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Participatory policy design: igniting systems change through prototyping

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ABSTRACT

The complexity of 21st-century socio-ecological-technical challenges increasingly strains the capacity of 20th-century policy design approaches. This new context opens an opportunity to evolve norms and perspectives on *what* is the intent of policy, but perhaps more importantly, on *how* policy is constructed – and for *whom*. In this article, we share an alternative to conventional policy design, expanding the notion of "policy-as-content" to embrace a more participatory approach to frame, make, and implement policy. We briefly present how we combined systems and behavioral design frameworks to scaffold prototyping activities during a design research project that explored food waste as a critical path for co-designing sustainable and equitable food systems in the City of Chicago. We highlight relevant activities of this project to show how our approach can challenge embedded norms and privileges in existing urban food systems and interrogate traditional ownership of problem definition and solution finding in policy design processes. Finally, we conclude with the implications of employing this approach to policy design when promoting large-scale change.

1. Introduction

Historically, policy has been a mechanism to allocate and provide or deny access to various resources within relevant contexts and influence the conditions through which organizations activate and mobilize them. Policy design's credibility has relied on evidence-based practices and social science methodologies that use evidence from prior efforts to avoid replicating known errors (Turnbull 2018; Howlett 2019). This more "informational" analytical approach, or design *of* policy (Sanders 2005), applies a top-down strategy, in which policies tend to be framed, made, and implemented in linear and discrete processes, usually by agents that are themselves disconnected from the

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context their work is impacting. While such processes have generally worked within stable conditions, emergent rapid and interconnected socio-ecological and socio-technical dynamics present new contextual tensions, giving shape to new levels of complexity. These socio-ecological-technical (SET) shifts beg institutions to examine not just *why* a policy is needed and *what* it is designed to achieve, but also *how* it is designed and *who* it is for.

The food waste crisis in America is indicative of this complexity, in which the high demand for more sustainable and equitable solutions to fit diverse 21st-century realities becomes constrained by policy design processes established to address 20th-century problems. In 2016, the United States spent over $218 billion – 1.3% of GDP – growing, processing, transporting, and disposing of food that was never eaten. It is estimated that 52.4 million tons of food are sent to landfills every year, and an additional 10.1 million tons remain unharvested at farms, totaling roughly 62.5 million tons of annual waste (ReFED 2016). As landfills close due to lack of space or capacity, organizations across sectors still struggle to promote large-scale behavior changes or paradigm shifts in food waste management policies.

In the U.S., public agencies, private companies, research institutions, NGOs, foundations, and other agents are mutually influential in deciding whether and how to reconfigure food waste management practices and adopt new related competencies. Any policy designed to improve the sustainability and equity of existing food systems requires an in-depth understanding of multi-level and cross-sector dynamics in these networks and institutional arrangements (Wigboldus et al. 2016), including enforcement of local policies, institutional buying power, local production capacity, and the local population's dynamics and patterns of daily life. Conventional forms of problem-solving have proven to be incapable of activating and engaging various stakeholders involved in this context; as a result, this American crisis has become representative of an increasingly evident fracturing of policy into multiple potential futures at the intersection of socio-ecological and socio-technical conditions.

The State of Illinois, for example, has many policies that continue to incentivize monoculture plantations of large producers, prioritizing their economic growth over more sustainable farming practices and the development of urban food producers (Schnitkey 2020). The consequences of these dynamics are evident in Chicago's institutional inability to adapt or create new policies that incentivize composting and facilitate soil recovery for urban food production (Castillo et al. 2013), which have disproportionately penalized low-wealth and marginalized Chicago populations, particularly people of color, in gaining better access to affordable, healthy food (Goddu et al. 2015). The same inability poses significant barriers to strengthening local economies; composting activities, for instance, are likely to create four times more jobs than landfilling (Illinois Environmental Council 2020). Without proper resources and policies to condition access to local markets, such as public schools, restaurants, and grocery stores, those who produce food in urban settings cannot outcompete existing contracts with large producers and scale up their operations (Block et al. 2012).

In addition to the particular contextual, social, and temporal dimensions of complex challenges related to food waste, Chicago's situation serves to illustrate how the

narratives around the future of food systems have themselves splintered. With radically different stakeholder perceptions about how to solve food waste at the city level, agreeing upon the nature of the problem to be solved is itself a challenge that must be addressed before institutions can make and implement new policies that enable progress toward more sustainable and equitable outcomes.

The creation of meaningful, future-driven approaches – designing *for* policy (van Buuren et al. 2020; Hoppe 2018), rather than design *of* policy – presents an alternative by interrogating how relying on historical data and best practices imported from elsewhere can reinforce traditional assumptions about what to solve and how to solve it. Future-oriented solutions consider the plausible in addition to the probable (Dorst 2011; Maurits, Martijn, and Jorrit 2019), emphasizing the notion of desirable futures as a means to better frame and structure problems: Are we solving the right thing? Who defines what is "right," or better, for the recipients of policy?

These questions are critically important in policy design for complex SET challenges, such as food waste in Chicago, where the very goods at stake – equitable business opportunities, sustainable management of natural resources, public health – reflect human and social rights rather than merely discretionary assets. However, without proper approaches and structures to explore alternative futures, rather than benchmarking the past, contemporary practices in policy design will continue to fall short when aiming to solve 21st-century challenges.

In the case below, we share an alternative approach to conventional policy design, which leveraged participatory design and prototyping methods to explore how the issue of food waste could become a critical path for co-designing sustainable and equitable food systems in the City of Chicago. While design approaches can also be useful to policy implementation and evaluation, especially when the problem is well-defined and available data is reliable, this particular work had a procedural emphasis on investigating new ways to tackle complex policy design challenges and contexts. We considered sustainability and equity properties of an urban food system that can adapt and sustain itself over time, continuously enabling all agents to have equal access to information and opportunities to participate as producers and consumers of food that is nutritious, and produced with low environmental impacts, fair wages, and adequate animal welfare (Chicago Food Policy Action Council 2020). We grounded this approach in the structured application of systems and behavioral design frameworks and methods that allowed us to incorporate relevant contextual variations, disruptive systems forces, and root cause conditions into both the ethics of new policy design processes for igniting large-scale change and long-term transformations, as well as the resulting interventions necessary to accomplish this ambitious goal.

2. Co-designing sustainable and equitable food systems in Chicago

The 2017 research project "Co-designing Sustainable and Equitable Food Systems" was conducted in collaboration with the Chicago Food Policy Action Council (CFPAC), and informed by the non-government organizational (NGO) network expertise on the

history, diverse narratives, and structural conditions that have created and maintained systemic racism and massive inequities in greater Chicago (Chicago Food Policy Action Council 2020). Founded in 2002, CFPAC's mission is to facilitate responsible policy development to improve Chicago residents' access to culturally appropriate, nutritionally sound, and affordable food grown through equitable and environmentally sustainable practices. CFPAC's motivation to engage in this project was prompted by a desire to expand their efforts in building local political power, supporting those working throughout the food chain, and facilitating partnerships and understanding across populations. As a result, the project focused on prototyping new processes and models of large-scale collaborations to deal with unsustainability and inequity in Chicago's food system, with food waste as a critical path to engage with this complexity.

2.1. Contextual background

Public awareness about the multifaceted nature of food waste challenges in Chicago has increasingly forced organizations across sectors to give the topic more attention. Despite the City's commitment to the development of sustainable and equitable futures over the past two decades, existing organizations still lack appropriate incentives, resources, and mechanisms to adopt and implement food waste management practices; on the contrary, they face significant operational and economic barriers due to having their operations based on tax implications (Pai, Ai, and Zheng 2019).

This widespread organizational reliance on policies that were not designed to support sustainability and equity is exacerbated by individuals' tendencies to assume that their responsibilities end at their trash bins. Without considering cultural practices that reflect people's beliefs and habits, it is unlikely that any emerging policy will bring about desired changes. Chicago's Blue Bag Recycling Program provides an instructive example. Initiated in the 1990s, the program required residents to purchase official "blue bags" for collecting recyclables, which were then picked up with ordinary trash. While seemingly straightforward, the program suffered from numerous flaws of execution and perception; the additional cost and hassle of purchasing bags created an immediate barrier that was made worse by the revelation that recyclables were not separated but instead deposited in landfills with other forms of garbage, irreparably creating distrust in the system that persists despite the program's long-ago demise. This failure reflects a lack of proper infrastructure that was amplified by the severe underestimation of community member skepticism, caused in large part by the burdens of ineffective processes and diverse resources allocation required to make the system work (Feldman 2010).

Today, the city continues to suffer from the effects of residents' mistrust in public services and lack of proper infrastructure for waste management practices, including food waste. As a response, there is a swift and distributed emergence of small, creative initiatives across the city, such as food-scrap bike haulers, community gardens, and compact vermicompost urban farms, that work closely with residents and business owners to provide alternative options for more reliable initiatives. However, without

proper support and incentives, these solutions tend to respond to the failures of existing organizational models and their dynamics rather than establishing a new infrastructure to enable behavior change across system levels. Moreover, they tend to rely on individual and organizational goodwill and capacity to pay for additional services in place of a citywide strategy worthy of the scale of the issue. What their bottom-up approach gains in experimental freedom, it suffers from in the form of inter-organizational competition for resources, market access, and equitable opportunities.

In the absence of more effective policies, Chicago's unstructured governance system limits the scalable impact of meaningful solutions, including those that contribute to the City's sustainability and equity agenda. The collaboration with CFPAC focused on exploring ways to restore the integrity of local food systems and promote behavior change in food waste management practices. The agreed recognition that overcoming structural barriers required navigating the multi-level dynamics that have historically determined who has (or does not have) access to certain types of resources and how they can (or cannot) be mobilized toward achieving the intended outcomes, led the collaboration to explore a more systematic approach to policy design.

2.2. Methodological approach

The incoming hypothesis of our work was that policy solutions in these complex spaces demand interventions at the intersection of social, ecological, and technical systems, and the strategic integration activities across organizational levels. We also assumed the need to closely consider the dynamics, degrees of control, and interests of various agents if we were to activate and mobilize different types of resources effectively, as well as accounting for individual-, organization- and systems-level factors that may hinder their access.

In order to create the conditions that could enable meaningful short- and long-term behavioral change across systems levels, we leveraged frameworks and methods from the fields of behavioral and systems design. Where behavioral design primarily focuses on creating conditions that promote individual-level behavior change, systems design focuses on creating conditions to promote institutional-level behavior change that can influence the dynamics of the overall system. Combined, frameworks and methods from both disciplines allowed a diverse group of people to expand their understanding of the issues at hand and consider the various components shaping the systems at play and the associated relationships determining the behavior and resulting dynamics. Rather than artificially and optimistically simplifying problems by removing complexity and optimizing toward a single intervention, we intentionally surfaced tensions among diverse groups as a strategy to collectively craft a broader array of more sustainable and equitable solutions.

The subsequent sections introduce our case on food waste in the City of Chicago, in which we applied this integrative approach to policy design in the context of three interconnected activities: (1) design research that reframed the issue of food waste to incorporate considerations of diverse patterns of daily life and systemic tensions, (2) a

workshop with design experts to co-create new models for large-scale collaborations, building from preliminary insights gathered from the research, and (3) an impact-driven conference called BarnRaise 2017 that was designed to expand options and support the acceleration of large-scale impact by focusing on material and symbolic interventions that could help diverse stakeholders envision alternative livelihoods. Combined, these activities have ignited new and continued collaborations between academics, policy experts, community leaders, and executive leaders centered around improving the sustainability and equity of Chicago's food system.

2.2.1. Design research: food waste in the city of Chicago

In our first phase, we used various research methods, including semi-structured and open interviews, field and user observations, abstract diagraming, pattern finding, silo bridging and prototyping, over the course of three months to engage with a wide variety of agents shaping the dynamics of food systems, including producers, restaurant owners, policymakers, haulers, dumpster divers, leaders in community-based organizations, entrepreneurs, gardeners, investors, employees of large corporations, managers in industrial facilities, chefs, and food designers.

Individuals were selected based on a diversity of thoughts and experience with urban food systems and their expertise in activating and mobilizing different resources to promote behavior change within or across system levels. We also considered diversity in demographic representation (e.g. age, gender, ethnicity), sector and institutional representation (e.g. public institutions, private sector companies, NGOs, and academia), organizational function within the urban system (e.g. food producer, distributor, collector), and individual role or rank within the organization (e.g. directors, managers, analysts). Because all participants consume food and produce food scraps or waste, we focused on learning from the daily activities related to food production and consumption contexts rather than on food waste as a stage of a particular process. No single structure can reflect all the dynamics of a system or the total value that an individual has to contribute. However, the intentional use of a framework to explicitly discuss, make decisions, and articulate the overall composition of the group was fundamental for both surfacing political frictions, market dynamics, and historical and cultural bias before being transferred into the research as well as potentially anticipating lack of representation and overlaps.

For this project, we used frameworks and methods from the Whole View (WV) model for analysis (Whitney and Nogueira 2020). Rather than providing a single linear process to make sense of reality or speculate about potential futures, the WV provides seven design frameworks and related methods that can be combined to fit the contexts that individuals and organizations are working in. By alternating views of purpose, operations, offerings, and users, this model is particularly useful in situations with high degrees of uncertainty, equipping individuals and organizations facing new levels of complexity with a new "way of thinking about the project rather than illustrating the right answer" (Whitney 2015, 72). Although relevant throughout any complex design

process, the model is particularly relevant in early stages, conventionally referred to as *problem framing*.

To release control and ownership of the research process and results, we invited subjects that were interested in continuing to participate into the activities of sense-making, using frameworks from the WV to help teams organize information and visualize ideas and arguments, with the goal of making them less abstract and easier to understand than when they are represented in words alone. This participatory approach to data analysis is critical when aiming to intervene in complex challenges, where knowledge about the SET conditions and resources are distributed across agents. Involving different parties' voices, values, and concerns in data analysis also helped ensure that diverse individuals and organizations had agency in the research about the context in which they are embedded.

Three patterns of issues related to people's experiences and behaviors around food waste in Chicago resulted from the analysis, reflecting evidence of structural, systemic barriers in social, ecological, and technical systems that impeded progress in sustainability- and equity-oriented efforts:

- **Perception of value** – People did not acknowledge the impact of food waste on the built environment, natural resources, or budget.
- **Lack of proactivity** – Because there is no infrastructure to support individual or communal change around food waste management, people were not motivated to change how they waste food.
- **Lack of education** – There are misconceptions around participating in, being aware of, and communicating the benefits of food waste management.

With this expanded perspective on patterns of behavioral issues, we used the Innovation Lenses Framework (ILF) (Nogueira, Ashton, and Teixeira 2019) to better capture the socio-technical and socio-ecological dynamics of a governance system that is ill-equipped to deal with internal structural barriers. The ILF model employs eight different types of capital, distributed across social (human, social, political, cultural capital), ecological (natural capital), and technical systems (financial, manufactured, digital capital), to support multiple modes of inquiry to explore system behaviors and interactions (Nogueira et al. 2020). We applied this framework to map ownership, access, and influence over available assets in Chicago's food system, and to visualize an expanded set of variables influencing the resulting system's dynamics.

Visualizing systems dynamics helped us map critical relationships and flows between variables underlying system-level food waste behaviors in Chicago. The maps were collectively and iteratively crafted through participatory processes and prototyping methods, drawing from the knowledge and experience of the various agents involved in our research. This approach allowed participants to surface and revise each other's assumptions about the context and create a shared understanding of the flows of different types of capital within and across social, ecological, and technical systems. From this analysis, we identified leverage points, or intervention spaces, that can accelerate large-scale change due to their higher power and influence in the system compared to other variables (Meadows 1999) (Figure 1).
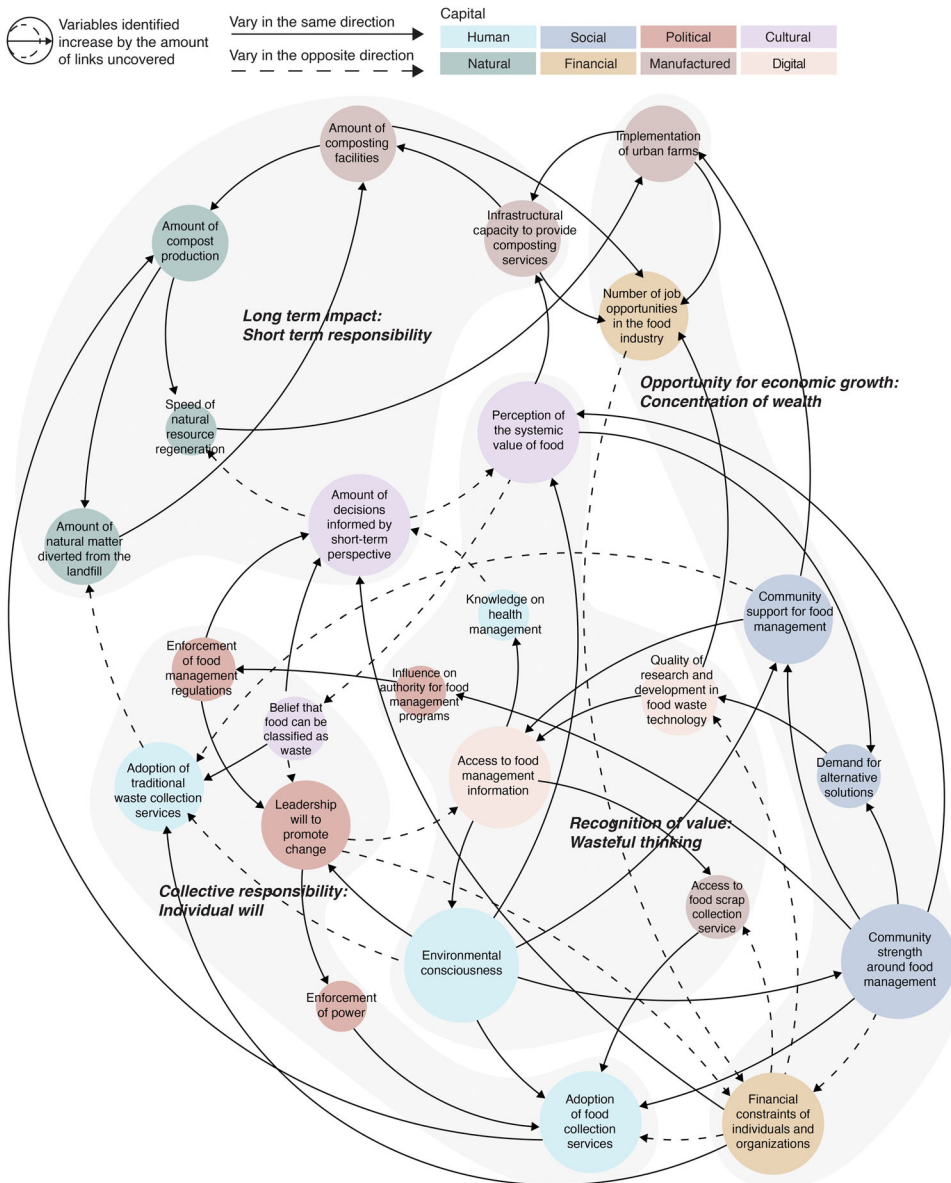
Figure 1. Simplified systems dynamics map of food waste system in Chicago, indicating the four tensions identified through design research. In this conceptual map, the colored circles represent the variables, and the arrows represent the nature of their interactions. Solid arrows indicate the elements vary in the same direction, and dotted arrows indicate they vary in opposite directions.

This qualitative analysis also resulted in the identification of four structural SET tensions, which reflected how and why available assets and resources were being allocated, accessed, and mobilized within Chicago's food system:

- **Opportunity for economic growth: Concentration of wealth** – Wealth concentration limits access to others' benefits, including access to healthy food. When

communities have access to healthy food, there is a greater opportunity for growth and the creation of thriving communities.

- **Recognition of value: Wasteful thinking** – Due to incentives for individual and organizational profitability, the moment food is classified as waste, it loses its value in the linear food and waste chains.
- **Collective responsibility: Individual will** – Without proper policies or the explicit recognition of the value of food, individuals and organizations struggle to understand that food waste is a collective responsibility. As a result, alternative solutions tend to rely on an individual's knowledge and proactivity.
- **Long term impact: Short term responsibility** – Tensions between the convenience of everyday life and the long-term impact of daily choices mean that individuals are protected from the systemic impact they generate in the form of food waste.

Combined, the patterns of behavioral issues and systemic tensions suggested that an alternative approach to food waste policy design could help increase the environmental performance of the City's food systems, while also supporting inclusive and just business development opportunities focused on improving access to healthy food to while lessening the financial burden of low-wealth and marginalized local populations. The findings of this research culminated in a report, which was shared in advance with participants of the impact-driven conference, BarnRaise 2017 (Nogueira, Russ, and Lafranchise 2017).

2.2.2. Workshop: co-creating large-scale, collaborative models

In parallel with these research activities, we hosted a workshop with representatives of five Chicago- and New York-based design firms and students and faculty members from different programs at IIT's Institute of Design. The goal was to engage design experts in exploring alternative large-scale collaboration engagement models for achieving more sustainable and equitable food systems solutions. In addition to understanding the limitations of current design practices in urban food waste, this workshop served as a platform for debating the challenge of sustainable and equitable food systems in the City of Chicago, which also led to content incorporated in the research report.

Workshop participants received a design brief before the event with theoretical and practical references relating to social, ecological, and technical dynamics and tools and frameworks from design, industrial ecology, and sociology (Nogueira and Russ 2017). We invited each design firm to consider these references and present an outline of a two-and-a-half-day impact-driven conference as background for activities of co-creation and integration among all participants of the workshop. First, design firms shared their outlines with other workshop participants. Then, together all participants compared the work and sketched a new, integrated outline, which became the first draft for a new large-scale collaboration model unique to Chicago and the design. Subsequently, we hosted several online meetings to discuss and refine the final version of the model with the all participants and train members of the design firms that facilitated ideation activities and prototype the model during the impact-driven conference.

2.2.3. Impact-driven conference

BarnRaise 2017 was a two-and-a-half-day, impact-driven conference that explored food waste as a critical path to co-design more sustainable and equitable food systems in the City of Chicago. During the event, over 130 participants from 35+ organizations representing diverse disciplines, industries, sectors, levels of expertise, and affinity to food-related challenges worked in ten multidisciplinary groups, each with a different focus determined by its members. All groups were formed by two members of a renowned design firm, two graduate-level design students , and conference participants that self-organized according to their interest. Group members were encouraged to assume ownership of their processes by proactively taking on roles as facilitators, reporters, and timekeepers, and by selecting which area they wanted to apply their expertise. This democratic approach to group formation and engagement allowed participants to collaborate based on affinity, instead of previously defined diversity, and more meaningfully recognize their role in both problem and solution. This process ultimately resulted in more effective and efficient choices to inform cross-sector, multi-level engagements.

In the interest of prioritizing collective ownership of discussions and shared responsibility for creating solutions over applying standardized processes and data collection methods, we presented a set of advanced design frameworks and models, such as the WV, the ILF, and others from behavioral design, to support teams to work at their own pace as they developed concepts. These activities were scaffolded by a general agenda to ensure that participants understood and agreed upon the relevance of the content (Figure 2).

Throughout the event, the strategic use of cross-pollination activities created bridges across dispersed networks, expanding participants' perceptions about the nature of problems and the range of available knowledge, political access, and technical expertise represented in the event. The use of design models and frameworks, enabled participants to discover common ground, informing how diverse types of resources and
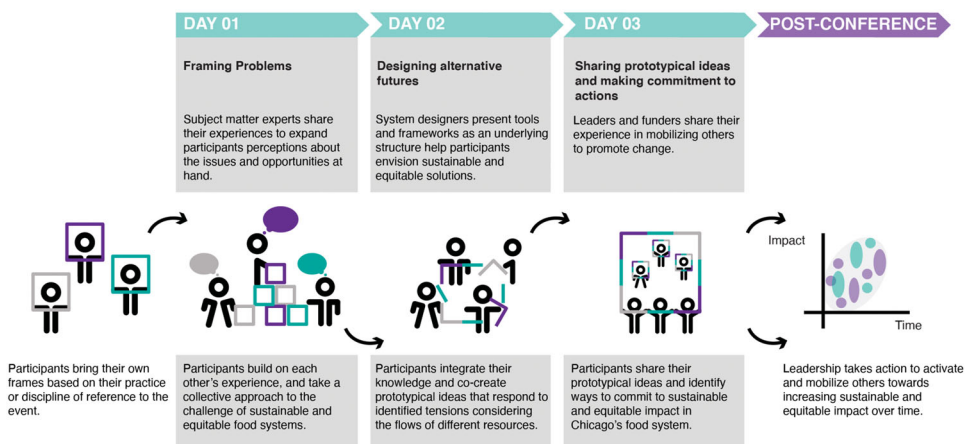

Figure 2. Conceptual representation of the conference user journey. The top shows strategies behind talks given by keynote speakers, and the bottom shows strategies related to participants' interactions.

experiences could be integrated into conceptual interventions. This approach also helped teams surface individual and group bias that could impact sustainability and equity within Chicago food system dynamics significantly earlier in the process, before refining their ideas.

Between subject matter and design experts' lectures, intentionally structured ideation sessions, and rapid prototyping and simulation activities, the BarnRaise 2017 offered a safe space for open, critical debates and critiques and the exploration of new models of engagement and partnerships. Rather than refined solutions, by the end of the event, ten groups created ten conceptual platforms that reflect a collective intention and aspiration for improving Chicago's food system. For example, one group created a digital platform focused on user experiences, using gamification to make food diversion more effective by shifting collective behavior from shame to appropriation. Another group explored alternative investment models for entrepreneurs aiming to empower sustainable and equitable food practices. A third used Artificial Intelligence and sensor technology to track long-term change and accelerate perception of progress in collective behavior change. These examples suggest a new way of framing and making interventions that can inform policy design and implementation.

This project and resulting conceptual platforms sparked a series of additional collaborations that supported CFPAC's efforts to impact policy design in urban environments. For example, some researchers, participants from the conference, co-founded the Midwest Consortium for Equity, Research, and Food Policy (M-CERF), a consortium of Chicago-area based university and community researchers that works with communities to support transitions to more sustainable and equitable futures. Among several other contributions, this ongoing collaboration has supported progress in the Good Food Purchasing Policy, which leverages procurement practices of major Chicago institutional buyers to drive changes in the food system by requiring suppliers to meet set performance criteria in five categories: environmental management, labor, animal welfare, nutritional content, and supplier diversity (Chicago Food Policy Action Council 2020). The work has also resulted in additional efforts and resources for small-scale and community food organizations, such as a nascent "navigator" dashboard system that will connect heretofore distributed ecosystem entities more effectively and efficiently.

3. Participatory prototyping

The SET challenges surrounding food waste in Chicago's Food System represent a new, more dynamic context that frequently hampers the sustainability and equity of organizations designed to thrive in stable conditions. In the pursuit of more flexible approaches that fit this new context, we employed participatory prototyping methods to facilitate diverse interactions among dispersed groups, and also as a form of foresight mechanism to explore alternative policy design processes facing SET challenges. Building on the notion that "(a)s a non-linear, systemic process, prototyping presents a design-led research approach that is collaborative, participatory, and context-dependent" (Nogueira, Ashton, and Teixeira 2019, 575), we used systems and behavior design

frameworks as an underlying content structure to mediate strategic top-down and bottom-up approaches to policy design (Forlano 2016).

Collectively creating and testing low-fidelity, low-resolution prototypes allow diverse individuals and organizations to explore and create tangible and intangible values while making their models. Properly done, participatory prototyping activities can become a strategy to invoke and explore the real-life future implications and impact of existing or nascent policies, enabling those involved to test the boundaries of the problem space while generating new contextual and behavioral insights (Kimbell and Bailey 2017). For us, prototyping activities elicited new questions about what was or was not working, as well as what *could* work in Chicago's food system. It also helped us recognize how public and private institutions might need to develop new design competencies to properly use prototyping methods to engage and retain wider audiences throughout policy design activities if they were to use this new approach.

The participatory nature of our prototyping activities reflect emergent perspectives that prototyping is not merely a domain of expertise (Lury et al. 2018; Stappers, Sleeswijk Visser, and Keller 2014; Stappers and Giaccardi 2017) or a different form of experimentation compared to traditional analytical or scientific inquiry (Chow 2013, Huppatz 2015), but a method to actively exchange and integrate the knowledge of multiple agents in and outside of the context of intervention in the interest of achieving large-scale social and behavioral change (Nogueira, Ashton, and Teixeira 2019). In a policy context, we focused on exploring prototyping as a center of gravity, around which framing, making, and implementing are modes that continually evolve and shape one another as new information is surfaced and integrated to inform alternative futures (Figure 3).
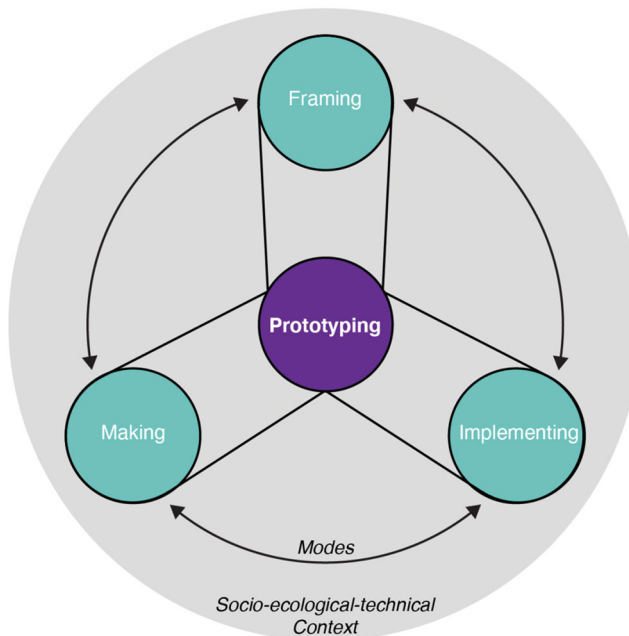

Figure 3. Conceptual diagram showing prototyping as a method for facilitating non-linear, iterative engagements throughout activities of policy framing, making, and implementing.

In the diagram above, *policy framing* represents a mode of inquiry, it critically questions and analyzes the situational context, systems effects, and individual behaviors to shape and articulate the nature of challenges, their relevance, and the agents involved in them. For example, in our case, we initially used the notion of policy framing to determine the boundaries of the research project and the scope of the workshop and conference to inform the content of the work, who participated, and what roles they took on throughout the event. But it was also activated throughout the engagements as new information about Chicago's food system was uncovered.

Policymaking, in contrast, becomes a mode of raising questions to address the existing order and inform the fundamental barriers to overcome them. It asks, "what if?" and "how might we?" questions, allowing individuals to continuously search for new points of view and alternatives for interventions. Here, we applied an iterative and generative process for policymaking through synthesis and the collaborative mechanisms in the working sessions. By treating policymaking as a *conversation and negotiation* between a diverse set of stakeholders, rather than as a top-down effort, we allowed the content and properties of policy to emerge from the discussion and continual recentering of what we were solving for, for whom, and how we might define success, consequently activating the framing mode.

Finally, *policy implementation* invokes a collaborative mode, through which participants develop and test interventions with tangible and intangible value for sustainability, equity, and legitimacy. In combination, as applied with CFPAC, these modes allowed participants to learn by doing, actively connecting people and environments to iteratively discover, explore, validate, and provoke changes in a contextually relevant way. The use of performance criteria presented in other policy efforts led by CFPAC, for example, enabled us to both determine what good looks like, but also to see under what conditions those criteria can best be met and how contextual factors impact success and opportunities for future refinement.

The shift from a linear progression of steps to a discursive set of modes with a clear structure of content to navigate between them presents a reframe to conventional practices of policy design. Rather than considering policy design a project, with a clear beginning and end, this approach suggests that changes in contexts will result from a continually evolving, socially informed set of interventions that are adaptive, public, and relational in their dynamics (Nogueira et al. 2020), and which can feed and augment more traditional hypotheses to potentially broaden their policy impact (Schmidt 2020). It also challenges the linear nature of resource access and allocation throughout fragmented policy design processes, allowing initial decisions to be continually questioned into later stages and the distributed nature of ownership. This distinguishes participatory prototyping of policy from more conventional policy prototyping activities, in which policymakers tend to maintain control and ownership of the policy process and definition of intended outcomes (Abrams et al. 1991). Instead, this iterative process focuses on distributing ownership across agents by continuously, flexibly, and transparently integrating diverse stakeholders, including recipients of the policy, toward a shared purpose. In the absence of structural constraints, participatory prototyping activities can ignite systemic and behavioral change even before a policy is enacted.

4. Implications

Policy solutions to contemporary complex problems, such as food waste in Chicago, demand intervening at multiple interconnected social, ecological, and technical system levels, taking real-world dynamics, degrees of control, and various agents' interests into account. Throughout this work, we found that participatory prototyping activities helped participants explore various perspectives and future implications of existing and nascent policies by providing new foresight into the impact of potential solutions and the allocation of resources.

The process of changing policy design practices requires examining how people engaged in this process perceive reality differently, and how this impacts their agency to act accordingly. Leading and promoting participatory prototyping activities in policy design thus demands the ability to quickly diagnose where individuals and organizations involved in these activities are with regards to their design capabilities and create a journey that supports all participants involved. For this project, we created a three-stage journey. First, we recognized the need for increasing *awareness* about food waste as a critical path for co-designing sustainable and equitable food systems. This resulted in a research project that exposed diverse agents to new vocabularies, frameworks, and methods that could be used to expand participants' abilities to identify opportunities to create value, and to discover fundamental challenges regarding the translation of these opportunities into meaningful interventions. Second, we offered *experiences* with design-led workshops and the impact-driven conference that simulated transdisciplinary and transectorial collaboration, which focused on applying these frameworks and methods to the previously identified opportunities and related fundamental challenges. Through these experiences, participants learned the value of applying a structured approach to explore alternative futures and how to recognize where and when this approach could be useful within their own organizational context. Finally, we continue to engage with several participants in building their internal design *competencies*, advising them in their use of design frameworks and methods, and supporting their decision-making processes for this specific project as well as others.

Combined, these activities to increase awareness, provide experiences, and build competencies expanded participants' ability to effectively recognize when design frameworks and methods may be useful in both identifying factors that hinder their success at earlier stages and dilating individual and collective perceptions of what is relevant and possible moving forward. For example, design frameworks from the Whole View provided a content structure for participants of the BarnRaise to lead circular economy policy efforts in Chicagos 'farmers markets. They used the frameworks to conduct research and facilitate cross-sectorial engagement during ideation sessions. By providing alternative views, the model helped these leaders surface hidden biases and interpersonal frictions among participants and convert them from barriers to elements of collective debate and negotiation. The same group of leaders used the Innovation Lenses Framework to co-define criteria for how eight different types of resources would circulate in any given intervention (Nogueira et al. 2020). Once again, the frameworks supported leaders to recognize and include existing conflicts and different points of

view in the policy design procedures of framing and making, rather than leaving it for the policy implementation stage.

By focusing on a new policy design process through which individuals and organizations are involved in collective experiences of learning by doing, we were able to identify four significant implications and related questions for the future application of participatory prototyping to policy framing, making and implementation activities, each of which has the potential to help achieve large-scale change:

- **Politics of Change:** Policy interventions will have a higher chance of achieving sustainability and equity if policy designers can devise relationships between and across dispersed and diverse agents, sectors, and industries. This will require moving beyond conventional, single group engagements to enabling collective experiences that expose the full diversity of contexts, access, and conditions that inform the use of assets, but also requires questioning norms of value, power, and roles. *How might policy designers recognize and call out these assumptions to avoid replicating or amplifying structures and processes of the past?*
- **Economics of Change:** Ambitious visions for long-term transformations may still be stymied by assumptions about funding models, definitions of success, and appropriate procedures that incentivize short-term life cycles. *How might new kinds of funding structures and sources contribute to more adaptive processes during policy framing, making, and implementation, as well as building and maintaining trust and credibility among diverse parties as contextual variations emerge?*
- **Stewardships of Change:** Where challenges of the 20th century tended to benefit from clear disciplinary boundaries, 21st-century SET challenges have distributed complexity and ownership. The increased scope and loosening of roles within policy design processes and interventions required for strategic cooperation throughout policy framing, making, and implementation may also result in embedding individual biases into algorithms and affordances, either accidentally or as a means to establish control. *How might clarity and alignment on individual and organizational roles surface assumptions of ownership and the "rules of the game," preventing new processes from reinforcing the privileges and benefits of certain agents over others?*
- **Uncertainty of Change:** Successful policy design requires working at both tactical and strategic levels. The former helps to reveal new insights about real-world dynamics, provide access to difficult to reach populations, and establish sustainable and equitable transactions of resources. The latter supports a broader understanding of the deficiencies of the entire system. *How might policy designers combine bottom-up and top-down strategies to achieve interventions that are both relevant and meaningful to specific contexts, while also developing an awareness of potential unintended consequences that might limit large-scale influence and transformations?*

Faced with complex SET challenges, participatory prototyping activities can serve as the center of gravity for policy design, employing a means to consider systems, organizations, and individual behavioral aspects that can help policymakers and other stakeholders more fluidly consider these four forces of change in both the process and the

outcomes of policy design. This approach allows diverse participants to work through recognized political frictions, market dynamics, and cultural bias more democratically, creating an opportunity to co-construct more sustainable and equitable futures through shared responsibility and collective ownership.

Grounded in our experience in Chicago's food systems, we suggest that some answers to these "how might we" questions across politics, economics, stewardship, and uncertainty reside in the application of frameworks from the disciplines of systems and behavioral design. The use of structured design frameworks and methods can help policymakers better understand how their interventions may function in and impact real-life contexts and provide mechanisms to engage diverse and distributed audiences in participatory prototyping activities oriented toward enabling alternative, better futures. Nevertheless, it is crucial to acknowledge the potential unintended consequences and challenges inherent to participatory modes of policy design. The effective use of these new models and frameworks requires institutions to develop new competencies to engage broader audiences throughout policy design activities, as well as new processes for collaboratively working with a broader set of constituents.

Individuals, groups, and organizations facing systemic barriers to access diverse resources or with higher constraints to mobilize them tend to be targets for inclusion in participatory activities, including prototyping. The inclusion of otherwise under-represented populations is laudable, but the extra participatory burden placed on representatives of such populations is also of evaluative concern. Even in success stories, participatory decision-making processes can draw energy and attention from other worthy work and may still yield asymmetrical benefits in which policymakers and other resource-rich stakeholders ultimately gain more than the intended recipients of policy (Gaber 2019; Venkatesh et al. 2004). The psychic and economic costs of continually contributing to these efforts can also accumulate over time, resulting in research malaise and lack of trust in both government and research institutions (Chicago Beyond 2018), however well-meaning their intent.

Additionally, the application of systems and behavioral design frameworks to prototype more diverse, equitable, and inclusive forms of participatory policy design processes can itself become a form of political action. In these contexts, the very dynamics that make the integration of systems and behavioral design disciplines powerful may be counterintuitive or objectionable to public policy practitioners who are accustomed to both setting the agenda and terms of the discussion (Blomkamp 2018). This is especially true in low-wealth and marginalized communities, where the novelty of this multidisciplinary approach and form of engagement may feel disconnected from the context in which it takes place, despite its high potential for making meaningful contributions. Ultimately, the process of engaging in participatory prototyping activities requires cross-sector, multi-level collaborations designed to develop interventions through "long-term partnerships for the sustainability of new collaborative services" (Deserti 2016, 69), including policy design. Initiatives aiming at advancing such expertise require proper structures, resources, and support for enabling iterative engagements rather than single or ad hoc instances, with the ultimate goal of integrating participatory prototyping mechanisms into policy design itself.

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Disclosure statement

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