Boundary Organizations in Practice:
Neighborhood-scale Organic Waste Management in Linden Hills, Minneapolis

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Executive Summary

Boundary organizations play an increasingly important role in bridging the divide between science and politics or more broadly in processes of developing shared meaning among different stakeholders. In contexts where a variety of actors with different types of knowledge converge to promote collective outcomes, boundary organizations have played an important role in transfer, translation and transformation of knowledge. Through the example of a composting pilot program in the neighborhood of Linden Hills in Minneapolis, this paper aims to provide conceptual insights into the design of boundary organizations, arguing that a knowledge-management perspective offers a potentially powerful tool for design.

While the value of such organizations in generative processes of bridging gaps between different actors is well established, there is little guidance in the literature on the design of boundary organizations in practice, or what information and framework might be useful while constituting them. Through the example of the Linden Hills program, it is argued that identifying the exact nature of information - the type of knowledge exchange (syntactic, semantic or pragmatic), and their nesting, is key to framework elements such as the design of the boundary organization and appropriate boundary objects. The paper aims to make a theoretical contribution to the literature on boundary organizations as well, by exploring how the relative proximity of a boundary organization to one or more actors influences the structure of boundaries themselves. And secondly, that distinguishing between functional activities that organizations perform, such as negotiation, advocacy, mediation, community building and so on from the ontological basis for instituting boundary organizations as knowledge management entities can provide conceptual clarity for the purposes of practical design.

Acknowledgements

This Plan C Professional paper is a product of my close engagement with residents of Linden Hills in Minneapolis and members of Linden Hills Power and Light, a non-profit group operating on the Linden Hills neighborhood. During the course of research I have reached out to many members of the Linden Hills community and their participation in this research is deeply appreciated.

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I: Introduction

In 2007, a group of eight residents of Linden Hills, a neighborhood in Minneapolis, Minnesota, initiated a novel organic waste composting pilot program in partnership with the City of Minneapolis (henceforth referred to as the City) and Hennepin County (Foth Infrastructure & Environment LLC 2013). The pilot required their users to separate garbage into three categories, recyclable materials (plastic, recyclable paper, metals etc.), organic materials (food waste, non-recyclable paper, compostable plastics, plant waste etc.) and remaining garbage. Organics form a significant, 32% of the total waste generation on average in Minneapolis[1]. These residents organized themselves into a neighborhood-based organization called Linden Hills Power and Light (LHPL) aiming to reduce the carbon footprint of the neighborhood through education, community engagement and action[2].

While the City provided technical information, green bins, collected the organic waste weekly, and sold it to the composting agency, LHPL took on the role of community engagement and awareness. A range of measures were adopted, from door-knocking campaigns, to distribution of flyers, the sticking of little tags of information on the green bins, to ice cream socials, videos on composting and zero waste community events, educational initiatives on composting, one-on-one interactions with household to spread awareness and resolve everyday concerns about composting and building support in the community through public events. (source: in-person interviews).

On the other hand, they worked with experts within government to understand best practices and report on the development of the pilot, challenges faced and the rates of participation. At the time of this study, over 60% of the households had joined the program, with a growth of 30% to 50% participation between the first month and first year itself. The pilot provided useful insights leading to the development of a

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[1] "Organics Collection in Minneapolis", a presentation by the Solid Waste and Recycling Division, Department of Public Works, City of Minneapolis. Accessed on 21st April 2016. Available at http://www.minneapolismn.gov/www/groups/public/@publicworks/documents/webcontent/wcms1p-117857.pdf

[2] Website: http://www.lhpowerandlight.org/

city-wide composting initiative. Given this, the pilot is considered largely successful in achieving its objective of testing a novel concept, encouraging adoption and generating lessons for wider implementation.

LHPL therefore became a conduit for the implementation of the program, between the city government and the residents of Linden Hills, assisting residents with their questions, translating complex information on composting into a form understood by people with little prior exposure to composting and generating a sense of ownership of the program through public engagement. The set of activities which enable collective action between two different actors, here the City and residents of the Linden Hills, with the deep involvement of a third organization which works with both actors has been studied as boundary work in the literatures on science policy, organization studies and public management. Boundary work is conducted at the interface and also limits of knowledge that two or more actors possess and the boundary organization works with both to assist in bridging these knowledge gaps such that mutual understanding is enhanced. In this case for example, the limited knowledge that the City possesses about the everyday challenges of waste segregation in households, or the limited information that residents have about the waste appropriate for composting represent the types of knowledge gaps that LHPL aimed to fill. For the purposes of this paper, LHPL's role at this interface or boundary between the City and residents is analyzed from the lens of boundary organizations and the boundary work they perform.

This paper aims to explore the evolution of the boundary work performed by LHPL and the lessons we could learn as policy practitioners while structuring implementation agencies and initiatives that require behavioral change on the part of individuals and households. While the value of such organizations in generative processes of bridging gaps between different actors is well established, there is little guidance in the literature on the design of boundary organizations in practice, or what information and framework might be useful while constituting them. Through the example of the Linden Hills program, it is argued that identifying the exact nature of information - the type of knowledge exchange (syntactic, semantic or pragmatic), and their nesting, is key to framework elements such as the design of the boundary organization and appropriate boundary objects. The paper aims to make a theoretical contribution to the literature on boundary organizations as well, by proposing that the relative proximity of a boundary organization to one or more actors influences the structure of boundaries themselves. And secondly, that distinguishing between functional activities that organizations perform, such as negotiation, advocacy, mediation, community building and so on from the ontological bases for instituting boundary organizations as knowledge management entities can provide conceptual clarity for the purposes of practical design.

This paper is organized as follows: the second section delves into the literature on boundary organizations and boundary work to highlight its relevance to the case study of composting in Linden Hills. The methodology of the study is presented in section three. In section four, key findings are presented from the perspective of boundary work and policy recommendations are made in section five.

II: Boundary Work and Organizations

The demarcation between science and non-science has been written about extensively in the social studies of science and it is well established that the boundary is not comprised of fundamental differences in their characteristics, but a set of socially structured circumstances and behaviors (Guston 2001). In other words, science, just like other social institutions is comprised of a set of "norms, beliefs, ideologies, practices, networks, and power and deeply engaged in the production and management of social order (Miller 2001a). In his formulation of boundary work, Gieryn (1983) focused on the boundaries between science and society to suggest that scientists use boundaries in a variety of ways – for the expansion or monopolization of authority and resources to the protection of autonomy of professional activities. This boundary work, Gieryn argues is a rhetorical strategy through which scientists attribute "selected characteristics to the institution of science (i.e., to its practitioners, methods, stock of knowledge, values and work organization) for purposes of constructing a social boundary". Boundaries therefore are socially constructed and the nature of boundary work performed is selected by actors to achieve specific goals.

Theorizing around boundaries has since then considered the role of boundary work as an important component at the interface of science and policy, or science and society more broadly, doing the work of translation, partnerships, advocacy, and negotiation. As Guston (2001) suggests, "This work finds that the blurring of boundaries between science and politics, rather than the intentional separation often advocated and practiced, can lead to more productive policy making." Jasanoff (1987) for example, examines the role of regulatory agencies in the construction and re-construction of scientific discourses in the attempt to implement policy in contested domains involving policymakers, scientists and the public. These regulatory agencies therefore become sites of negotiation and, language, the dominant means through which negotiations are conducted. The identification of an institutionalized entity that performs boundary work, or a boundary organization first appears in Guston (1999), who identifies three features of boundary organizations: a) they enable and legitimize the use of boundary objects which assist in processing information across the boundary by providing a common tool for knowledge exchange; b) involve and are responsible to stakeholders on either side of the boundary and c) have specialized roles for managing the boundary.

Beyond national contexts, boundary organizations have also been studied in the production of complex global policy efforts such as climate change. Miller (2001a) extended the theory of boundary organizations to suit international contexts in which the embeddedness of scientific and political institutions is less defined and institutional arrangements more dynamic. This perspective on boundary organizations emphasizes boundary work across intentional boundaries between well-established and embedded institutions with different mandates, but largely similar capabilities.

A second strand of literature more focused on boundary work in the organizational and implementation context emerges from the literature on planning and public management more broadly. The value of boundary work and experiences here is understood in contexts of “bringing people together from different perspectives in ways that allow them to appreciate one another’s perspectives” and in structuring “informed deliberative processes” in policy implementation (Feldman et al. 2006). Boundary work is also understood as being emergent and in the context of normalized and routine daily scientific and professional practice (Eden et al. 2006) or as a process of co-production or the simultaneous production of knowledge and social norms among different interest groups (Miller 2001b). As Eden and colleagues (2006) highlight in their work on environmental NGOs, in such cases the boundary is “more properly seen as a fuzzy zone of negotiation and rhetoric – a grey area which may, moreover, be very different for different issues.”

Cash and colleagues (2003) in their analysis of case studies on sustainable development problems define boundary organizations as “organizations mandated to act as intermediaries between the arenas of science and policy” and performing the role of boundary management. Boundary management, they argue is comprised of communication, translation and mediation and the more effective systems of management are those that “linked knowledge to action than those that did not.” (D. W. Cash et al. 2003). Carr and colleagues (2005), in their study of agricultural extension specialists who work with both farmers and scientists further extend the scope of boundary organizations by stating that they use the “politics”, “in its broadest definition to include policy, legislative, management, and resource allocation decisions. Similarly, ‘‘science’’ is broadly defined as a “special learning process comprised of both cognitive and communicative components and conducted both at the individual inquirer and group or societal scales.” They focus on farmers by defining them as people who “work on and manage farms on a daily basis – up close rather than from a city office”, thereby stressing the involvement of individuals in the engagement with boundary organizations.

This generative view is of boundary organizations is well summarized by Franks (2010) as organizations “which mediate between different social worlds and communities to bring people on either side of a boundary together to increase mutual understanding of one another's perspectives, capacities and needs while allowing individuals within the organization to remain within their respective professional boundaries and to maintain their responsibility to their different constituencies." Other scholars have emphasized this perspective through their work on the co-management of environmental governance through the bridging of science and local or Indigenous knowledge (Robinson & Wallington 2012), the utility of boundary work in resolving tensions between multiple knowledge sources and multiple users (Clark et al. 2016), the role of intermediary organizations in changing attitudes, building trust, sharing knowledge and bringing stakeholders together in efforts to stimulate payments for environmental services in rural areas (Pham et al. 2010), and the role of boundaries are junctures that enable connections across different groups in the collaborative governance processes (Quick & Feldman 2014). There are often significant differences in capabilities between actors, appearing in the form of different knowledge domains, some more normatively considered as expertise while others are not, and asymmetry in power or the ability to access resources and leverage other actors effectively in collaborative processes.

Knowledge management: an exploration into the ontological basis for organizational design

Adopting the generative view of boundary organizations as junctures, this section outlines a more fundamental question, that of the nature of knowledge being exchanged across the boundary. Whether scholars regard boundaries as barriers (Gieryn 1983) or junctures (Quick & Feldman 2014), or as different types of organizations from regulatory agencies (Jasanoff 1987) to cooperatives (Franks 2010) to intermediary organizations more generally (Pham et al. 2010), or as larger systems of management of a network of actors (D. W. Cash et al. 2003), they all refer to the process of sharing, transferring and co-producing knowledge in some form. Scholars have aimed to identify general structural and organizational characteristics of boundary organizations such as brokerage, trust building and network construction, managing negotiations through convening, translation, collaboration and meditation (Franks 2010; D. W. Cash et al. 2003).

However, across much of the literature these characteristics have been inductively derived from a retrospective analysis of case studies on existing boundaries organizations. While the essential characteristics of boundary organizations provide information on the roles boundary organizations ***might*** play, they do not necessarily outline a logic for how these boundary organization might be created, or what they should be constituted of in terms of skillsets and personnel in order to play their role most effectively in a particular context. In other words, does distinguishing between the activities organizations might perform (negotiation, mediation and so on), from the ontological basis for developing boundary organizations are knowledge management entities provide conceptual clarity for design? Paul Carlile (2004) similarly states that scholarship on boundary management does not specify "what type of boundaries are being faced, what is required to develop an adequate common knowledge, and how the current capacities and abilities might need to be changed to address the novelty now present." Deriving from this, the question of what type of boundaries are being faced might also be better informed from the perspective of knowledge and capabilities of actors and the resulting shifts into those boundaries upon the entry of a boundary organization into the arena of interaction between two or more actors.

I adopt the framework for managing knowledge across boundaries proposed by Paul Carlile (2004) and reproduced as Figure 1 below. This framework forms the basis for identifying the different types of knowledge that the Linden Hills community organization contended with as it engaged the residents of Linden Hills to roll out the composting program. Further details are provided when the case is discussed.

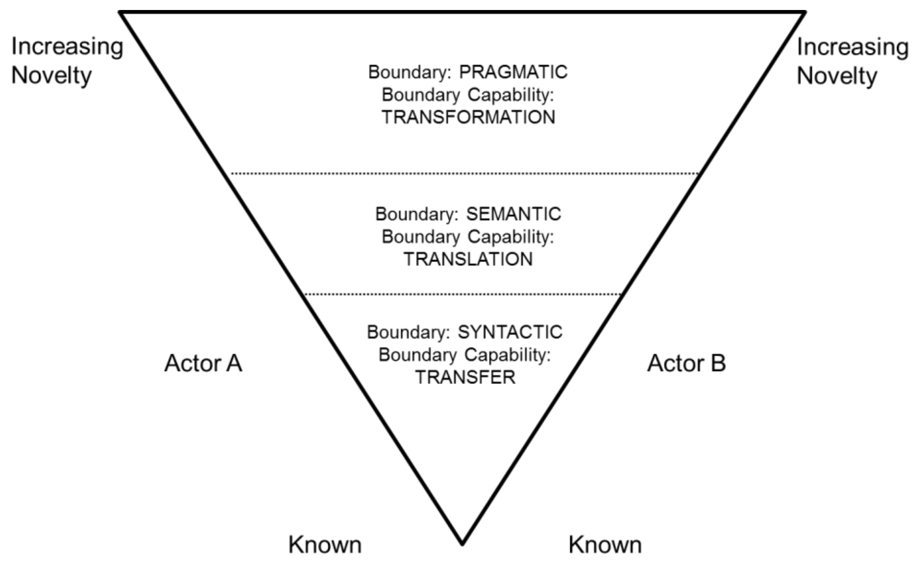

Figure 1: Types of Boundaries and Boundary Capabilities Source: Carlile 2004

Carlile suggests that the term boundary management has been used across widely differing contexts, such as those examined earlier in this review, and that the framework could "help resolve the incompatibility between three different perspectives of boundaries: an information processing approach that focuses on knowledge as a thing to store and retrieve, an interpretive approach that emphasizes the importance of a common meaning to share knowledge between actors, and a political approach that acknowledges how different interests impede knowledge sharing." These three approaches are classified as knowledge exchange processes across syntactic (information processing), semantic (interpretation) and pragmatic (political) boundaries, suggesting that different types of boundaries are produced as a result of the relative difference and dependencies among actors and the novelty of the change envisioned. At each boundary, there exists difference, dependence and novelty. Difference is a "distance" between actors in the amount of knowledge and/or type of knowledge available to them. Dependence between actors refers to the connections between their knowledges required to collectively accomplish an objective. Novelty is the difference between the current set of knowns and the unknowns required to accomplish the collective objective.

Rather than one monolithic boundary, the framework introduces us to three types of boundaries, depending on the types of knowledge being managed and the relative "distance" between the two interacting actors (A and B in the Figure) in terms of the complexity involved in their relational interaction with one another. The relational interaction needs to be understood not just as a function of the proposed change, but as the relative capabilities of the actors involved – where capability is a function of both capacity and ability. Capacity here refers to the extent of knowledge the actors possess and ability to the power dynamics between actors. Boundary objects or the tools that perform the work of transfer, translation or transformation must be adequately matched to the existing and evolving capabilities of actors at the boundary. Boundary objects, conceptualized in (Star 1989), are objects that are shared across boundaries to establish a common language for individuals to represent their knowledge (Carlile 2002). They include repositories (databases, libraries), standardized forms and methods, models (drawings, prototypes, simulations) and maps of boundaries (process maps, workflow matrices).

The syntactic boundary is one across which actors possess a common language or lexicon which makes the differences, dependencies and novelty of task explicit to both. Then a simple transfer of information is required to share knowledge. The boundary organization uses boundary objects that rely on this common lexicon to perform their work of transfer. At the semantic boundary, an additional task of making implicit knowledge explicit is required, achieved through the development of common meaning and interpretation as compared to just transfers of knowledge. At the pragmatic boundary, the shared meaning and language from the first two boundaries is transformed into shared goals through a negotiation of differing political interests.

From the point of view of practice at the syntactic level, the two actors may share a vast amount of existing knowledge, norms, language among other traits (there exist many 'known' variables), making the knowledge management process simply syntactic, or involving the processing of information between actors. Or as Carlile states, "common lexicon sufficiently specifies the differences and dependencies of consequence at the boundary, the boundary proves "unproblematic"; the primary concern is one of “processing” or transferring knowledge across it”. Therefore this approach to boundary management is also limited by the extent of stable conditions or common knowledge required beforehand.

At the next level, semantic or interpretive boundary work is required because the “distance” between actors in terms of unknowns increases. In practice, this could be the extent of exposure to a certain type of scientific knowledge, or the amount of tacit knowledge accumulated by a group of people through their work. The boundary being negotiated then adds novelty to the interaction and “novelty makes some differences and dependencies unclear or some meanings ambiguous. When new requirements and/or new actors are present, interpretive differences in what a word, measurement, or outcome means limits the effective management of knowledge between actors.” However, this form of semantic boundary breaks down because interpretive approaches do not deal with the different political interests actors might have and which are revealed in the process of developing shared meaning. Carlile suggests that “[U]nder these circumstances creating common meaning is not possible; what is required is a process in which actors negotiate and are willing to change the knowledge and interests from their own domain.” This brings us to the third level of pragmatic boundaries. At the pragmatic boundary, the novelty of the boundary work makes apparent the difference in interests between the actors and these differences generate costs to them. Costs include both the cost of learning new knowledge, but also the cost of transforming or adapting the current knowledge used by an actor.

To sum, the objective of the framework is to provide a comparison between different types of boundaries (syntactic, semantic and pragmatic) depending on the increasing complexity and novelty of knowledge being exchanged. In practice, Carlile suggests that this framework can help identify mismatches between the kind of boundary faced and the type or capacity of the process used. And that this process is cumulative and iterative. Cumulative because as one moves up complexity and novelty and faces a pragmatic boundary for example, the syntactic and semantic processes are still being utilised. And iterative because moving through the cycle of syntactic to semantic to pragmatic boundaries can produce more common knowledge for assessing and sharing knowledge between actors.

From the above, I argue that before boundary organizations are constituted, stakeholders have limited information about and can only conservatively project the potential outcomes of processes of collaboration, mediation and so on owing to the complexity of the system they are working within. In other words, a range of unobservable variables come into play in complex processes. However, they do have information about the types of knowledges in existence between them and the observable characteristics of constituent groups, such as income, language, education levels among others. Secondly, the activities that boundary organizations might perform are likely to emerge as a result of the interaction the boundary organization has over time with actors across the boundary. For example, a boundary organization might utilize advocacy as its key process for implementing change if it is proximate to one actor and relatively distant from the other in the political arena. In other cases where it is proximate to both, the organization might evolve a more collaborative process. Beyond proximity however, the actual strategies employed and activities developed are likely to be contingent on a number of environmental factors including funding, access to skilled personnel, nature of trust between different actors among other. These two arguments provide opportunities to explore the following conceptual points: a) Given the limited information available at the outset and the contingent nature of activities performed eventually by the boundary organization, a knowledge management perspective provides a potentially useful lens for organizational design; b) the proximity of a boundary organization to one or more of the existing actors has implications for the shifting of boundaries and the contingencies under which the organization will develop activities; and c) conceptualizing boundary organizations based on the activities they might perform in constrained environments can lead to a misrecognition of effort required to constitute them.

III: Methodology

To understand the role of Linden Hills Power and Light (LHPL) and the Linden Hills Neighborhood Council (LiNC), seven in-depth structured and semi-structured interviews were conducted during the months of April and May 2016. The information gathered through the interviews has been supported by reference to primary documents published on the Linden Hills pilot, websites maintained by Linden Hills Power and Light and the Linden Hills Neighborhood Council and information about the composting program available online. Additionally, I visited Linden Hills on multiple occasions during April and May 2016 to observe the weekly collection of compost and engage in informal conversations with household members who were using the composting service.

The interviews focused on the motivations behind initiating a pilot program, the role the local organizations, and the links between the local and city-scale programs. Interview protocols are attached as Appendix II. Respondents were also asked to provide information on personal waste management practices to evaluate household level changes and the role of LHPL/LiNC in their personal transition towards segregating waste. At the highest level, the purpose of the interviews was to enable an analysis of the process behind the establishment of the program from the perspective of boundary organizations. Hence, detailed information on the role of the organization, the barriers to implementation and the methods of translation of complex information into simple everyday vocabulary was sought. Study participants were selected using a theoretical sampling strategy (Glaser & Strauss 1967) that presumes participants have in-depth and specific knowledge about the process. Interviews were conducted both with residents of Linden Hills not officially associated with LHPL/LiNC as well as those who played a key role in LHPL during the implementation of the pilot, as well as one employee in the city government. This aided in an evaluation of LHPL/LiNC from the perspective of both LHPL proponents and residents who were impacted by the activities of the LHPL/LiNC. Interviews were designed and coded using process and descriptive codes as per the formats prescribed by Miles, Huberman and Saldana (2013).

The paper aims to develop a process narrative of the Linden Hills pilot and through interpretive policy analysis (Yanow 2007) examine the discursive elements of relationships between individuals and the waste they generate. Rather than examining the benefits of the pilot program, this study aims to develop a narrative of the processes that led to the development of boundary work within an existing organization in Linden Hills. A process study examines how "things emerge, develop, grow or terminate over time, as distinct from variance questions dealing with covariation among dependent and independent variables" (Langley et al. 2013). A careful documentation of a large number of events and instances offers insights into questions of ***how*** change occurs, complementing the "***what works?"*** conclusions that variance studies can provide. From the perspective of design, this focus on time can provide valuable insights into questions around what the organization was constituted as and how contingent factors lead to its evolution.

The Linden Hills pilot case study was selected as an exemplar because of the crucial role it played as a test case and forerunner to the city-scale program (Eisenhardt 1989). Secondly, the origin of LHPL within Linden Hills and its composition being of residents of Linden Hills offers particular insights into questions of shared common language and proximity of the boundary organization to one of the actors – both of which are discussed in the findings. The case forms an illustrative example to stimulate a conceptual conversation about the design of boundary organizations and is not meant to offer empirical evidence towards design. Rather, the case offers illustrative support to an exploratory set of questions with potential implications for future work in the study or boundary organizations.

A set of process based questions form the basis of data analysis, These are proposed as guiding questions as opposed to research questions to indicate their use for purpose of providing an illustrative example to conceptual work, rather than as tests for hypotheses.

1. What role did LHPL play in the implementation of the pilot program?
2. Where do different knowledge boundaries lie and what boundary objects were used across them?

3. How the source of origin and proximity of the boundary organization to one or more actors influence the nature of the boundaries and the resulting boundary objects?

IV: Findings and Analysis

Homogeneity in Linden Hills: Bourgeois environmentalism versus a productive use of homophily in boundary work

Before delving into the organizational design implications of the study, a discussion on the context within which this pilot has emerged is important. Linden Hills is widely recognized as one of the most affluent neighborhoods within Minneapolis. The demographic composition of 86.7% White identified individuals against 61.3% for Minneapolis, and the median household income of USD 91,958 as compared to the Minneapolis average of USD 54,482 (all figures for 2013[3]), tell a story about the wealth and homogeneity within the population in Linden Hills. Respondents confirm this, alluding to the 'safety' and neighborhood-y' sense they have of the area at several points in the interviews, while also more directly stating their relative affluence and homogeneity.

All the interview respondents had advanced academic degrees and identified strongly with liberal democratic politics. One respondent states:

> "…we voted for Bernie and also Marco Rubio. I mean it's the only state that did that, even on the Republican side, whatever's going on, it's not happening here."

Others referred to Linden Hills as a 'little happy land' or pointed to the scorn with which their community is often referred to as the 'Linden Hill Liberals'.

With more specific reference to the pilot, one respondent with a previous leadership position in LHPL echoed the thoughts of others,

[3] http://www.mncompass.org/profiles/neighborhoods/minneapolis/linden-hills

> "We're lucky in Linden Hills because it is pretty affluent, so we don't have families that are working 2-3 jobs just to get by, so that means there is also a little bit of spare time and capacity to think about these thing and taking them on. I realize that even other neighborhoods in Minneapolis don't have that."

A second respondent brought up the need to purchase higher cost compostable bags instead of regular plastic trash bags for discarding the organic waste. Currently, the bags are easily found in stores in Linden Hills, but often not outside the neighborhood. She states,

> "The only thing I can think of is if this is going to go broader, then Lunds, Rainbow and Cubs (three super-markets chains) need to have the compost bags so its accessible to people… In lower income communities, buying the bags actually might be hard, they're not cheap. They're not exorbitant, but you have to buy these special bags."

Equity concerns are discussed first to delineate some boundaries for this paper's analytical grounds as well as point readers to the self-critical awareness among residents of Linden Hills with respect to the success of the pilot. Affordability is an important aspect of replicating to other areas in the city. However, in order to study the role of boundary organizations, these questions are not discussed in the paper. Notwithstanding the relative ease with which it was possible to initiate and sustain the pilot in this neighborhood, there are valuable lessons to be drawn from an organizational perspective. Primarily, the relative homogeneity of the population in Linden Hills allows for the opportunity to examine issues of knowledge management in contexts with a well-established common lexicon, at least on certain matters such as the kinds of changes required to be made inside people's homes or the impact that the pilot program might have had on the residents' daily routines. This is discussed in greater detail in the section on knowledge management.

The work of boundary organizations: an examination of emergent and nested boundaries

Using examples from boundary work and the use of boundary objects in the implementation of the composting pilot, I identify three the types of boundaries encountered in the illustrative case.

Key to understanding the role of the boundary organization is through the lens of the knowledge being exchanged, as discussed earlier with the framework proposed by Carlile. In the case of LHPL, it is possible to distinguish between different types of knowledge being exchanged, against distinctively different boundaries and strategies that correspond to making the knowledge exchange most effective. The figure below replicates Figure 1, with specific reference to the pilot program under consideration.

At the syntactic level, we encounter with a boundary across which a simple transmission of information might be sufficient to successfully achieve an exchange of knowledge. This sort of information is most easily transferred in conditions of relatively stability and where a common language exists between actors at the boundary. The relative homogeneity of the Linden Hills population and the fact that LHPL was formed from within the community (rather than with personnel outside of it) provides a relatively stable set of conditions regarding some of the logistical aspects of making changes within the households. Such as which waste items are compostable and which are not, procurement of dustbins of the right size and the use and purchase of compostable bags. Leaflets and information brochures depicting which materials are compostable and which are not fall into this category of knowledge exchange, but are deployed under the assumption that residents are likely to read brochures and feel confident in their understanding of the composting process. Expert knowledge which LHPL gained from interaction with waste management officials in the government was therefore simply transferred in the same form in which it was received, as a set of instructions.

Another important facet to awareness was the voluntary nomination of one person per block as *compost captain*. Compost captains, derived from the pre-existing notion of block captains[4] were provided training by LHPL and the City or County on recycling. Compost captains met on regular intervals to share stories of success and barriers faced by residents, creating a contextual repository of knowledge. As one resident said,

> "[T]he benefit there is that it's often people that you know talking to you, your neighbors. So it was easy for me to ask questions."

And as a co-founder highlighted,

> "Yes a lot of people didn't know how to set up their kitchen. So we gave them several ways to do, if you have a pull out drawer, put two bins in there…. If you don't have space on the counter to have a counter top pail or if you're a big family and the counter top pail is three gallon, it fills up pretty quickly. So we said they could convert their existing garbage to compost since 70% of the existing garbage was compost anyway and then have a smaller bin under the sink for trash. So yes, setting up the kitchen was where we added value, the city wasn't going to do that."

These examples demonstrate the role played by LHPL ***inside*** people's homes – a crucial role that filled the gap between the formal program of collecting waste managed by the City, and the everyday practical challenges of separating waste, organizing the kitchen and perhaps most importantly, asking a question when in doubt.

LHPL worked closely with LiNC, which had been constituted over 30 years before LHPL. LiNC, like other neighborhood councils is a quasi-governmental body that benefits from official recognition. Programs like the Neighborhood Revitalization Program of the City government provide funds to the

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[4] The role of block captains has been strongly linked to enhancing community relationships and leading from that, safety in the neighborhood. Where active, block captains organize regular events for their residential block to create an atmosphere in which neighbors interact and get to know one another.

neighborhood council for small local initiatives such as tree planting. A mix of official recognition and relative autonomy, the neighborhood council therefore is a manifestation of a seriously considered shift towards decentralization. As one of the co-founders of LHPL states,

> "Minneapolis is very organized with the neighborhood associations. The neighborhood association met monthly. They had an electronic newsletter, a paper newsletter that they sent out every two months so we were able to get [articles] in that. We were able to get a front-page article in the newsletter that was delivered to every house. We were able to get the credibility of the neighborhood association as a partner."

The above is an example of a particular feature of neighborhood councils in Minneapolis and the credibility through association acquired by LHPL.

The knowledge 'transfer' processes described above give us one set of possible boundary objects and describe boundary work that doesn't necessarily involve close interactions between the two actors. However, composting is a complex process, while some aspects such as which types of wastes are compostable are possible to convey through knowledge transfer processes, others are more tacit. For example, questions such as "what happens on day three, is my compost supposed to look this way?" or "how does one reduce the odor that compost is creating in my kitchen?" Semantic boundaries require processes of creating shared meaning and communities of practice. Not all questions about composting can be answered through flyers and leaflets and it is here that residents learn together along with LHPL representatives, at block meetings and other community events. Live demonstrations of the composting process during meetings, compost captains and the presence of composting at community events are ways by which the relative complexity of the task is translated into everyday actions that any resident can perform. Asking questions when in doubt is another function that fits well into this type of boundary function. It is expected that when in doubt, residents were open to speaking up in block meetings, or ask questions about aspects they considered 'silly' because of the relative similarly between them and the individuals involved in LHPL. For example, a resident might be more motivated to ask a question when they recognize that the members of LHPL or block captains also live in similar types of houses as them, have similar work schedules and can afford to spend similar amounts of money on retrofitting their kitchens. As Carlile suggests, knowledge and boundary types are layered and hence while the semantic boundary does involve new boundary objects, it relies on the common language and norms present in at the syntactic boundary as well.

The third type of boundary is the pragmatic one, where different interests become apparent. A key difference between the LHPL members and some other residents and businesses is a commitment to the betterment of the environment. At the pragmatic boundary we're moving away from the everyday challenges of implementing a composting program and working with those who already have a stake in the process, to convincing those who don't. LHPL utilized a unique strategy for this that also serves as the boundary object – the process of community building. One of the co-founders of LHPL mentions,

> "Our group was founded on the notion of neighbors taking action for the environment, so we were as committed to growing our community, and connecting neighbors to one another as we were to the environmental piece."

Before delving into boundary work and objects however, a discussion on the location of boundaries can help clarify the proposal here that the introduction of a boundary organization itself yields an additional set of boundaries and resulting boundary objects, in addition to the one existing between the city and the residents of Linden Hills. This is illustrated through Fig. 2 below:

Figure 2: Emergent boundaries resulting from the institution of boundary organizations

On the left hand side, I depict the manner in which boundary organizations have been conceptualized in much of the literature – as doing the work across a boundary between two actors A and B. It is unclear however what the influence of the insertion of a boundary organization between these two actors is. In other words, while boundary organizations have been stated to perform critical functions, little attention is paid to their own organizational identity, location, and proximity to one or more actors across boundaries, and influence on the boundaries themselves. While in theory it might be feasible to reify the identity and location of the boundary organization and focus purely on the boundary work, in practice, the right hand side is likely to be more relevant. The boundary organization has a real material form in practice, people working in it, an identity, funding, and relationships with the organizations across whose boundary its work is being performed. In this case, LHPL is a boundary organization, but is also uniquely positioned as an organization with very close ties to the residents because it is comprised of residents of Linden Hills, while working between the city and residents. This proximity to the residents offers potentially new opportunities for structuring boundary objects, ***between*** LHPL and the residents.

The pilot program carried a strong message of bringing the community together, right from the selection of what sort of environmental program to pilot (composting rather than solar power plants), to the messaging in block meeting and community events – that this pilot was something the residents of Linden Hills were accomplishing together. That the pilot was an opportunity to build community and affect change as a community and also impact the environment positively. For complex and transformational change regarding an external or public facet such as the environment, LHPL drew on a symbol that was privately important to the community, using the community building activity itself as a boundary object. This interpretation of boundary objects differs slightly from literature, which has identified boundary objects at the pragmatic level as objects, models and maps, which would resemble the community-based events that LHPL organized. Here, in addition to the community-wide events, I suggest that organizational activities could themselves be treated as objects that perform the function of transformation across the boundary. The characterization of community building as a boundary object however reflects the definitions of boundary objects in the literature – as a boundary spanning device that facilitates a process by which individuals can jointly transform their knowledge. The three levels of knowledge boundaries and the respective boundary objects are summarized in Table 1.

Table 1: Nested Boundary Work in Linden Hills

Boundary Type	Knowledge exchange parameters	Boundary Objects
Syntactic	Simple transfer of knowledge of information generally required for making changes in the private sphere. Homogeneity and mutual understanding of context, a common language of communication, and trust among neighbors are key ingredients.	Leaflets, flyers, information brochures
Semantic	“Tacit” knowledge – not just knowing what needs to be done, but whether what’s being done is appropriate and what impacts the action will have. On questions outside the domain of “private” expertise.	Compost captains, group meetings, block meetings
Pragmatic	An area of contestation about meeting larger public goals such as climate change mitigation. Knowledge exchange and adoption might lead to costs.	Community building

V: Policy Recommendations and Conclusion

The study proposes the following recommendations for practice, or in other words, the practical design of boundary organizations.

First, recognizing the difference between the activities that boundary organizations may perform once constituted and distinguishing them from the basis for design, that is knowledge management, can enhance the use of available information. It is suggested that knowledge management can become a powerful starting-point for design given the limited information available about the complex process that lead to transformative change. Practitioners could, through an assessment of the actors they are working with, identify observable characteristics and the types of boundaries that emerge as a result of them to arrive at an understanding of the nested nature of and types of boundaries that exist.

Secondly, the material existence of boundary organizations is often neglected in the literature on boundary organizations. Once constituted, boundary organizations take up space between the actors they are working with, and bring new dynamics to the relationship. Their introduction sets up new boundaries, as a result of how they are constituted as well as the coproduction of new spaces of engagement with existing actors. This process influences the activities they will perform – in some cases, community building and in others, advocacy and negotiation depending on the distance between them and the actors and the power they exert in relational terms.

Third, and deriving from Carlile, the boundaries themselves are nested, rather than monolithic entities. An evaluation of knowledge then provides practitioners valuable information about what types of boundary objects are best suited for each boundary. A boundary organization therefore would need to be designed to address multiple boundaries, through a variety of boundary objects. This also provides conceptual clarity to the role of the organization, which can get otherwise subsumed and become ambiguous if the focus of design is on activities rather than boundary objects.

In sum, theorizing around boundary organizations has relied extensively on an ex-post analysis of cases that served boundary functions. The importance of boundary organizations in structuring complex processes is now well established by scholars who study institutions and public management or planning processes. However limited attention has been paid to the organization itself, its identity, structure and location. Further work on making these characteristics explicit could enhance our collective knowledge about the design of such entities to meet the challenges of knowledge management in complex policy scenarios.

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APPENDIX I: Coding format

Main Code	*Sub-Code*	Abbreviation	Code Description
PERSONAL		PERS	Aspects relating to waste management processes followed by interviewees within their households.
	PROCESS	PERS-P	Details pertaining to the process of waste management within the household
	CHANGES	PERS-C	Changes made in the process after the introduction of the organics recycling program in the neighborhood
	BARRIERS	PERS-B	Barriers faced upon the introduction of the organics recycling program in the neighborhood
	OPPORTUNITIES	PERS-O	Factors that made it simple/easy/intuitive/hassle-free for the household to participate in the organics recycling program
	NIMBY	PERS-N	Whether the interviews knows or wants to know where the garbage goes after they put it in the bin.
MOTIVATION		MOTIV	Motivation at either the individual or neighborhood level for starting or engaging with the organics recycling program
	CLIMATE CHANGE	MOTIV-CC	Motivation is strongly linked to concerns over global warming or climate change
	ENVIRONMENT	MOTIV-ENV	Motivation is strongly linked to general concern about the environment without a mention of global warming or climate change. For example, reduction in landfilling will be included under this code.
	LOW-EFFORT	MOTIV-LOW	Motivation is strongly linked to the low effort (time and cost) required to participate in the organics recycling program
	GOOD-FIT	MOTIV-FIT	Motivation is strongly linked to the 'fit' that the program has with a household's current routine. In other words, was the household already recycling? Did they already segregate their waste?
NORMS		NORMS	Norms refer to the un-written rules (external to self-motivated participation) of the organics recycling program that might have led to an increase in participation/motivation to participate
	PEER PRESSURE	NORMS-PP	Peer pressure as a motivation to participate
	BLOCK CAPTAIN	NORMS-BC	The active presence of a block captain and block level activities as a motivation to participate
LOCAL		LOCAL	Key 'local' factors that contributed to the

			success of the program as defined by the interviewee. Local implies household or neighborhood level activities, as separate from city-level activities. More importantly, local implies activities initiated by individuals or NGOs and other non-governmental actors.
	NEIGHBOURS	LOCAL-N	Interaction with and getting information from neighbors and 'people we know' is an important facet of a local program
	AWARENESS	LOCAL-A	Awareness created on a personal one on one level is an important aspect of a local program. Awareness is tailored to the problems being faced.
	EMOTIONS	LOCAL-E	Local program evokes trust, belonging.
	EVENTS	LOCAL-V	Local events are a useful means to reach out to the neighborhood and create awareness
	BENEFITS	LOCAL-B	Benefits of a program being local as compared to city-scale
	COSTS	LOCAL-C	Costs of a program being local as compared to city-scale
CITY-SCALE		CITY	
	BENEFITS	CITY-B	Benefits of a program being city-scale as compared to local
	COSTS	CITY-C	Costs of a program being city-scale as compared to local
BOUNDARY ACTOR		BOUNDARY	Single code for tasks/activities performed by the two neighborhood-scale associations in Linden Hills (the Linden Hills Neighborhood Council and Linden Hills Power and Light). These are specific tasks that the two bodies performed which the interviewees believe were either not possible or would have been done less effectively by the city-government/city-scale actor. I refer to these organizations as boundary actors as they function at the boundary between individuals as the government, attempting to fill gaps in implementation either overlooked or under-planned by city-level actors.
PROGRAM		PROG	Overall views on the program, not necessarily from a personal perspective.
	SUCCESS	PROG-S	What about the program is successful?
	IMPROVEMENT	PROG-I	What about the program needs improvement?
SCALING		SCALE	Refers to inputs received on the current process of scaling up the Linden Hills pilot program to the city-scale
	CHALLENGES	SCALE-C	Challenges that the scaling process will pose

			for implementers
	LESSONS	SCALE-L	Lessons from the pilot program that could strengthen the scaled up city-level program
LINDEN HILLS		LH	Interviewee's perceptions about Linden Hills' culture, politics, demography etc. that contributed to the program's success/initiation in Linden Hills.
	POSITIVE	LH-P	Positive aspects of Linden Hills
	NEGATIVE	LH-N	Negative aspects of Linden Hills
MINNEAPOLIS/ MINNESOTA		MPLS	Interviewee's perceptions about Minneapolis/Minnesota culture, politics, demography etc.
	POSITIVE	MPLS-P	Positive comments
	NEGATIVE	MPLS-N	Negative comments

Appendix II: Interview Protocols

SET A: STRUCTURED INTERVIEW FOR REPRESENTATIVES/MANAGERS/STAFF

Note 1: The numerical bullet points refer to themes of research and the alphabetical bullet points below each numerical point refer to specific questions related to that theme of research.

1. **Process tracing: History and motivations behind launching the local program**
   a. Could you tell me a bit about the pilot program and its origins?
      i. Who initiated it?
      ii. Can you recall specific conversations or events where this program was initially discussed?
      iii. What were some of the initial challenges? How did you overcome them?
      iv. Are there other similar local initiatives in your community?

   b. What motivated the people in your neighborhood to start this program?

2. **Process-tracing: What is the program?**
   a. Can you describe the waste management plan in this neighborhood? *(Follow up questions below)*
      i. What is your role in the program?
      ii. Since when have you been involved in the program?
      iii. As a manager/professional staff, what are your specific responsibilities?

3. **Interaction between the local program and ongoing city level waste management programs**
   a. What is different about the pilot when compared to the program operated by the city municipality?

b. Can we tell me the differences now as well as before and after the pilot?

c. What links if any does the local program have with the city waste management program?

d. Now that the pilot is being scaled up, what challenges and opportunities do you envision?

4. Civic participation:

a. What were some of the initiatives taken by the association and the residents when this program started, to create awareness or to enhance participation?

b. Did many of these venues for participation already exist? For example, were there regular meetings of the neighborhood association, activities that the community were involved in together, and so on?

c. How did the residents respond to the program when it first began? Has that changed?

5. Perceptions

a. Do you perceive any change in residents with waste management since the program began?

b. How has this evolved over time?

c. What do you think are the challenges and successes of the program? (prompts include efficiency, service, problem resolution)

6. Minneapolis culture/politics as an ecosystem

a. Are you aware of similar initiatives in other neighborhoods in Minneapolis?

b. Do you think there is a greater acceptance of such local initiatives in Minneapolis?

c. When people localize something, what do you think it says about them/you?

d. Do you think localization is a good thing?

e. Do you feel you received adequate support from local authorities while implementing this program? In what way?

f. Have you lived in another city for a long period of time? Which one? What did you feel about your neighborhood there? Were similar initiatives in place or being discussed?

Summing up: summarize the discussion and ask if participant has anything to add

SET B: SEMI-STRUCTURED INTERVIEW FOR RESIDENTS

Note 1: The numerical bullet points refer to themes of research and the alphabetical bullet points below each numerical point refer to specific questions related to that theme of research.

1. **Personal waste-management routine**

    a. What do you do with the waste generated at your house? Please tell me about each source of waste: organic (from the kitchen and garden), recyclable and other waste.

    b. How has the local organic waste management program changed your routine?

2. **Process tracing: History and motivations behind launching the local program**

    a. Can you tell me what you know about the organic waste program in your neighborhood? (*follow up questions below)*

        i. How do you see your role in this program? As a resident, what do you do every day with respect to participating in this program?

        ii. Are there other similar local initiatives in your community?

3. **Civic participation:**

    a. What were some of the initiatives taken by the association and the residents when this program started, to create awareness or to enhance participation?

b. Did many of these venues for participation already exist? For example, were there regular meetings of the neighborhood association, activities that the community were involved in together, and so on?

c. Can you tell me how your own response to the program has changed (if at all) since it was started?

4. **Perceptions**

   a. Would you say the program has performed well or poorly based on your initial expectations? (prompts include efficiency, service, problem resolution)

   b. What do you think could improve?

5. **Minneapolis culture/politics as an ecosystem**

   a. Are you aware of similar initiatives in other neighborhoods in Minneapolis?

   b. Do you think there is a greater acceptance of such local initiatives in Minneapolis?

   c. When people localize something, what do you think it says about them/you? Do you think localization is a good thing?

   d. Have you lived in another city for a long period of time? Which one? What did you feel about your neighborhood there? Were similar initiatives in place or being discussed?

Summing up: summarize the discussion and ask if participant has anything to add