

## Living Lab exploring routinized kitchen practices to reduce cross-sectoral food waste

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### Abstract


This article explores the relationship between everyday food ordering practices in municipally operated kitchens in Denmark—referred to here as public kitchens—catering to public institutions, including schools and care homes, and the logistics defined in public procurement agreements to reduce systemic food waste. In Denmark, it is standard practice for public kitchens to order

wholesale food at short notice, as per their food procurement contracts. However, this timeframe, with its short ordering deadline (up to 16 hours prior to next-morning delivery) has been found to cause wholesalers to maintain buffer stocks to meet demand, often resulting in excess waste. Using practice theory, we explored cross-sectoral ordering and delivery practices, specifically focusing on the daily rhythms and operations in publicly owned kitchens. Our aim was to establish whether kitchen ordering practices and wholesalers' supply schedules could be aligned, consequently reducing wholesale waste. A Living Lab approach was employed, engaging seven publicly owned kitchens in Copenhagen. As a participatory research

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### Conflicts of Interest

This article is part of a longitudinal research study on food waste in the Danish public food supply chain. The authors declare no conflicts of interest.

approach, Living Labs actively engage stakeholders in real-world settings while embracing their diverse realities. We conducted 18 semi-structured interviews before, during, and after the Living Lab. To guide our analysis, we applied the three-elements model from practice theory, analyzing the data through situational mapping. The findings provide insights into how the alignment of food procurement practices, through multi-actor involvement and cross-sectoral partnerships, can reduce food waste across the supply chain.

### **Keywords**

food waste, Living Lab, public food procurement, food system research, public kitchens, wholesaler, food delivery, food ordering, everyday practices

### **Introduction**

Food waste has become a significant priority in both food policy and sustainability transition processes. It needs to be reduced within and across sectors as part of sustainable and systemic food systems transformations (Evans et al., 2012; Halloran et al., 2014; Hodgins & Parizeau, 2020; Sala et al., 2017; Sørensen, Løje et al., 2016; Sørensen, Tetens et al., 2016). Addressing food waste across supply chains requires a systems thinking approach, integrating various supply chain components and practices to optimize consumption (Halloran et al., 2014; Hodgins & Parizeau, 2020). A key aspect of this approach is collaboration between supply chain actors, such as public-private partnerships, which can help address the social and environmental impacts of food waste while promoting sustainability and shared responsibility (Halloran et al., 2014; Sonnino & McWilliam, 2011).

One promising model for fostering such collaboration and systemic innovation is the Living Lab approach. Widely recognized as a driver of agrifood innovation (Aare & Hansen, 2024), Living Labs provide a structured framework for facilitating interactions between diverse actors and improving system alignment in everyday operational contexts. By facilitating a holistic approach to both knowledge acquisition and practical implementation, Living Labs enable real-world experimentation (Fuglsang & Hansen, 2022; Gascó, 2017;

Liedtke et al., 2012) and support sustainable transformations within food systems (Aare & Hansen, 2024; McPhee et al., 2021).

Sustainability in food production, distribution, and consumption is complex (Christensen et al., 2024; Wahlen et al., 2012) involving various meanings and everyday practices (Moser et al., 2021; Wahlen et al., 2012). Sustainable practice changes require coordination between diverse actors alongside mechanisms of negotiation and reflection to translate overarching sustainability goals into actionable policies and practices (Christensen et al., 2024).

One key mechanism for bridging this gap is public procurement, identified as a vital regulatory tool for promoting sustainable development within the food supply chain. Given the public sector's substantial market presence (Alhola et al., 2019; Florén et al., 2017), procurement agreements can play a crucial role in influencing sustainable policies and local practices, and are shaped by regulatory frameworks (Alhola et al., 2019; Smith et al., 2016; Sonnino & McWilliam, 2011; World Health Organization [WHO] Regional Office for Europe, 2022). Achieving sustainable change requires political willpower and the capacity of local actors to gradually implement changes in everyday practices (Smith et al., 2016). Also, policy efforts to promote sustainable consumption, such as public procurement, can be fostered by shaping existing conditions (Wahlen et al., 2012) and cultivating a sense of ownership of the change process among those involved (Sørensen, Løje et al., 2016).

Publicly owned kitchens operate within public procurement policy constraints, which dictate purchasing conditions and supply chain dynamics (Sørensen, Tetens et al., 2016; WHO Regional Office for Europe, 2022). However, implementing changes within these procurement frameworks requires adaptation to the realities of professional municipal kitchens. These kitchens function as both physical sites of meal production and metaphorical spaces (Sun, 2021) where cross-sectoral interactions, including sustainable food ordering and delivery, shape the broader supply chain. Successfully aligning procurement practices with sustainability goals thus requires cross-sectoral collaborations (Sørensen, Tetens et al., 2016) and co-

ordination across temporal sequences.

This article is grounded in practice theory, emphasizing that food consumption, including ordering and delivery, results from actions within and across interconnected practices throughout the food supply chain. Time plays a crucial role in shaping social organization, activities, and changes within these practices (Shove et al., 2012; Wahlen et al., 2012). Time organizes and structures human experience across past, present, and future, enabling engagement in various activities (Krämer & Wenzel, 2018). In publicly owned kitchens, tight schedules and routinized workflows dictate operational rhythms (Sørensen, Løje et al., 2016), serving as both requirements and resources. These temporal structures, defined by characteristics such as frequency, pace, and duration (Blue, 2019), connect different actors across the supply chain, influencing procurement practices and consumption patterns.

This article explores how changes to ordering logistics disrupt the temporal organization of publicly owned kitchen operations, while identifying both barriers and opportunities for broader implementation to reduce wholesalers' buffer stocks and associated waste.

### ***The Food Waste Project: Cross-Sectoral Study on Food Waste in the Supply Chain***

This research is based on a four-year cross-sectoral project exploring food waste within the public food procurement supply chain. It involves two of Denmark's leading food wholesalers, selected public kitchens in Copenhagen, and the Copenhagen Food Procurement Department, referred to in this article as the 'Food Waste Project.'

Preliminary studies for the Food Waste Project revealed the significant waste of fresh fruits, vegetables, and dairy products is closely linked to procurement contract requirements, alongside the cultural norms, needs, and expectations within the kitchens and wholesalers themselves (Clausen et al., 2025). The long-standing practice of allowing public kitchens to place orders up to 16 hours prior to next-morning delivery contributes to this waste. Wholesale partners in the Food Waste Project report that these short ordering deadlines necessitate buffer inventories to ensure timely delivery, which in turn increases food waste. Their experi-

ence with supplier schedules suggests that aligning kitchen order deadlines with supplier delivery cycles could help reduce reliance on buffer stocks, thereby reducing related food waste. Our research examines how such a change would affect the kitchens' daily routines, and questions if it could be realistically integrated into their workflow.

### **The Food Waste Living Lab**

To explore these ideas, the project consortium designed a Living Lab where kitchens were required to place their orders 24 hours earlier than usual. Drawing on the increasing application of Living Labs in agrifood innovation (Aare & Hansen, 2024; McPhee et al., 2021), our approach facilitated real-world experimentation and interaction between actors across the food supply system, engaging with their everyday operational dynamics (Ballon & Schuurman, 2015; Fuglsang & Hansen, 2022; Gascó, 2017; Liedtke et al., 2012; McPhee et al., 2021). This process facilitated change through co-creation and knowledge sharing across the key domains, including wholesalers, the municipal administration, and public kitchen representatives.

The aim was to identify the opportunities and barriers encountered by publicly owned kitchens when adjusting long-established operational rhythms of ordering, including time, pace, and other related practices, and to explore whether aligning ordering times across the supply chain could reduce waste without disrupting kitchen operations. The goal would be to make such changes permanent in future contracts.

However, due to formal constraints outlined in the Food Waste Project's collaboration agreement, all initial communication with kitchen staff had to be conducted through their administration to respect resource allocation for external inquiries. Consequently, direct contact with kitchen staff was not permitted during the Living Lab's development phase. Instead, the Living Lab was co-created in collaboration with administrative officials (civil servants), who served as intermediaries representing the kitchens' perspectives. Once the kitchens were identified, their feedback and comments were integrated into the Living Lab wherever feasible.

A primary concern regarding this experiment was that changing ordering procedures might shift

food waste from wholesalers to kitchens if the prolonged time between order and delivery led to imprecise ordering and excess stock. To address this, we introduced food waste measurements in the kitchens during the Living Lab.

### *The Living Lab Design*

The Living Lab operated from early November 2022 to late February 2023 and involved seven public kitchens in Copenhagen Municipality. These included municipally operated kitchens in schools, daycare centers, social institutions, and care homes, but excluded kitchens in similar institutions where operation is outsourced. The Danish wholesaler Hørkram Foodservice A/S supplied all the kitchens under a shared procurement contract. eSmiley, a company specializing in online food waste reduction solutions, provided professional and technical support for measuring food waste in the

participating kitchens.

The study involved the phases outlined in Figure 1 and elaborated below: a pilot study in August 2022 to develop selection criteria for kitchens in the Living Lab, a start-up workshop, and food waste measurement in the kitchens. The process was documented through interviews before, during, and after the modified order deadlines. The results were presented at a workshop in August 2023 with participating kitchens, municipal administrations, and the procurement department.

To develop relevant selection criteria for participation in the Living Lab and inform our research design, we conducted a pilot study to interview five kitchens across the municipal administrations (Children and Youth, Health and Care, and Social Services) and performed kitchen tours to better understand the physical layouts, operational rhythms, and unique daily practices of

**Figure 1. Living Lab Process**

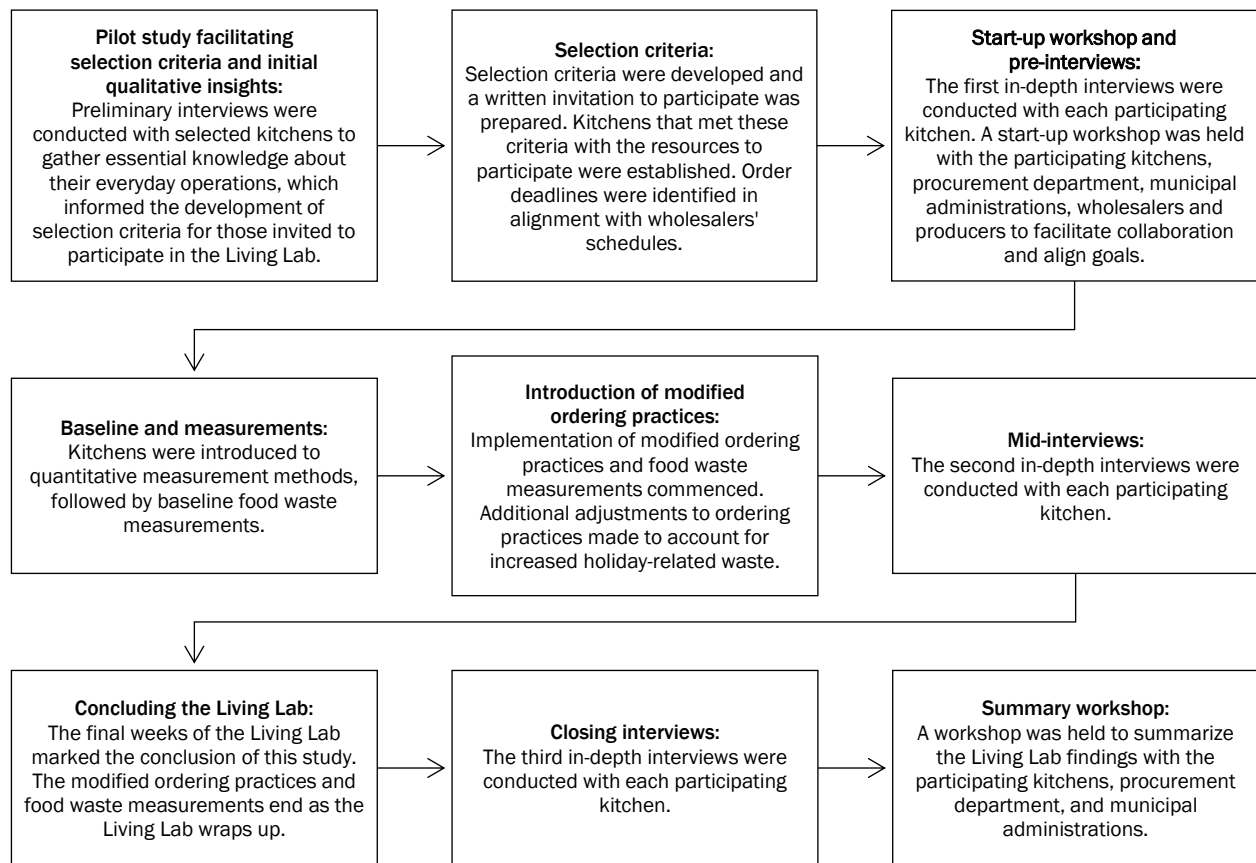


Figure developed by Roskilde University, 2024.

different kitchens.

Based on these insights and to ensure diversity within our Living Lab, we established the following selection criteria:

- Kitchens from each municipal administration, encompassing residential care and daycare centers;
- Kitchens serving diverse clientele to capture a range of menu planning, routines, values, flexibility, and employee perspectives;
- Variation in size, storage capacity, employee numbers, and diners served; and
- Employees with diverse educational backgrounds to reflect different professional competencies.

The pilot study highlighted the need to focus on the relationships between menu planning, ordering, and inventory management, alongside kitchen managers' professionalism and resource management. These aspects were included in the interview guides.

The municipal administrations identified kitchens meeting these criteria capable of participating. A formal invitation, outlining the project's purpose and process, was sent to eight kitchens in Copenhagen, and seven accepted (see Figure 2).

To modify order deadlines in the Living Lab, wholesale representatives from two wholesalers in the Food Waste Project reviewed their fresh produce supply chains to determine the required lead time for customer orders to adjust quantities accurately. They assessed procurement practices for fresh fruit, vegetables, and dairy (the Food Waste

Project categories) to evaluate the impact of extending customer order deadlines by 24, 48, or 72 hours.

Their conclusions recommended a 24–48-hour extension to improve operations and reduce reliance on buffer stocks, a well-documented challenge identified in internal statistic assessments at both wholesalers (Clausen et al., 2025; WHO Regional Office for Europe, 2022). They also noted increased food waste during the holiday seasons, suggesting further order modifications are necessary for the Christmas period. To align kitchen and wholesaler practices, we extended the order deadline by 24 hours (see Figure 3) and conducted a voluntary test run over the holiday period.

### Data Collection and Analysis

We launched the Living Lab with a start-up workshop that was attended by representatives from the participating kitchens and municipal administrations. This workshop introduced participants to the purpose of the Living Lab and the systemic aspects of food waste.

Over the 12-week period of modified ordering, three rounds of in-depth interviews were conducted, primarily with kitchen managers. The first interview focused on their expectations and concerns before order deadlines were changed, and included kitchen tours to gain further insights into their physical set-ups. The second interview, held halfway through the study, explored their experiences with the new practices. The final interview at the end of the Living Lab gathered their overall impressions.

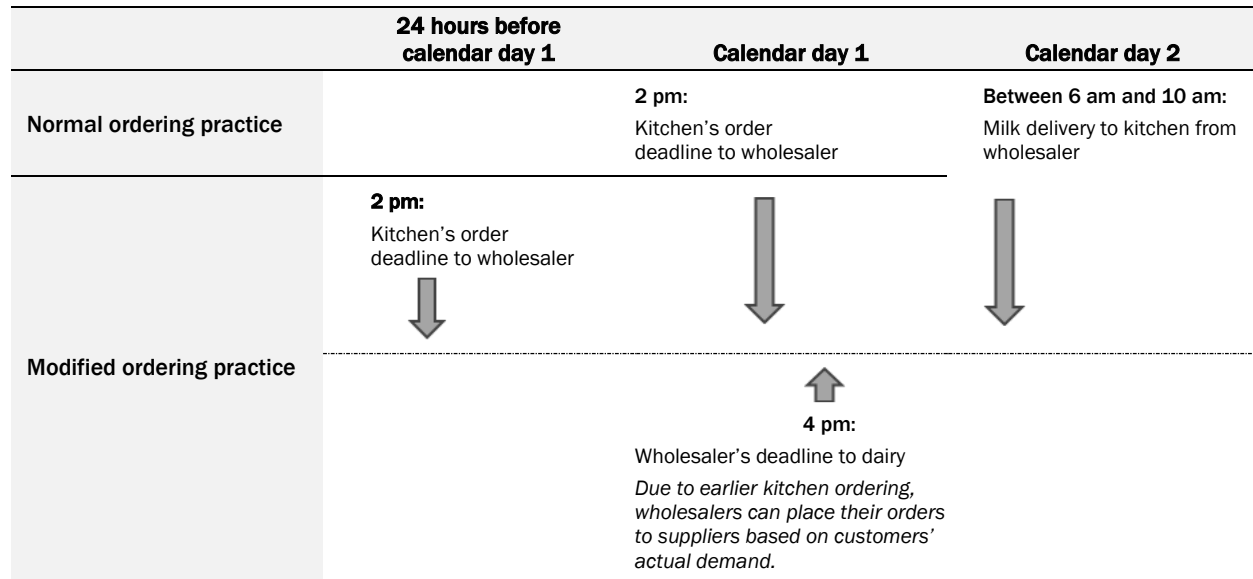
Two kitchens had to withdraw early<sup>1</sup> and,

**Figure 2. Overview of Kitchens Participating in the Living Lab**

Kitchen #1	Kitchen #2	Kitchen #3	Kitchen #4	Kitchen #5	Kitchen #6	Kitchen #7
<ul style="list-style-type: none"> <li>• Children and Youth Administration</li> <li>• Daycare facility</li> <li>• Small kitchen: fewer than 50 diners daily</li> </ul>	<ul style="list-style-type: none"> <li>• Children and Youth Administration</li> <li>• Daycare facility</li> <li>• Medium-sized kitchen: 5–150 diners daily</li> </ul>	<ul style="list-style-type: none"> <li>• Children and Youth Administration</li> <li>• Daycare facility</li> <li>• Small kitchen: fewer than 50 diners daily</li> </ul>	<ul style="list-style-type: none"> <li>• Social Services Administration</li> <li>• Residential care center</li> <li>• Medium-sized kitchen: 50–150 diners daily</li> </ul>	<ul style="list-style-type: none"> <li>• Children and Youth Administration</li> <li>• Public school facility</li> <li>• Large kitchen: over 150 diners daily</li> </ul>	<ul style="list-style-type: none"> <li>• Health and Care Administration</li> <li>• Residential care center</li> <li>• Large kitchen: over 150 diners daily</li> </ul>	<ul style="list-style-type: none"> <li>• Health and Care Administration</li> <li>• Residential care center</li> <li>• Small kitchen: fewer than 50 diners daily</li> </ul>

<sup>1</sup> One kitchen faced unexpected construction work, forcing it to move location, while another dealt with an unanticipated reduction in staff due to illness.

**Figure 3. Normal and Modified Ordering and Delivery Practices in Kitchens**



therefore, only participated in the first interviews. Each interview lasted approximately 30 minutes, scheduled around the kitchen's daily operations. All interviews were recorded and transcribed. Informed consent was obtained from all participants, and they could withdraw at any time.

### *Food Waste Measurements*

We introduced food waste measurements in participating kitchens to determine whether the modified ordering practices shifted waste from wholesalers to kitchens. The company 'eSmiley' provided measurement equipment, technical support, and a digital data compilation platform. There was a four-week baseline period of regularly scheduled orders, followed by twelve weeks of measurement with order deadlines brought forward by 24 hours. To reduce bias, kitchens did not receive their data for the first six weeks, but had full access for the final six.

Food waste measurements were not introduced at wholesale level, as the participating kitchens represent only a small fraction of their customer base, making the absolute food waste reduction negligible.

### *Data Analysis Strategy*

Data analysis was conducted in two phases: first with the Food Waste Project consortium and, later,

the authors and our student researcher.

Initially, a workshop was organized within the consortium with representatives from the wholesale sector, researchers, food procurement officials, food waste consultants, and members of eSmiley. During this workshop, we presented an outline of both quantitative and qualitative data with food waste measurements and interview quotations collected before, during, and after the Living Lab, providing a comprehensive data overview.

The purpose of the workshop was to discuss preliminary insights, evaluate their significance, and identify key areas for further analysis. Based on the consortium's feedback, the authors of this article then proceeded with a deeper data analysis, focusing on two particular key areas highlighted by the consortium: (1) the relationships between types of kitchen (in terms of administration, clientele, size, and competences) and their resources and motivation to adopt modified ordering practices, and (2) the operational practices within the kitchens and how they relate to the perceived potentials and challenges of modifying ordering practices across kitchen types.

These key areas identified during the consortium workshop became focal points in the second data analysis phase, which ran from summer 2023 to spring 2024. We applied various mapping tech-

niques based on Clarke's (2005) situational analysis approach to explore, visualize, and thematize the complexities of the data within a structured framework (Clarke, 2005). The purpose of these mapping exercises was to acquire a broad understanding of the practice situations and visually represent all the integrated human and non-human elements involved.

We began by reviewing the sound recordings of each interview alongside their transcripts and created messy maps, noting anything immediately relevant. These messy maps were then organized into ordered maps, categorizing actors, situations, ideas, and discourses, focusing on those taken for granted by kitchen employees to address what seemed invisible for further analysis. Finally, we developed relational maps to explore and grasp the connections between elements identified in earlier maps and their relational dynamics. We continually revisited and revised the messy maps throughout the analysis process to rethink and re-examine the data. The mapping process revealed intricate details of kitchen operations, leading to rich discussions that emphasized how cultural traditions, situational expectations, and temporal variations—both daily and throughout the year—affected food ordering as well as waste practices. These insights highlighted an ongoing tension between managing time and expectations while balancing the need for flexibility and creativity. This tension pointed to three key analytical themes: 'temporal rhythms', 'stock-keeping', and 'shifting perspectives: from localized kitchen practices to systemic food waste management approaches.' We explored these in depth using practice theory, specifically the three-elements model, as well as the concepts of change and temporal rhythms (Blue, 2019; Krämer & Wenzel, 2018; Shove et al., 2012).

The three-elements model conceptualizes practices as a combination of material, competence, and meaning (Shove et al., 2012, p. 29). Materials encompass objects, infrastructures, tools, hardware, and the body itself. Competence refers to skills, knowledge, and know-how, while meaning relates to the social and symbolic significance of the practice (Shove et al., 2012).

By concentrating on these elements, we created new messy maps with fresh perspectives on

the interconnectedness of practices. For example, when focusing on materials, (such as the computer-based ordering system, food products, and the human operator managing the ordering system), we uncovered links to infrastructure and legislative requirements embedded in the computer-based ordering system. These factors extend beyond immediate operations, connecting to broader political agendas such as the green transformation of the food system, which mandates the availability of specific types of food in the ordering system for the kitchens to purchase. When examining meanings, we explored discourses such as 'changing order practices is time-consuming' versus 'changing order practices helps reduce food waste.' Both narratives play a constitutive role in driving the change in practice itself.

The exemplified elements in focus are not isolated, but linked to other practices, each consisting of similar elements. The relevance of these elements can vary depending on their availability in each situation and the perspective of the carrier of practice (the practitioner), again an outcome of his/her competences.

## Analysis and Results

This analysis identified three key themes across the participating kitchens that will be elaborated in this chapter:

- **Temporal Rhythms:** The new ordering schedule is misaligned with long-established work patterns that the kitchens have optimized to streamline operations.
- **Stock-keeping:** Modified ordering takes more time due to unpredictable stock levels.
- **Shifting Perspectives: From Localized Kitchen Practices to Systemic Food Waste Management Approaches:** Emphasizes the central role that kitchens play in shaping food practices, focusing on optimizing operations, sustainability, and ensuring the well-being of their employees and diners.

Our analysis explores how these themes are interconnected and examines how kitchen employ-

ees serve as both intermediaries and carriers of these practices.

### *Temporal Rhythms*

Everyday operations in a publicly owned kitchen are shaped by multiple tasks, priorities, and demands, such as meeting nutritional needs, minimizing waste, and ensuring 90 % of meals are organic. Time pressure is, therefore, a significant challenge in the participating kitchens and attending to all of the various tasks requires an all-encompassing strategy.

Kitchens employ time management as an organizing strategy, helping to create an overview of the human and non-human activity needed during the day, week, or year to meet these demands. They use work plans that outline working hours, meal plans to detail what to prepare and when, and annual cycles that describe key tasks by term, also accounting for the use of seasonal food products. These plans act as structural tools to embed time management into daily operations. Utilizing this method creates repetitive temporal rhythms in the practices and also presents the opportunity to synchronize cross-sectoral repetitive activities, such as food ordering.

Food ordering has been embedded in kitchen routines for years, shaped by cultural habits across various kitchen types and sectors, creating established ordering routines embodying specific expectations regarding time, human action, and material elements. As one kitchen manager explained,

Calling in to order our goods the day before delivery is something I've done throughout my career. Changing this routine is significant; it's a whole new way of thinking. We need time to integrate this new routine. (Kitchen 4)

Synchronization between the kitchen manager's order and the delivery process forms a routinized complex of interconnected practices. These timely transactions thus create a collective temporal order, ensuring the kitchen manager receives his or her deliveries and the supplier processes the order on time. Adjusting to new initiatives such as the Living Lab, however, presents even more of a challenge, as additional time demands affect the

kitchen manager's ability to address core responsibilities.

Inspired by Pantzar and Shove's (2010) outline of how to analyze and explain changing temporal rhythms, we argue that the (routinized) temporal rhythms in publicly owned kitchens in Copenhagen are outcomes of varied work procedures and practices constantly shifting while conditioning the performance of each other. So, in addition to disrupting established routines, implementing the Living Lab's modified ordering schedule requires significant adjustments to the repetitive rhythm of ordering and its related practices.

As one manager noted,

Ordering today and receiving goods tomorrow makes it easier to check my storage, so I don't need to plan an extra day ahead. But I'm worried that the new order deadline might cause me to miss something, and then I won't get it until the next order. (Kitchen 3)

This kitchen manager's concerns about the modified ordering practice suggests that the Living Lab's interference in everyday operations affects individual kitchen ordering rhythms, as well as disrupts the interconnected practices of stock management and delivery coordination. In this kitchen, where deliveries are received weekly, the kitchen manager is uncertain how changes to the order rhythm will affect the ability to maintain an accurate stock overview. This highlights a broader challenge: navigating the ripple effects of the new ordering schedule on stock management, potentially leading to over-ordering or under-ordering. This disruption highlights the complexity of balancing the internal rhythms of the kitchen with the external rhythms of suppliers' schedules, while also showing the interrelatedness of these cross-sectoral order practices and their separate but complementary temporal rhythms.

Nonetheless, the kitchens have evolved well to the changing rhythm in their stock-keeping practices as one kitchen manager explained:

My staff quickly grasped the modified ordering system and they adapted by already noting on the order form what we needed for Monday

on Wednesday instead of on Friday as they would usually do. This change has made our order list ready despite the modified practice and, although it takes more time, it's manageable. (Kitchen 4)

Sharing the responsibility of ordering through a communal order note that is accessible to all kitchen employees can reduce the overall time spent. This approach equally distributes the task between multiple staff members rather than burdening the responsibility upon a single kitchen manager. In this case, change includes both human actors, as carriers of the practice, as well as the infrastructures and technologies supporting them. In this example, the practice of utilizing a communal order note offers kitchen staff members a chance to participate and improve ordering efficiency. By utilizing a method that is accessible to all, staff can assess and share the kitchen's needs on a daily basis and offer inventory insight in a collaborative way.

The challenge of embedding a new ordering routine into established kitchen operations arises not only within the temporal rhythm of the singular practice of ordering or the resulting synchronized cross-sectional order-delivery routine, but also across interconnected practices shaping the kitchen's daily operations. As one kitchen manager explains,

It's easy to order 24 hours earlier when I receive my delivery on Fridays. Then, I order on Tuesday or Wednesday. But it's challenging when deliveries are due on Tuesdays because in that case I need to order on Sunday and I don't work every Sunday. On long weekends, I have to order on Friday, like today. And all amid daily operations, such as early closures, self-controls, placing orders, planning menus, endless meetings, and food production. I was supposed to leave at 2 pm, but it's likely to be 4 pm today due to unexpected staff shortages. I'd prefer to postpone ordering until Monday, but that's not possible. And when I checked the storage today, it's already full of this morning's deliveries. I have to figure out what will be used over the weekend when I'm not here

and order based on that. (Kitchen 4)

This account highlights how the practice of ordering is intertwined with other kitchen practices, such as stock oversight and food production. The kitchen manager's explanation also illustrates how ordering is conditioned by prior actions, such as menu planning and self-control, and how these practices, in turn, shape future activities. The interdependence between these practices is evident, with each mutually influencing each other.

Moreover, the kitchen manager's description reveals how temporal rhythms are embedded in these practices, particularly regarding the modified ordering schedule. The modifications introduce new time constraints, consequently affecting the broader time-bound systems within the kitchen, such as work schedules, time off, and overall coordination of tasks. This example demonstrates that the practices are not performed in isolation but are deeply interconnected within the kitchen's operational framework and beyond, creating a ripple effect extending to other time-sensitive tasks.

On that particular Friday, the kitchen manager is navigating a range of competing and cooperating practices, all vying for the limited resource of time. Time management, through tables and schedules guiding the temporal rhythm of daily operations, becomes both a challenge when time is scarce, as on this Friday when working hours must be extended to complete all tasks, and a valuable resource for practices requiring synchronization.

The dual role of time management as both a challenge and a resource led us to consider the three-elements model suggested by Shove, Pantzar, and Watson (2012). By modifying the ordering practice, one can introduce novel combinations of existing elements that mutually shape each other, such as the need for new competencies around enhanced stock oversight and forward planning. The character of these elements manifests differently across various moments in time.

For example, the material elements of stocked food interact with both the competence and meaning associated with the workday ending at a specific time. This interaction is linked to the competences and meanings involved in the Living Lab's new

ordering practices, and also the ethical commitment to adhering to the terms of participation in a research project. In this instance, adjusting the order disrupts long-established temporal rhythms, patterns shaped not just by cultural habits but also by legislative frameworks, as procurement contracts define order deadlines and delivery requirements.

However, the modified ordering schedule not only disrupts temporal rhythms but also stock management. As kitchen managers adjust to new ordering deadlines, they must reconfigure stock-keeping strategies to maintain stable inventory while balancing the risk of overstocking and shortages.

### *Stock-keeping*

The modified order schedule disrupts the usual flow of inventory management. Hence, the kitchen employees are challenged regarding the predictability of quantities, creating uncertainties of increased risk of over-ordering, leading to increased waste in the participating kitchens, or under-ordering, leaving kitchens short on essential ingredients. The additional time spent calculating needs and checking inventory puts a strain on already tight schedules, adding complexity to an otherwise streamlined process.

Stock-related issues predominantly appeared in relation to holiday seasons and creative practices as elaborated below.

### *Holiday seasons*

During holiday seasons, expectations about food shifts towards more spontaneity and a high volume of special requests, as ‘hygge’<sup>2</sup> takes greater priority. For example, kitchens often cater for spontaneous events, such as creative activities in schools and kindergartens or music events in nursing homes, where teaching staff place last-minute orders for edible Christmas treats. These activities and events challenge the kitchen’s ability to align their timely orders with the demands of hygge, often leading to last-minute orders and

increasing the risk of food waste. As one kitchen noted:

We like to celebrate. The residents should be allowed to celebrate! And then we often have to order at the very last minute. (Kitchen 6)

In these periods, greater flexibility in ordering is necessary to accommodate the festive atmosphere and higher expectations. While this may temporarily increase food waste, it is considered acceptable to reflect the festive atmosphere and meet residents’ higher expectations. Our analysis thereby suggests that employees’ views on food waste vary by context.

Additionally, kitchen staff at residential care centers notice that during the holiday season some residents receive visitors more often wishing to dine with them, while others may skip meals to eat with their families. In this context, the organizing practice of registering for dinner becomes crucial for a kitchen’s ability to order the right quantities of food, align with wholesale order deadlines and supplier schedules, thereby integrating cross-sectoral actors through temporal, spatial, and digital connections. For example, one kitchen reported:

We have had several more last-minute orders during Christmas. The modified ordering has been especially challenging because it adds to the already increased workload of organizing Christmas activities. On Christmas Eve, while managing daily operations, we also encountered unexpected changes in diner numbers—on this occasion, increasing by over 30 people just the day before. Consequently, I found myself needing to place additional orders anyway. (Kitchen 4)

Ordering optimal amounts of produce is directly linked to the number of diners, which fluctuates significantly during holiday periods. This variability necessitates a flexible approach to last-

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<sup>2</sup> According to the Ministry of Foreign Affairs of Denmark (n.d.): “Hygge is often about informal time together with family or close friends. ... It usually involves sharing a meal and wine or beer, or hot chocolate and a bowl of candy if children are included. ... You celebrate the small joys of life, or maybe discuss deeper topics. It is an opportunity to unwind and take things slow” (para. 5).

minute ordering to accommodate unexpected diners, especially within residential care centers. This can be challenging, as both the wholesaler and kitchen operate on distinct temporal rhythms, encompassing their respective fundamental practices. However, the altered ordering deadlines required by the Living Lab reduce this flexibility, occasionally forcing staff to be more creative with the ingredients available.

### *Creative adaptation*

The need for kitchens to plan further ahead also involves creative competences. How the kitchens handle this need for creativity appears in the dynamics between the kitchen manager as an agent of change and carrier of established practices along with the related elements of meaning, competence, and materials. For instance, one kitchen manager noted:

In our kitchen, we're accustomed to using whatever fruit and vegetables are available. This adaptability is our advantage in this Living Lab. If we find ourselves low on potatoes over the weekend, we simply use something else. However, if the menu specifically lists potatoes and we've run out, there's not much I can do about it on Monday. That's challenging because then there are unmet expectations.  
(Kitchen 4)

This kitchen has integrated creative practices into its daily operations and views creativity positively as long as the menu remains flexible, for example by listing "vegetables" rather than specific items such as "potatoes." However, tensions arise when creativity clashes with diners' expectations, a challenge heightened by the new ordering schedules.

Another kitchen leverages its creative competences to actively prevent food waste resulting from the modified ordering schedule and increased need for stock management:

We've managed to use the surplus stock that resulted from the changed ordering deadline. For example, we suddenly had four liters of yogurt that was about to expire. So, we

changed the dessert from red berry pudding to yogurt mousse instead. But it requires me to think more creatively to use any surplus stock.  
(Kitchen 7)

The ingrained elements of preparing dessert changed when the available food material shifted to yoghurt, requiring the carrier of practice to exercise agency by applying and/or developing professional competencies to adapt menu plans.

Despite disrupting temporal rhythms and stock-keeping strategies, the modified ordering schedule also prompted broader reflection on the kitchens' role in the food system. As they navigated ordering constraints and inventory management, they became more aware of their impact on cross-sectoral waste reduction.

### *Shifting Perspectives: From Localized Kitchen Practices to Systemic Food Waste Management Approaches*

Kitchens in Copenhagen have long prioritized internal optimization, while also focusing on meeting political goals for organic and climate-friendly food. This deeply ingrained focus on refining their own processes has become central to their operations, but it may have contributed to having a narrower perspective, making it less common for kitchens to look beyond their own practices and consider the broader supply chain. Through the Living Lab, kitchens began to shift their focus, developing an understanding that their practices, such as ordering, are part of a larger food waste management system.

The dynamics between the elements of meaning, competence, and materiality influenced how kitchens adapted to the shift in the timing of ordering practices. Prioritization of daily tasks was shaped not only by the modified ordering system, but also by external factors, such as the kitchen managers' perceptions of diner expectations, political agendas, and their role in the green transition. These perceptions are embedded in time, as the practices required to meet these expectations are time dependent and consequently shaped by temporal characteristics, such as duration, pace, and time of day or year. The disruptive change of

established routines, such as the implementation of modified logistics in the Living Lab, can create tension and challenge the balance between external expectations and daily operations. Despite this inward focus, the kitchens recognized the necessity of systemic change:

We've never been aware before of how it all connects, how food waste at the wholesalers and producers can be connected to what we do in the kitchens. But it makes sense when the producers explain it to me. (Kitchen 3)

The Living Lab served as both an eye-opener and a challenge for the kitchens, prompting them to broaden their focus and address food waste across the entire supply chain. This shift motivated many participants:

If it turns out to affect the supply chain from the producer onwards, I find that interesting. Is that possible? (Kitchen 3)

Presentations from food producers and wholesalers at the start-up workshop introduced this broader perspective, aiding the evolution of the kitchens' understanding of their role and deeper responsibility within the food system. As one manager reflected,

This change doesn't directly benefit me—it poses a challenge. But what motivates me is discovering potential benefits. (Kitchen 4)

Although adapting well-established practices was challenging, kitchen managers expressed openness as their understanding of meaning and competence evolved. In the realm of practices, change is constant, influenced by related activities, elements, technologies, and infrastructures. One manager noted: "I see this as part of the climate effort that we all need to be part of" (Kitchen 3). Despite uncertainty about the direct impact on their own operations, the managers acknowledged the systemic importance of their role in the green transition.

Recognizing that the kitchens had historically focused inward, the Living Lab emphasized a sys-

tems perspective, inspiring the idea that modified ordering practices could reduce food waste at wholesale level and beyond:

Planning my workday differently is a simple solution if it reduces food waste significantly. (Kitchen 1)

While some kitchens found the modified ordering practices challenging, others saw it as a matter of planning:

Ordering is simply a habit (Kitchen 4)

and

If I'm not too rigid in my routines, there's no problem. (Kitchen 1)

Kitchens emphasized that collaboration with teaching staff, parents, and management was essential for them to implement systemic changes successfully. By explaining the connection between logistics and cross-sectoral waste reduction, kitchens became more supportive of the project's objectives, reflecting a shift from localized practices to a shared responsibility in reducing food waste.

The sense of community and collective action showed that the kitchens were motivated by the potential for systemic change. Throughout the Living Lab period, most of the kitchens developed new meanings and competences, shifting their mindset towards modified ordering practices incorporating both an internal and systemic focus:

It would be great to help the food producer or wholesaler through our ordering," one manager said. "Everything points to continuing this way, especially if we agree on methods that consider our challenges. For instance, there are limits to how far in advance we can order perishables like bread, milk, and fresh produce. (Kitchen 5)

While tension between the temporality of ordering processes and the materiality of different food types persisted, especially around holidays and vacations, the shift introduced by the Living Lab

was perceived as both manageable and meaningful. It revealed new perspectives on the systemic impact of these changes, highlighting the importance of transparency, increased knowledge, and open dialogue in facilitating understanding and cooperation across the supply chain.

## Discussion

A key finding of this Living Lab is that a kitchen's relationship with food suppliers (wholesalers and producers) is deeply embedded in long-standing, routinized operational practices configured of elements of meanings, competences and materialities. These routines are tied to temporal rhythms embedded in the kitchen and supplier operations, while also being part of a complex and dynamic system. Introducing modified ordering schedules through the Living Lab disrupted these established routinized rhythms. Incorporating these adjustments required innovative coordination of various related kitchen practices as well as re-configuring the elements within these practices to enable the change to be adopted during the Living Lab.

This study demonstrates that temporal rhythms that involve coordination and meaningful relationships in institutional kitchens extend beyond technical schedules. Present actions, like adjusting ordering times, are shaped by a sense of meaning originating in the past and extending into the future, such as reducing food waste in line with sustainability targets. We suggest the interplay between modifying this time-bound, routinized practice of ordering and its related meanings further reinforces the meaning of time in the practice dynamics. According to Christensen et al. (2024), this interplay between diverse practices and meanings reinforces these dynamics, impacting consumption patterns and climate policies.

The framework for food ordering and delivery is governed by procurement contracts that dictate timelines to align with kitchen mealtimes and driver schedules across locations. Modifying ingrained routines, such as ordering practices, requires new competencies to understand how these temporal rhythms operate across sectors and influence practices within and beyond the organization. For example, changes in kitchen ordering directly affect wholesalers' purchasing activities,

enabling them to reduce buffer inventory. Previously, wholesalers relied on buffer stock to meet demand, often resulting in leftover waste (Clausen et al., 2025; WHO Regional Office for Europe, 2022). The Living Lab introduced a modified ordering schedule along with explanations to the kitchens highlighting the benefits of adjusting temporal rhythms to achieve better collaboration and reduce food waste throughout the supply chain. This approach aligns with Florén and Davis's (2017) findings, indicating that providing immediate, context-specific information is effective in changing behavior, thereby enhancing coordination between kitchens, wholesalers, and producers.

Although the impact of the modified ordering practices was intended to align cross-sectoral temporal rhythms of order and supply practices, it also presented a stock-keeping challenge for the kitchens during the Living Lab. The modified ordering schedules disrupted stock management routines, introducing a temporal risk of over-ordering or under-ordering as the kitchens adapted to the new rhythms.

This study highlights how aligning kitchen ordering practices with wholesaler and producer timelines can improve inventory management and potentially reduce food waste. By adjusting to the modified schedules, kitchens were able to optimize their stock-keeping practices to coordinate with wholesalers' supply schedules. For example, when kitchens adapted their shared communal order notes to the new schedules, they not only shared the responsibility of ordering, but also reduced the resources needed to adjust to this new stock management practice, as it enabled several staff members to contribute to monitoring inventory. The key to successfully adopting these stock-keeping practices was to adapt to new competencies, such as enhanced stock oversight and forward planning.

A major outcome of this Living Lab was the shift in perspective, helping the kitchens see themselves as part of a larger food system network. By participating in the Living Lab, kitchens began to realize that their ordering practices had ripple effects across the supply chain, resulting in increased awareness of their potential to reduce buffer storage at wholesalers and producers, contributing to a broader effort to reduce food waste.

The shift in perspectives enabled a new dynamic between the elements of the ordering practice, enabling kitchens to explore and move beyond internal operation to a deeper understanding of the systemic implications of their practices. By expanding a kitchens' competences and meanings, they were able to recognize that reducing systemic food waste requires collaboration across the supply chain, from producers to kitchens.

Despite the challenges of integrating these new perspectives, the kitchens embraced this systemic view. They realized their ability to reduce food waste was not limited to their own operations and this motivated them to align their practices with the larger goals of sustainability and food waste reduction.

### Conclusions

This study underscores the need for a systemic approach to food waste reduction by understanding time-bound interdependencies in public kitchen settings. Using Shove, Pantzar, and Watson's (2012) three-elements model, we observed how modified ordering practices reshape kitchen operations. The new ordering system (material element) requires enhanced stock oversight and planning (competencies), shifting the focus from internal optimization to a broader role in reducing supply chain waste (meaning).

Our findings suggest that modified ordering deadlines can be implemented successfully in publicly owned institutions across Denmark to reduce buffer-associated food waste, particularly for perishable items, such as fruit, vegetables, and dairy. Food waste measurements in participating kitchens

showed a decline of 2.5% during the Living Lab, with kitchens gaining broader insights into systemic food waste issues.

For successful implementation, consistent communication of shared goals between kitchens, wholesalers, and producers is crucial. Emphasizing the significance of these changes increases the likelihood of adoption, whereas recognizing it requires a cultural shift in a profession that values freshness and flexibility. Implementation should be approached with patience and knowledge sharing, emphasizing the social contextualization of time.

Although this study focused on the temporal rhythms of food ordering and kitchen operations, broader application could enhance produce freshness and shelf life, potentially influencing industry production planning. Future research should explore these potential benefits further.

This study demonstrates how modifications in ordering deadlines—when supported by transparent communication and shared goals on reducing food waste—can catalyze broader systemic change positioning publicly owned kitchens as active practitioners in driving sustainable transitions across the food supply chain.

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