverage points in each. What can I do within each to enact change, how significant is that change, and can I identify changes in each that can trigger larger shifts? I can try, aiming to be mindful of my privilege, humble about my abilities, and courageous in my ambition.

Research is at once the most obvious leverage point and famously slow. Academic research can produce insights that change public knowledge, influence public perception, and shift design practice. Even when it does, however, it often takes a very long time for new insights, methods, and frameworks to be adopted in practice. And yet not all research is slow to make an impact, as we can see, for example, in critical research about machine learning algorithms and their role in our societies. It is important to recognize the role of advocacy and organizing in leveraging research insights for policy change. For example, substantive research about facial recognition was used by organizers to advocate for banning it. Personally, I am in a privileged position, able to refocus my research where I see leverage. After all, addressing the *mindset* of problemism is a very difficult leverage point, but it is one with very strong leverage. Within the scope of the paradigm change this book argues for, I believe that the myths present us with leverage points we can tackle to move minds and views, and reframe issues. If the myths of computing depoliticize the discourse of systems design, then we can restore the acceptance that computing already

is political by retelling the story differently, debunking false claims, and reframing the perspective. This is slow, and the work of persuasion takes time, but I would not be writing this book if I did not consider them worthwhile, and dare I say, you would not be still reading if you did not at least partially agree. I have not always followed Meadows's suggestion not to "waste time with reactionaries" highlighted in the epigraph, but I have eventually learned to "work with active change agents and with the vast middle ground of people who are open-minded." Chapters 10 and 11 speak to this.

Teaching is a notoriously slow leverage point too, but it is often said that the biggest impact most academics have at the end of their career is to be found in their students. And it does matter what we teach and how. "After all, educators hold the power to shape public perception of computing. We do this through the problems we focus on in our classrooms; through who we choose to teach; in how we shape students' career choices; and in how we conceptualize computing to journalists, social scientists, and society. The world has critical questions about computing and it is time we started teaching more critical answers" (Ko et al. 2020, 32). I have been fortunate to be able to reshape what I teach, and how I teach it. Many of my students are deeply concerned about the state of the world in terms of sustainability and justice. They are dissatisfied about the role of technology in our societies and deeply uncomfortable with the ethical dilemmas they anticipate facing in their future professional roles. They want to make a difference. Equipping them with critically systemic thinking and an appreciation for the other critical friends of computing has been a deeply rewarding experience. As one reflected in 2021:

> I know that once I leave the academy, ethics and professional responsibility will be ignored in the workplace unless I make a point of bringing it up myself. I am comforted by the fact that through this course, I've built a toolkit of critical thinking frameworks and principles for organizing against harm that prepares me for the rocky road ahead. When I graduate, I will be a tech worker but I will also be a co-conspirator working in solidarity with my "users" to fight back against injustice.

Finally, "the traditional academic roles of research and teaching are not sufficient to drive transformative change in a time of rapidly accelerating global crises, so those with the greatest knowledge and understanding of

these crises have a moral obligation to provide leadership, and engage in advocacy and activism" (Gardner et al. 2021, 5). *Service* too presents very specific and largely bureaucratic constraints, as well as the entrenched hierarchies of academic conference organizing, disciplinary communities, university departments, and funding policies. It is also a place where the matrix of domination profoundly influences what can be done by whom. Many academics cannot afford to withdraw their labor from departments where they are marginalized or from reviewing at conferences where their research is not valued. But whatever the constraints, we can prioritize and try to apply our labor and skills to elevate marginalized voices, to support those who have more profound insights than us and less visibility, and to help organize. That is what I have been trying to do. Chapter 12 will speak to the work of organizing collective action.

RESTRUCTURING AND REORIENTING

To flourish, just sustainability design must be critical without abandoning the generative aspects of engineering and design, as captured in its first principle. Embedding computational thinking and problem-solving into critically systemic frameworks retains their analytic strengths, allowing us to deploy them ethically and productively. Part II provided the conceptual and theoretical underpinning for this restructuring. It focused on the elements and relationships of key assumptions in the theories, methods, and practices of systems design. Technically generative features of design practice currently built on the myths of computing can be recast into new ways of thinking and working. Some aspects are worth salvaging, after all: We need problem-solving abilities; we need computational thinking; and we need some rational decision-making. The proposed restructuring alters layers of knowledge and practice of established computing disciplines.

The next chapters explore what that means. Chapter 10 illustrates a critically systemic shift in requirements engineering, and chapter 11 presents a shift in decision-making studies. Both illustrate how the principles of JSD reorient my own work. Other critical friends have developed different perspectives and themselves present important critical friends that are not all shown here, but from whom and with whom JSD should expect to learn and grow.[2]

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