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When Green Procurement Meets Complexity: The Case of Sustainable Neighborhood Projects

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Abstract: In a rapidly urbanizing world, cities form the key context for a sustainable transition. The neighborhood scale is suggested as a successful scale to realize cross-sector, inter-organizational collaborations. The multifaceted goals and resulting interdependencies in sustainable neighborhood (SN) developments seem to render them complex. Neighborhood scale can be understood as a program of related projects encompassing a wide range of actors interacting in a non-simple way. The added complexity comprised at the neighborhood scale challenges the promise of sustainable transition, creating a gap between what is promised as SN and what is delivered. While filling this gap is deemed pivotal to boost the performance and success of SNs, this study focuses on the practice of procurement. Green procurement has a prominent role in fostering the sustainable transition and alleviate the projects' poor performance in energy consumption and carbon emissions. However, green procurement is complicated and often hampered by the complex nature of the programs and projects required to realize SNs. Using an in-depth case study of an ongoing SN development in Norway, we seek to explore green procurement in SN programs. The present study has several contributions. First, we provide a fresh look at SNs using the notion of program management and the principles of nearly decomposable systems. Second, the study demonstrates that green procurement can support coordination in programs, and propose several implications for purchasers to consider when devising a green procurement strategy for SN programs, laying the groundwork for new procurement research focusing on structural complexity. Furthermore, our study encourages purchasers to think like architects to grasp the various levels and make better decisions in complex projects and programs.

Keywords: green procurement; program procurement; project procurement; green public procurement; sustainable neighborhoods; complex projects and programs

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1. Introduction

In a rapidly urbanizing world, cities form the key context for a sustainable transition. While many measures are adopted on an urban scale, such as improvements in the mobility system, particular interest lies in the neighborhood scale. Neighborhoods are suggested as a successful scale to realize cross-sector, inter-organizational collaborations. The neighborhood scale brings different opportunities, e.g., energy-efficient measures, shared mobility, integrated solutions, and cross-sectoral partnerships, which could be exploited in the transition towards low carbon society [1,2]. As a result, interest in the sustainable neighborhood (SN) topic has increased rapidly in recent years [3,4].

Nevertheless, despite this interest, SN development's inter-organizational dynamics and its practical implications are still relatively unexplored. Recent research shows that SN projects are confronted with many challenges [5,6]. Of which, many are inter-organizational related. The multifaceted sustainability goals and resulting interdependencies found in SN developments seem to render them complex, often performed in multi-project contexts.

In project studies, the notion of 'program' is widely recognized as an approach model for understanding and managing multi-project contexts [7,8]. Neighborhood scale developments can be understood as a program of related projects encompassing a wide range of organizational actors interacting in a non-simple way. The added complexity comprised at the neighborhood scale challenges the promise of sustainable transition, creating a gap between what is promised as SN and what is delivered as such [9]. This highlights the need to improve the current project management and organizational practices [6]. While filling this gap is deemed pivotal to boost the performance and success of SN projects, this study takes the first step and explores the practice of procurement in SN programs, especially that procurement has a prominent role in fostering the sustainable transition.

Evidence from both research and practice shows that environmentally sustainable or green procurement can alleviate projects' poor performance in energy consumption and carbon emissions [10–14]. Research has also shown that environmental requirements increase the procurement process's complexity [10,15]. Green procurement is hampered by the complex nature of the programs and projects required to realize SNs, as purchasing departments design procurements as one-time transactional processes. In other words, green procurement does not seem to address the various levels found in SN programs. Hence, limiting its potential and application in SN programs. Notably, this study focuses on the procurement of development contracts of projects [11]; procurement of projects rather than procurement within projects.

A better understanding of procurement is vital, given that complex projects and programs have long been associated with failure [16–18]. We provide a 'nearly decomposable' view [19] to improve our understanding of green procurement in complex projects and programs. Understanding how complex projects can be 'nearly decomposed' has been identified as a promising and potentially rewarding area of research [20]. Using a case study of an ongoing SN development in Norway, the current study explores the organization of green procurement and its potential for coordination in SN programs. More specifically, we seek to answer the following questions:

1. How can green procurement support coordination in sustainable neighborhood programs?
2. What are the implications for purchasers when devising a green procurement strategy for sustainable neighborhood programs?

We contribute to the literature on green procurement and sustainable urban development by providing insights and implications on how organizations can better design and implement procurement in complex urban projects and programs. Based on the analysis of the practical evidence, we suggest a conceptual model of green procurement for SN programs. We report our study as follows: The next section introduces the theoretical framework of the study. We focus on understanding how organizations can perform procurement in programs. We then describe our empirical setting and case findings. Next, we discuss the findings' implications in light of the research questions, followed by concluding remarks and future research suggestions.

2. Key Concepts and Theory

2.1. Program Management

Multi-project contexts are described "as highly political, with a constant competition going on between different managers and projects concerning priorities, personnel, attention, and resources" [21] (p. 404). Program management is a common approach to managing complexity embedded in multi-project contexts [20,22,23]. In this paper, we understand program management as "the integration and management of a group of related projects with the intent of achieving benefits that would not be realized if they were managed independently" [8] (p. 289). In this sense, the term 'program' is used to define a grouping of projects for coordinated management [24]. Coordinated management could translate into greater efficiency and effectiveness and business focus [8]. The former covers general improvements in management aspects, including effective resource utilization, greater management visibility, and useful knowledge transfer between projects. The latter

concerns the alignment of projects with the strategic direction of the broader organizations. However, the level of coordination between projects can vary, depending on the program's contextual setting and objectives.

2.2. Nearly Decomposable Systems

According to the theory of the nearly decomposable nature of complex systems [19], decomposability is a function of the number and degree of interaction between subsystems within a system. A system is rendered as nearly decomposable when the interactions within the subsystems are stronger and more frequent than those between the subsystems. The principle is also referred to as 'loose coupling' [25,26] and 'information hiding' [27]. The subsystem's definition or interface is designed to reveal as little as possible by locating the interdependencies within the individual subsystems rather than between them. Simon [19] summarizes this nearly independent behavior of the component subsystems in the following two propositions: "(a) in a nearly decomposable system, the short-run behavior of each of the component subsystems is approximately independent of the short-run behavior of the other components; (b) in the long run, the behavior of any one of the components depends in only an aggregate way on the behavior of the other components" (p. 474). This highlights the simultaneous need for independence and responsiveness at the component and aggregate system levels, respectively [28]. In this structural sense, a hierarchic program may refer to the decomposition in both product and organization [29]—or design choices for projects and organizations managing these projects.

Simon's concept of nearly decomposable systems is directly compatible with Ashby's work on multi-stable systems [30]. These systems maintain viability by allowing their internal subsystems to adjust to specific local conditions whilst (necessarily) being loosely coupled to each other. For each subsystem to adapt and regain stability in the face of local stimuli, the couplings with other subsystems must be limited to not interfere too much with each subsystem´s adaptive process. On the other hand, a certain level of couplings is necessary for subsystems to inform each other on upcoming disturbances and not in the least, to create a "...greater repertoire of possible behaviours" [30] (p. 223).

An important concept that drew upon nearly decomposability is modularity. Modularity is an attribute of complex systems and can be defined as "a special form of design which intentionally creates a high degree of independence or loose coupling between component design by standardizing component interface specifications" [29] (p. 65). However, systems are not necessarily conceived in modular forms. Schilling [31] proposed a causal model explaining the factors that cause systems to migrate towards or away from modularity: the heterogeneity of inputs and demands, urgency, and synergistic specificity. This could offer programs a broad range of design choices, depending on their modularity level: modular at one end and integrated at the other. In management studies, modularity in product and organization design may follow different trajectories [32]. Colfer and Baldwin [33] argued that "the mirroring of technical dependencies and organizational ties is an approach to organizational problem-solving that conserves scarce cognitive resources" (p. 710). Recent research has investigated the different trajectories of modularity in terms of product and organizational mirroring to achieve better collaboration in programs [23] and benefits within and across firm boundaries [34].

2.3. Procurement in Nearly Decomposable Programs

This section proposes a theoretical framework to understand how green procurement can be demonstrated in SN programs (Figure 1), using the principles of nearly decomposable systems.

Using the analogy of heat-exchange from Simon [19], we try to imagine SN as a nearly decomposable program. Consider that a new SN development is undertaken as a program of related projects, interacting in a Simonian way. The program can be decomposed into several modules: product and organization. In the product module, the projects (e.g., buildings and infrastructure) represent the system's product subsystems. In

the organization module, the actors managing the projects (e.g., landowners, developers) represent the system's organization subsystems. However, this does not mean that the program should always decompose in both modules. For example, Tee et al. [23] shed light on how programs can complement modular designs with integrating practices to achieve better collaboration results. They illustrate how different decomposition in product and organization modules result in different situations and conditions for collaboration.

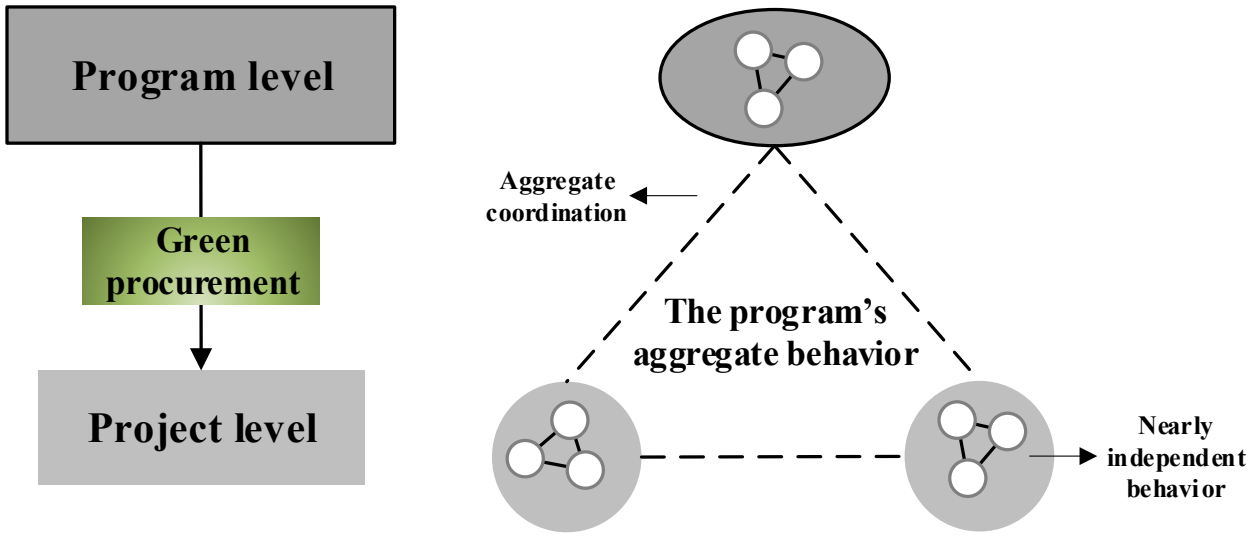

Figure 1. Green procurement of projects in nearly decomposable programs.

The actors involved should locate most of their resources and interdependencies within their projects, leaving a small yet not negligible amount when dealing with the other projects and actors in the broader program. However, the program manager has to bear the responsibility of aggregate coordination between projects, compensating for the lack of inter-project coordination, and excessive specialization within projects. Aggregate coordination includes goal alignment, system integration, and contractual agreements [7,8,20,35]. Moreover, running the program on a nearly decomposable mode requires standardized interfaces and design rules at the program level. That is, "a clear set of design rules reduces the related need for ongoing communication and coordination among development team members" [36] (p. 1437). Other interfaces that support coordination could be product planning forums, reward systems, and cross-training [32].

Since our study focuses on SNs, we consider the effect of procurement on the environmental performance of neighborhood developments. In contrast to traditional procurement, green procurement incorporates environmental considerations into tendering and contracting activities [15]. Green procurement can be practiced at the project level when procuring development and construction contracts of projects [11] and/or within projects when procuring components and building materials [13]. The same applies to green public procurement (GPP) [37,38]. However, green procurement and GPP research have, to a great extent, focused on the inclusion of environmental requirements in individual projects rather than programs—addressing complexity derived from environmental challenges rather than from structural challenges. This highlights the need to broaden our understanding of the procurement practice in programs. Existing research may provide insights or clues on how to address green procurement at the program level. For example, the environmental requirements have to be in line with the organization's long-term goals [39]. In our case, the various green requirements applied in the different projects should compose a coherent set aligned with the SN program goals. Project actors could pass through environmental requirements due to their program position, where most actors are both clients and suppliers at the same time [39]. Furthermore, another aspect that can inform the program level is to

complement procurements with dialogue opportunities. A growing body of research has addressed the benefits of dialogue to procurements [37,40–42].

In essence, we suggest the following implications, assuming that the SN program has a nearly decomposable architecture. First, the way the SN program is designed and decomposed affects how the procurements are designed and implemented. Understanding the decomposition criteria or factors can be of great value for purchasers and purchasing departments involved in SN programs. With our analysis, we hope to develop some ideas for a more deliberate design that could support the green procurement practice in SN programs. Second, we expect the interdependencies between the projects themselves to be weak but not negligible. This means that even though there has to be room for isolation over a certain period, projects cannot work in complete isolation. Someone, i.e., a program manager, has to bear the responsibility of aggregate coordination between projects. Furthermore, certain interdependencies, especially infrastructural features of a neighborhood, maybe literally difficult to align neatly across projects. We also expect the procurement practice to play a role in aggregate coordination towards realizing the neighborhood as sustainable. Specifically, allowing the nearly independent behavior of projects and supporting the program's aggregate behavior.

3. Data and Methods

3.1. Data Sources and Analysis

This study is part of a broader research project, "The Research Centre on Zero Emission Neighborhoods in Smart Cities (ZEN center)," focusing on developing zero-emission neighborhoods in Norway. We employed a qualitative single-case design [43] to explore how procurement practices were organized to achieve environmental sustainability goals and contribute to coordination and collaboration at the program level. This allowed for an in-depth analysis of the way procurements were designed and implemented in the case.

Our study relied on an analysis of both primary and secondary data. We conducted 22 interviews regarding primary sources, focusing on key decision-makers, managers, and planners relevant to our setting, both the public and private sectors. The interviews followed a semi-structured approach. This allows the informants to share the project's experiences, depending on their background and involvement. They were done in two stages to cover different neighborhood development phases (Table 1). The interviews were recorded and transcribed in agreement with the informants. Secondary sources of data comprised of internal project documents (e.g., tenders, contracts, and agreements), press releases, news articles, workshop reports, meeting minutes, news posted on social media, research reports from the ZEN center, and notes from site visits. Table 1 shows an overview of our data collection stages and data sources. The first round of interviews took place during the project's conceptualization stage. The second round took place during the planning and implementation stages. The first round enabled us to cover early development activities and collect data about the project context. The second round was focused on collecting data about project actors and procurement activities. In particular, we collected reflective data about how procurement and contracting processes were deployed to improve environmental sustainability and coordination between actors.

NVivo software was used primarily for coding but was also useful for storing different data sources. The software acted as our virtual workplace due to the vital role it played in the analysis process. Initially, we coded the interview transcriptions following several general categories, including project description, procurement and contracting, interdependencies and collaborations, dialogue opportunities, involvement activities, environmental sustainability and masterplan, ZEN concept, challenges and conflicts, and the municipality's role. Coding was mainly driven by research setting and data. However, some categories were based on previous research [44]. For example, the notion of program management made us differentiate between two types of interdependencies (between projects and program, and between projects). The theoretical insights from green procurement literature also drew our attention to the masterplan's environmental requirements.

Next, these categories were used to summarize the final themes. The continuous interplay between theory and data [45] helped us revise and make multiple iterations before landing on the study's main findings. When encountering conflicting issues or missing data, we checked this with key informants via interviews or emails. Inter-interview comparisons were also performed to validate information or get updates on ongoing activities.

Table 1. Data collection and sources.

	Stage 1 (2017)	**Stage 2 (2019/2020)**
Objectives	Focus on early-stage activities, visions, objectives, risks, development plans, potential stakeholders, and challenges	Focus on project development, organizing, green procurement and contracting processes, and collaboration agreements
Primary sources	Nine interviews ETS (1), EM (3), developers Y and N (2), energy and transportation companies (2), architect (1)	Thirteen interviews ETS (4), EM (5), developers Y, N, T, and V (4)
Secondary sources	Municipal documents and presentations (e.g., announcements and workshop summaries) Internal project documents (e.g., agreements, contracts, feasibility study reports)	Municipal documents and presentations (e.g., municipal and procurement strategy documents) Internal project documents (e.g., agreements, contracts) News articles and research reports
Informant roles	Project manager (PM), purchasing manager (PuM), general manager (GM), construction projects manager (CPM), spatial planning manager (SPM), communication manager (CM)	

3.2. The Ydalir Project: Overview and Case Selection

Our case study focuses on the Ydalir neighborhood development, located in the city of Elverum, around 140 km northeast of the Norwegian capital, Oslo. The project's development works started in 2015 and currently in the implementation phase, with an estimated timeframe for completion in 2030. Around 1000 residential units (a combination of detached houses and apartments) will be built around a new school and kindergarten (Figure 2). Ydalir development aims to develop a new, large neighborhood in a new way to reduce both mobile and stationary energy needs and greenhouse gas emissions. It also aims to be a good place for sustainable living, not only through physical solutions but also through having social arenas, meeting places, stable relationships between people and between people and place.

The specific setting of Ydalir development is well suited to improve our understanding of green procurement in complex urban projects and programs for several reasons. The neighborhood-scale development constitutes an overall project (with an estimated cost of around Euro 300 million) comprising various infrastructure and building projects and many involved actors from both the public and private sectors. The key actors are Elverum Municipality (hereafter EM), Elverum Land Development Agency [Elverum Tomteselskap] (ETS), Ydalir Housing Development [Ydalir Boligutvikling] (YB), housing developers, consultant agencies, transportation company, energy utility company, and waste management company. Notably, ETS and YB are owned by the municipality. Though the overall project was not officially referred to as a program by the informants or project documents, the development resembles a program structure. On top of being a complex structure, Ydalir has many multifaceted sustainability goals, mainly due to involvement as a pilot project in the ZEN center. Realizing Ydalir as a ZEN means that all greenhouse gas emissions from materials and energy during the construction and operation stages should be offset by locally produced energy. The ZEN ambition is described in Ydalir's masterplan, a guiding document for the development work. Most importantly, the overall project or program used various procurement practices, including public procurement, public-private partnership (PPP), and private development contracts. All of them qualified as green, except for the procurement of the infrastructure project.

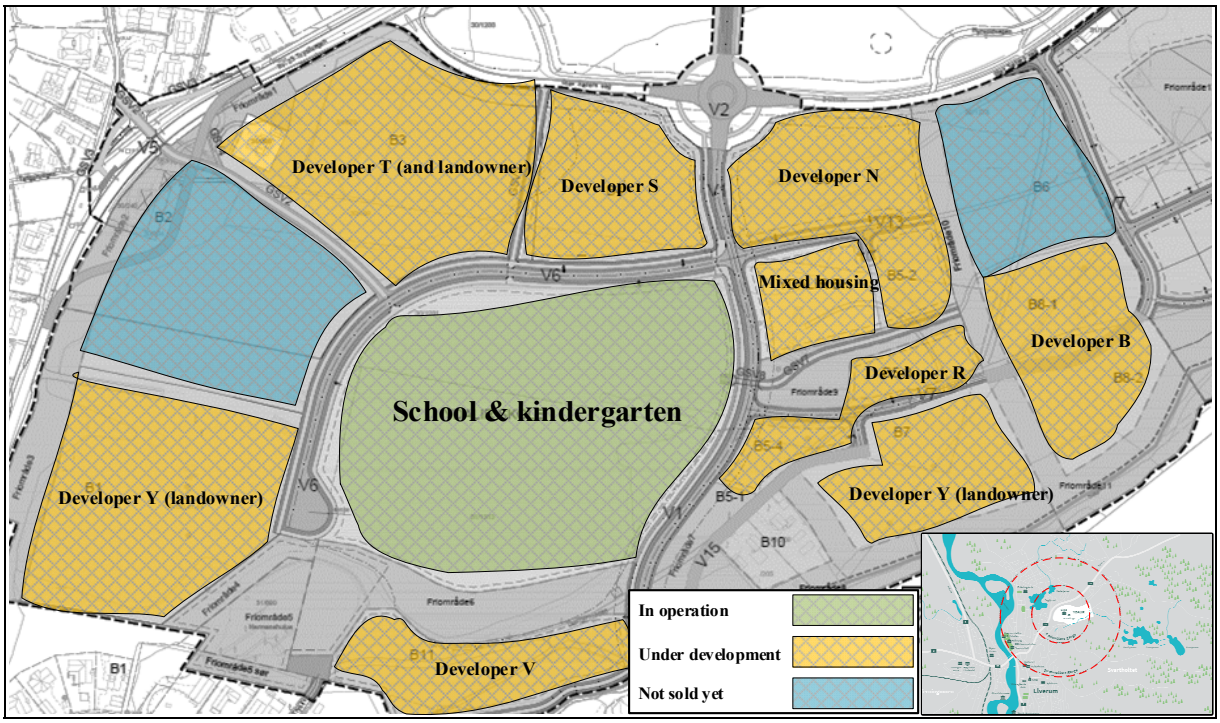

Figure 2. The Ydalir neighborhood development: land lots, projects, and developers. Source: Elverum Tomteselskap (ETS).

4. Findings

4.1. System Architecture in Ydalir

Ydalir architecture takes the form of a hierarchic program (Figure 3), comprising of different projects and actors. At the program level, EM plays the role of the program sponsor or manager. By moving one level down the hierarchy, we see the landowners and first-tier developers. In our case, the landowners are also first-tier developers. ETS owns 80% of the whole development land, and the remaining 20% belongs to two other developers (hereafter T and Y). The three landowners entered a collaboration agreement to develop the neighborhood infrastructure, assigning project management responsibility to ETS (Figure 4).

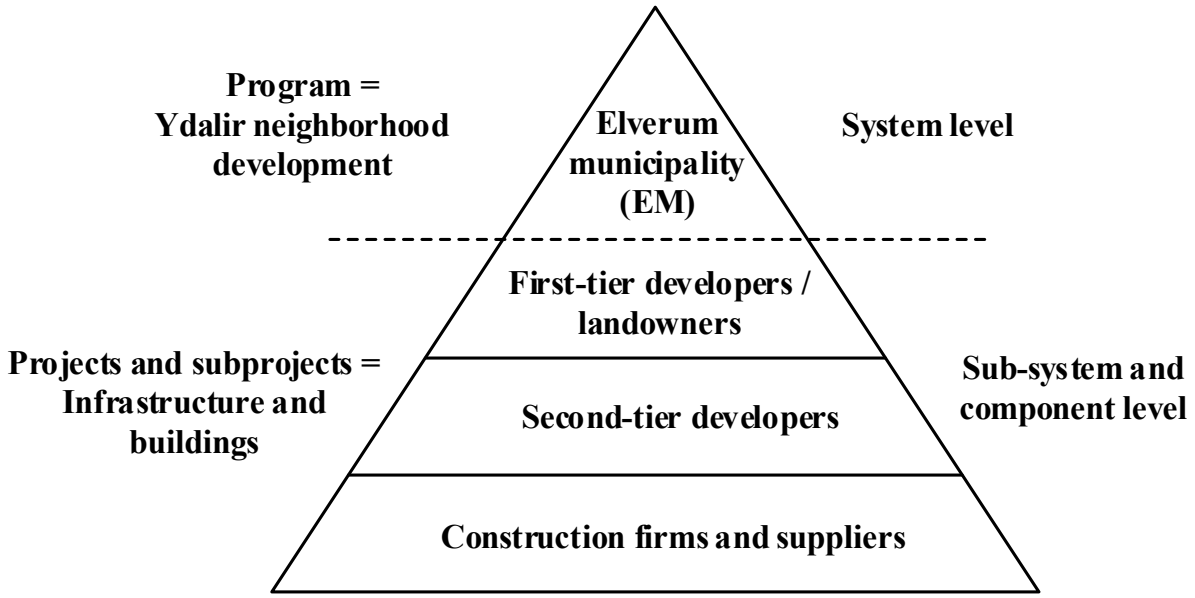

Figure 3. Ydalir architecture: program, projects, and actors. Adapted from [20].

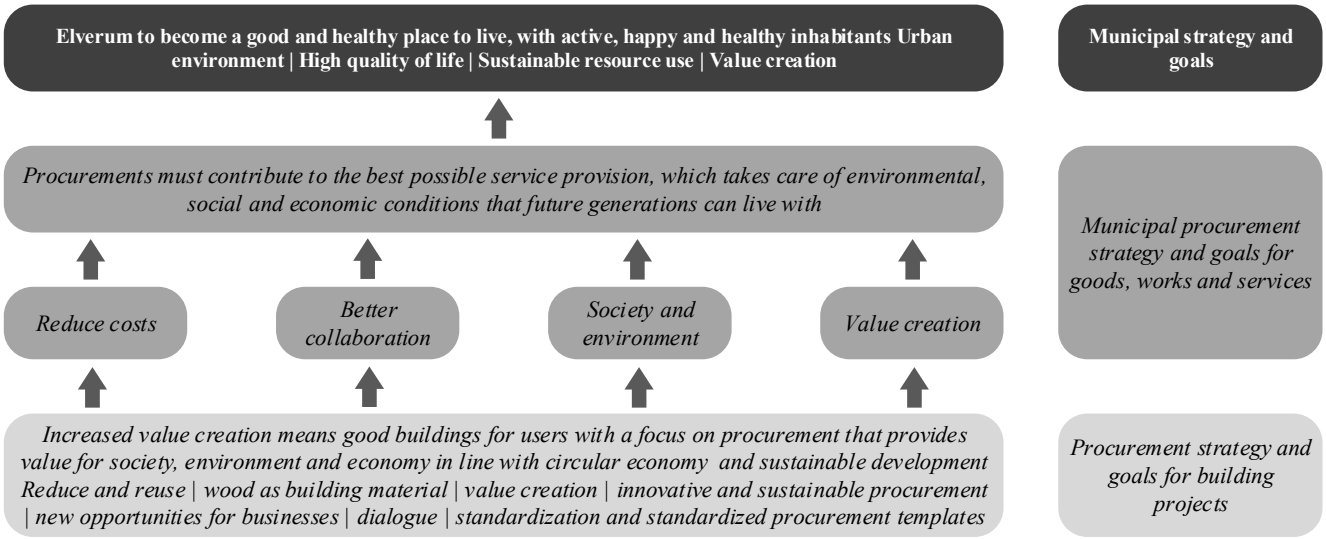

Figure 4. Municipal and procurement goals in Elverum municipality. Adapted from [46].

These actors have different business approaches and value chain preferences (i.e., in-house or outsourcing). ETS is a semi-public development agency, entirely owned by EM, aiming to enable population growth by developing lands for housing and businesses at a reasonable price. It operates as a private entity, assigned with several development tasks, such as infrastructure and land development contracts. Often plays the role of program manager and coordinator on behalf of EM Developer Y is a local real estate developer who focuses on buying lands, developing zoning plans (land use permit), and re-selling real estate to others. In Ydalir, he planned to outsource the development to second-tier developers or sell ready-for-building land lots directly to private individuals who wish to build small houses. On the other hand, developer T is a large real estate developer with an extensive value chain system, covering activities from buying land lots to house delivery. It is important to note that developer T has rejected the masterplan and ZEN ambitions due to incompatible design concepts and cost justifications: "First and foremost, it's about our concept. All our homes are built in a very similar template. If we are going into ZEN then we have to change our concept" (PM-T). Notably, some of their environmental goals seem to be in line with the masterplan: "We will offer solar cells, charging ports for electric cars, bicycle parking, district heating. So, we also have some plus concerning the environment".

Moreover, EM has tried to position them partially with the masterplan through the zoning process: "I can say that I make them take a little more of the same consideration that the master plan will give. We cannot force them to create environmental accounting, and so on. However, a good part of the [masterplan] guidelines, they have chosen to fulfill, but not in such a way that we can say that they are a full-fledged part of ZEN and the master plan" (SPM-EM).

The next level in the hierarchy is the second-tier developers or housing developers who buy land lots from above landowners to build residential projects. These developers vary widely in size and knowledge level: "There are some [developers] who have their own units to build massive wood [construction], others have experience with PV cells and have built passive house buildings before. And others do not really understand this or have no experience with that. So, there are different knowledge levels among them." (GM-ETS). Coming to the last level in the pictured hierarchy is construction firms and suppliers. Some of these developers provide construction and contracting services, while others need to procure construction contracts.

4.2. The Organization of Procurement in Ydalir

In this section, we will present the procurement practices, in particular, between the municipality and developers. The municipal council in Elverum assigns building

and construction projects to departments within the municipality. EM, as a public client, follows EU public procurement to procure building and infrastructure development contracts. Figure 4 outlines the EM's procurement goals and illustrates how procurement contributes to municipal goals: "We use something we call [procurement] strategy for the implementation of construction projects where we have documented in writing how we think and achieve optimal solutions in terms of cost, sustainability, and collaboration" (CPM-EM). Such strategy has also facilitated the use of innovative solutions in projects: "The most important thing we have done in Elverum is that we have created a procurement strategy that forms the basis for the implementation of innovation as an opportunity in all construction projects" (PuM-EM). Moreover, the municipal council can also allocate some projects to municipality-owned organizations (Figure 5).

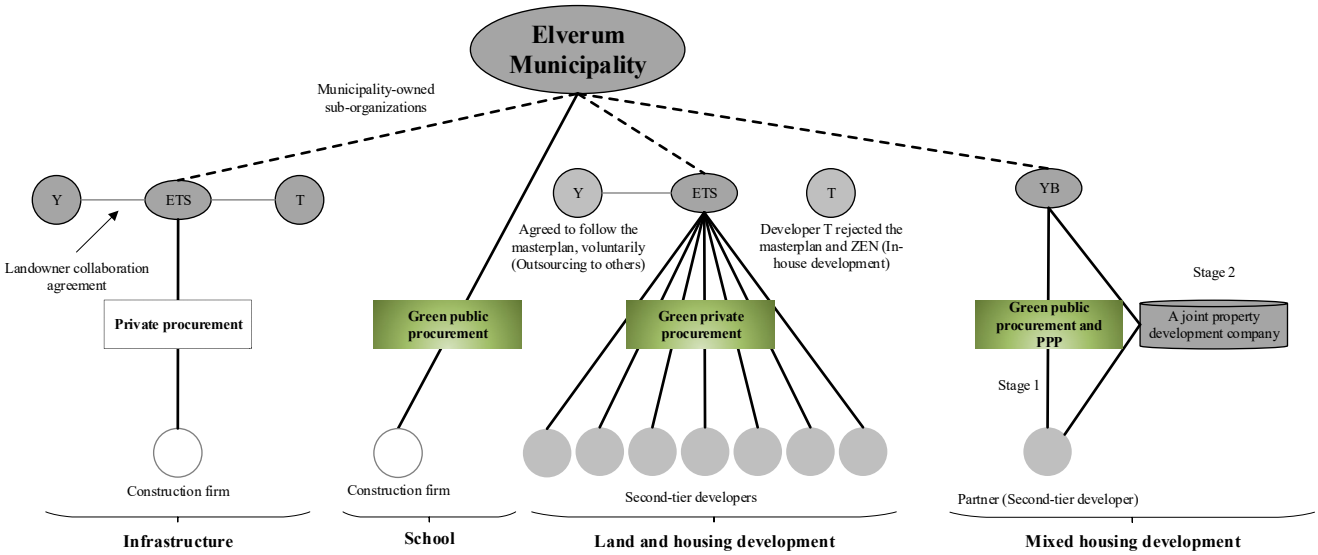

Figure 5. Agreements and procurement paths in Ydalir.

The development process in Ydalir was coupled with an emergent procurement practice, compensating for the lack of a procurement strategy at the neighborhood level (Figure 4). This can be traced back to the nature of the development process of neighborhoods: "The challenge may be that it's not common to do it this way. Usually, you buy land, and you start building. But in Ydalir, there is development work. Many are not used to such a process as it's new for them" (PM-ETS). The conflicting interests between different actors have also made the development work more complex: "different actors with different backgrounds and different time perspectives" (CM-ETS). Another source of complexity can be found in the combination of sustainability ambitions and requirements. In particular, when Ydalir became part of the ZEN center: "but then we have become part of ZEN, and then everything has become a little more complicated, in a way" (PM-ETS). The municipality was aware of such newness, but they saw Ydalir as an opportunity to develop their capabilities and prepare for the future.

Procurement in Ydalir consists of parallel and sequential practices covering infrastructure and building projects of different sizes and durations (Figure 5). Our findings reveal several reasons why the Ydalir program, a publicly-led neighborhood, has different procurement practices. First, program decomposition into projects required several development partners to take on the projects, which then decides the number and variety of procurements. For example, the municipality used public procurement to select a qualified partner in the school project. In contrast, ETS used private purchasing to obtain housing developers. Second, the variety of the procurement practice comes from the temporal nature of Ydalir and different time perspectives, causing the development to decompose into smaller projects over time. It is built in stages, rather than all at once, and projects

are procured and implemented over different periods. Third, the variety of procurement practices was particularly considered necessary to meet each project's specific needs. For example, infrastructure works required construction firms and suppliers with experience in road and water infrastructure projects. In contrast, land and housing development required actors with experience in real estate development. Another important factor that affected the procurement landscape is that the municipality is not the sole owner of the development lands. Two private developers (Y and T) own and control 20% of the development lands.

4.3. The Many Faces of the Municipality

Our data shows that EM has deployed three different involvement modes across Ydalir: (1) direct involvement in the school and kindergarten, (2) indirect (through ETS) in infrastructure and housing developments, and (3) hybrid (through YB) in the mixed housing. We use the term 'many faces' to depict EM's multifaceted presence in Ydalir, including its entirely owned sub-organizations. In the following, we will highlight each involvement mode and its effect on procurement.

First, EM has direct involvement in the school project. This case depicts the conventional role municipalities play when procuring public buildings and facilities with high ambitions. Since it is a municipal project, EM was able to demand high environmental ambitions and requirements throughout the procurement process, including the passive house standard. The outcomes seem to be in line with the masterplan: "I believe they cover most of the requirements. The school will not be delivered with PV cells, but we work with own project for that if you can say. Therefore, it will not be ready by autumn, 2019. It will come later. Otherwise, I think they cover most of the requirements" (PM-EM). Small discrepancies from the masterplan were justified because energy use is different between school and housing projects.

Second, EM presence in infrastructure and land development contracts is indirect, assigning the task entirely to ETS (Figure 5). Our analysis suggests that EM's indirect presence can be attributed to public procurement rules and coordination capacity. EM utilized ETS to avoid dealing with the limitations in the current planning and building laws: "[...] as of today we are an organization that works outside the public procurement rules [. . .] we are defined as a freestanding organization which can operate without adhering to public procurement regulations, or as a private organization" (GM-ETS). That is, local authorities are not allowed to ask for specifications higher than what is mentioned in the current Norwegian planning and building laws: "when carrying out the construction of a building we follow technical regulations and we can't ask stricter than those regulations" (SPM-EM). It is important to note that the current planning and building laws in Norway are very demanding concerning environmental issues and energy requirements, but it is still lagging behind the country's environmental policies and ambitions. Moreover, EM wanted to anchor the masterplan and ZEN requirements in the municipal and zoning plans to seize control over both first- and second-tier developers, as developers must obtain their zoning plans and permits before proceeding with detailed design and construction. However, the current laws do not allow Norwegian municipalities to include some of the requirements in the zoning plans, including the passive house standard and greenhouse gas accounting for transport, materials, and energy consumption, reducing their leverage over developers. "We thought we had the opportunity to make stricter requirements. So yes, we have become aware of this now after the New Year [of 2019]. So, in the last two months, it has been known what conditions and regulations we are allowed to demand in the zoning process" (SPM-EM). Apart from developer T, the masterplan was anchored in contracts between ETS and second-tier developers, and between ETS and developer Y. This obligates the developers to follow the ambitions and requirements mentioned in the masterplan: "if they [ZEN requirements] were not in the contracts, they [developers] would not do it. I believe not" (PM-ETS).

Furthermore, operating like private entities enabled ETS to be more flexible when dealing with developers: "we can work in, let's call it, a more effective way than the municipality can in their isolation setting" (GM-ETS). ETS functions as a complexity-damper throughout the program, coordinating the numerous development activities between actors, following up the projects' performance, and ensuring compliance with the masterplan. For example, ETS has established checklists of key performance indicators to follow up on the various developers (except developer T), based on the masterplan's four central themes: planning, energy, mobility, building, and material use.

Third, EM seems to hold a hybrid position in the mixed housing project. Initially, EM wanted to build 12 social housing units. As a condition to receive financing from the Norwegian State Housing Bank [Husbanken], the bank demanded that these units are become integrated with ordinary housing. EM then thought about expanding the project to cover ordinary housing units, mostly since the land was too big for social housing alone. "So, social housing should be procured through public procurement, but the municipality does not want to build ordinary housing and compete for selling them in the open market. They do not want such a role" (PM-YB). Thus, EM decided to do it through one of its municipal sub-organizations and a collaboration partner taking the ordinary housing part of the project. At first, EM wanted to assign this task to ETS. However, this project lies outside ETS's regular scope, land development. Eventually, EM founded a new sub-organization (YB) to procure a collaboration partner and develop the mixed housing project. Here we see direct involvement by implementing public procurement and indirect involvement by assigning the task to another sub-organization.

Furthermore, we notice that maintaining various involvement modes has improved learning and information exchange between different procurements. For example, much of the experience in the school's procurement process has been copied and reused in the mixed housing project, in particular, dialogue meetings and tendering. It is also interesting to note that the school project's project manager was reallocated from the municipality to YB, transferring with her best practices and experiences learned in the municipality and school project: "she [the project manager] brought us a lot of expertise related to procurement process which we did not have experience with, and her expertise was used consciously in YB" (PM-YB).

4.4. Dialogue-Oriented Procurements

Collaboration between projects was perceived by several informants as positive, especially when sharing infrastructure costs or finding innovative solutions. However, in practice, the collaboration between developers was characterized as inferior. Or, as one developer put it: "we are competitors" (PM-V). Because several housing projects are taking place in parallel and having similarities in their product offerings, developers act as rivals compete to secure specific resources—in this case, home buyers. For developer T, collaboration takes place only with the municipality: "there is no collaboration there. But if we had been within ZEN. Yes, then it would have been different. But as long as we are outside ZEN, we will only cooperate with the municipality" (PM-T). In what follows, we will look at a different type of collaboration and dialogue, namely dialogue opportunities accompanying procurement (Table 2).

Table 2. Overview of project procurements in Ydalir.

Project	Scope	Type	Time	Dialogue	EM Role	Inclusion of the Masterplan's Green Requirements
Infrastructure	It covered roads, waste, water, electricity, and district heating	Private procurement	2016–2019	None.	Indirect	The actual work started before the formulation of the masterplan -no measures are related to climate and environment
School and kindergarten	Design and construction of buildings for school, kindergarten, sports hall, and outdoor facilities	Public procurement	2017–2019	Dialogue meetings/conferences, negotiated tendering, and interaction-based contract model	Direct	The masterplan was under development at the time of this procurement, but it covered many aspects of the masterplan. -zoning plans (i.e., introducing ZEN ambitions) -green ambitions are communicated in the dialogue meeting (e.g., wood as building material). EM introduced Ydalir as ZEN -BREEAM very good as a minimum -energy (i.e., passive house standard) -building and material (i.e., passive house standard, environmentally friendly materials with low GHG emission) -mobility (i.e., facilitates for environmentally friendly means of transport: walking, cycling, and possibly vehicles)
Land and housing developments	Each project includes zoning, design, construction, and sales of housing units. Projects cover 9 different land lots scattered around the school	Private procurement	2017–2030	Five dialogue workshops.	Indirect	Strictly follows the masterplan. It was included and attached to contracts as an obligatory element. -overall planning (i.e., green infrastructure, buried waste systems) -building and material (i.e., passive house standard, environmentally friendly materials with low GHG emission, Environmental Product Declaration-EPD) -mobility (i.e., encourage bicycles and public transport, reduced parking lots, EV charging, car-sharing arrangements) -energy (i.e., passive house standard, solar cells, carbon accounting)
Mixed housing development	Financing, developing, construction, and selling 12 care homes (for younger people with disabilities) and ordinary housing. Shared parking and short-term parking for kindergarten	Public procurement and PPP	2020–2022 *	Dialogue meeting, negotiated tendering process, PPP contract model	Hybrid	The procurement goals and specifications are positioned to be in line with the masterplan -zoning plans (i.e., introducing ZEN ambitions) -green ambitions are communicated in the dialogue meeting -the masterplan was part of the tendering documents

* Expected finish date of care homes.

4.4.1. Land and Housing Development

The new neighborhood is regarded as an environmental frontrunner for EM, the mastermind behind Ydalir. The overall agenda for the program was defined and positioned into the broader EM's strategic objectives. Energy and climate strategies include the use of renewable energy, environmentally-friendly energy solutions, and environmentally-friendly materials. Nevertheless, ETS was uncertain about the environmental ambitions that are best for Ydalir. For example, they did not know what to put in the contracts or what solutions it should involve: "we as a pilot project, contracting become more difficult [. . .] we talked a lot how and in what way ZEN requirements can be included in the contracts" (PM-ETS). This characterizes the early stage of the development with high ambiguity and uncertainty. ETS decided to conduct a conceptual study and masterplan development after receiving a grant from Enova, a public enterprise owned by the Ministry of Climate and Environment in Norway and responsible for promoting environmentally friendly production and consumption of energy. Five workshops over a period of six months (between 2016 and 2017) were dedicated to different aspects of neighborhood development, including user and quality aspects, energy, building and infrastructure, and mobility. "We had a conceptual study phase [...] It was through the workshops where we had collaboration and dialogue. We have dialogue with different actors as needed and set up meetings with different themes" (PM-ETS). Such a process contributed positively to the discussion on how complex sustainability goals can be integrated into neighborhood development: "the process has by far given all the players a common understanding of the challenges and complexities associated with green neighborhood development" [47]. The resulted masterplan structured the neighborhood ambitions and requirements under four guiding themes: planning, energy, mobility, and building and material use (see Table 2). "It was an open process and open discussions and collaboration. Absolutely. The vast majority was over-enthusiastic about the project. But not every developer participated [in the workshops] bought a land, many withdrew really" (PM-Y). Accordingly, developers interested in developing housing projects in Ydalir get a copy of the masterplan attached to their land development contracts from ETS, as an obligation, they have to follow.

4.4.2. The School and Kindergarten

The procurement process of the school and kindergarten project went through several rounds of dialogue with the market. First, a high-level supplier conference was held in 2015 on the county level announcing that new projects are coming with sustainability and energy ambitions (e.g., building with massive wood). Later in the same year, the municipality invited interested construction firms and suppliers for another dialogue conference, before the formal tendering phase: "we had a tendering conference and invited all the suppliers who were interested in tendering to come for information and ask questions." (PM-EM). The dialogue conference was initially arranged for two school projects. The meeting was described as open, where they have a dialogue with the participants. The input from these dialogue meetings was then used to describe the qualification and award criteria in the tendering documents. Next, EM announced the qualification process to select five qualified candidates before inviting them to submit their tenders. During the formal competitive tendering phase, they initiated negotiation meetings with each one of them. The negotiation was more like job interviews, giving them the chance to change or improve their personnel: "we wanted it to be like a job interview. We wanted to verify/check that the key persons mentioned in the offer, who will work as project managers, construction managers, architects, and consultants, have worked together in the preparation and writing of the offer description" (PM-EM).

After the contract was awarded to the selected contractor, the municipality applied a non-traditional contract model that allows for more interaction and dialogue during the project development process. Experiences from supplier and dialogue conferences resulted in the municipality choosing to carry out its first interaction contract. "We call the contractor an interaction contractor. It had a little more contract conditions than the design-

build contract. [. . .] In the contract, we regulate and control which advisors or architects will be used and how the collaboration will occur." (PM-EM). This model gave the project team more room to think comprehensively about the project's solutions and specifications. In addition, they agreed with the contractor to give incentives connected to competencies. The main contractor could choose advisors, subcontractors, or suppliers, that he thinks to have better competency instead of punished for it in price competition. The project was complete (as planned) in the summer of 2019 and recognized as a success: "we have had very few conflicts in the project. It has been delivered within financial limits, and has been delivered five months faster than a normal construction project with sustainability goals" (CPM-EM). EM and the main contractor were awarded the 'Best Procurement Award-2019′ by the Norwegian Digitalization Agency for anchoring dialogue and innovative solutions in the project.

4.4.3. Mixed Housing Development

In 2020, YB launched a two-stage procurement process. The first stage is planned as a negotiated public procurement procedure (similar to the school project) to obtain a collaboration partner with contracting and design expertise. When asked about the reason to choose a negotiated procedure: "we want to discuss the small things rather than the big things, such as reevaluate the price or what roles the various actors will have, but not the big things. There is no negotiation room for them" (PM-YB). Initially, YB invited potential developers and contractors for a dialogue meeting. The purpose of this meeting was to obtain feedback before launching the formal tendering process. In particular, they wanted input on qualification and award criteria, tender evaluation, and documentation requirements. In both the invitation announcement and meeting minutes, it was mentioned that the project would be developed in line with the requirements and ambitions of the masterplan. According to YB, one of the developers emphasized the role of interaction during the project development phase.

Next, YB announced the qualification process to select five qualified candidates before inviting them to submit their tenders. The masterplan was added as an attachment in the tendering process (qualification and competition) of the first stage: "we do not know how this will be received by the market" (PM-YB). In the second stage, the winner partner and YB will enter a PPP agreement and establish a joint property development company responsible for financing, developing, constructing, and selling social and ordinary housing. EM will buy the social housing units, while ordinary homes will be sold in the open market. Notably, the collaboration partner's public procurement process is ongoing at the time of writing this paper.

4.5. Masterplan-Oriented Procurements

The masterplan was critical to understanding the environmental ambitions and requirements necessary to realize Ydalir as SN. Table 2 shows how the masterplan's environmental requirements are incorporated differently in project procurements. Our data suggest that integrating the masterplan into the procurement process is often more complicated than purchasers tend to assume. There may be several reasons for this.

First, the masterplan document is meant for long-term planning, which can be altered based on changing project conditions over time. For example, the masterplan was initially aimed at minimum mobility and parking capacity in the neighborhood area to achieve zero-emission goals. Car use must be reduced to a minimum, and more people should walk or use bicycles or public transports. However, the need to be market-relevant has resulted in a new revision of masterplan to relax the parking requirements, allowing for more places per each land lot: "and then this dilemma came up with developer Y that he could not sell and that those interested in [small housing] land lots said they do not want to buy because they do not have a parking place or garage" (PM-ETS).

Second, at first glance, the masterplan requirements appear as pieces of text that may easily be transferred between various tendering activities. In practice, the environmental

ambitions and requirements allow for different interpretations among actors: "the customers of the future do not care whether the home is a zero-emission or not . . . rather if it is a good and safe place for living there" (GM-N). In the land development contracts, the masterplan was added as an attachment leaving further interpretation for developers. The way developers interpret the masterplan affects how they pass through environmental requirements to other supply chain actors. We also noticed that the school project was more systematic in incorporating elements from the masterplan. In essence, the masterplan appears as a shared repertoire for environmental ambitions and requirements, but translating it into workable procurement requirements turned to be more complicated.

5. Discussion

Our study demonstrates that the complex nature of SN programs can hamper green procurement performance and success at the neighborhood level. By looking at the program and project levels, our results reveal different performance levels in terms of the initial promises of zero-emission goals, confirming that the gap between promises and delivery tends to be wider on complex and larger scales, as underlined by previous research [9,18]. This was evident when the original zero-emission ambitions at the neighborhood level deteriorated due to the failure to reach an agreement and maintain the original mobility and parking requirements, resulting in a new, less ambitious revision of the masterplan. The masterplan was altered several times to reflect the actors' consensus around sustainability goals. While this adaptable feature can be appreciated by actors wishing to relax their sustainability commitments, it poses a challenge to the whole development, driving it away from original sustainability and zero-emission goals. On the other hand, the school project's green procurement provided an example of excellent performance and success. As the school's sole owner and operator, the municipality addressed complex environmental requirements in the public procurement process and worked closely with its partners to ensure delivery. However, reducing emissions and energy consumption in the school alone does not realize the whole neighborhood as zero-emission. This presents a challenge for purchasers and purchasing departments to consider when involved in program scale developments.

Earlier, we referred to the study by Tee et al. [23], who illustrated how decomposition could lead to different trajectories in terms of product and organizational mirroring and, subsequently, different collaboration outcomes. We argue that the decomposition process could also be used to inform and advance green procurement in complex projects and programs. The case findings have made us realize that program decomposition had not been exploited to devise a deliberate procurement strategy at the neighborhood level. In what follows, we propose a conceptual model of green procurement and outline its underlying principles for SN programs (Figure 6). The model's theoretical foundation is based on Simon's concept of nearly decomposable systems and Ashby´s work on how a set of such loosely coupled systems interact.

First, decomposition into smaller (subsystem) projects helps to cope with SN program's complexity [20]. For the entire SN to become stable, each project must attain stability vis-à-vis its local environment, requiring interference between projects to be limited. In the Ydalir case, decomposition factors like zero-emission goals, municipal strategies and zoning plans, shared community solutions, different projects, mixed (public-private) land ownerships, and neighborhoods' temporal nature have made the municipality decompose the program into smaller projects. These decomposition factors and choices have led to specific procurement decisions for different projects, matching the dynamics of the interplay between involved actors, objectives, and time perspectives—particularly decisions about the number of procurements, procurement methods, and degree of centralization. For example, program procurement in Ydalir constituted several decentralized processes replicating the program's internal structure. This decentralized model could be of great value for complex and large-scale developments, especially in the case of multiple land

ownerships, rivalry among developers, and in times of uncertainty to shield some contracts from failure.

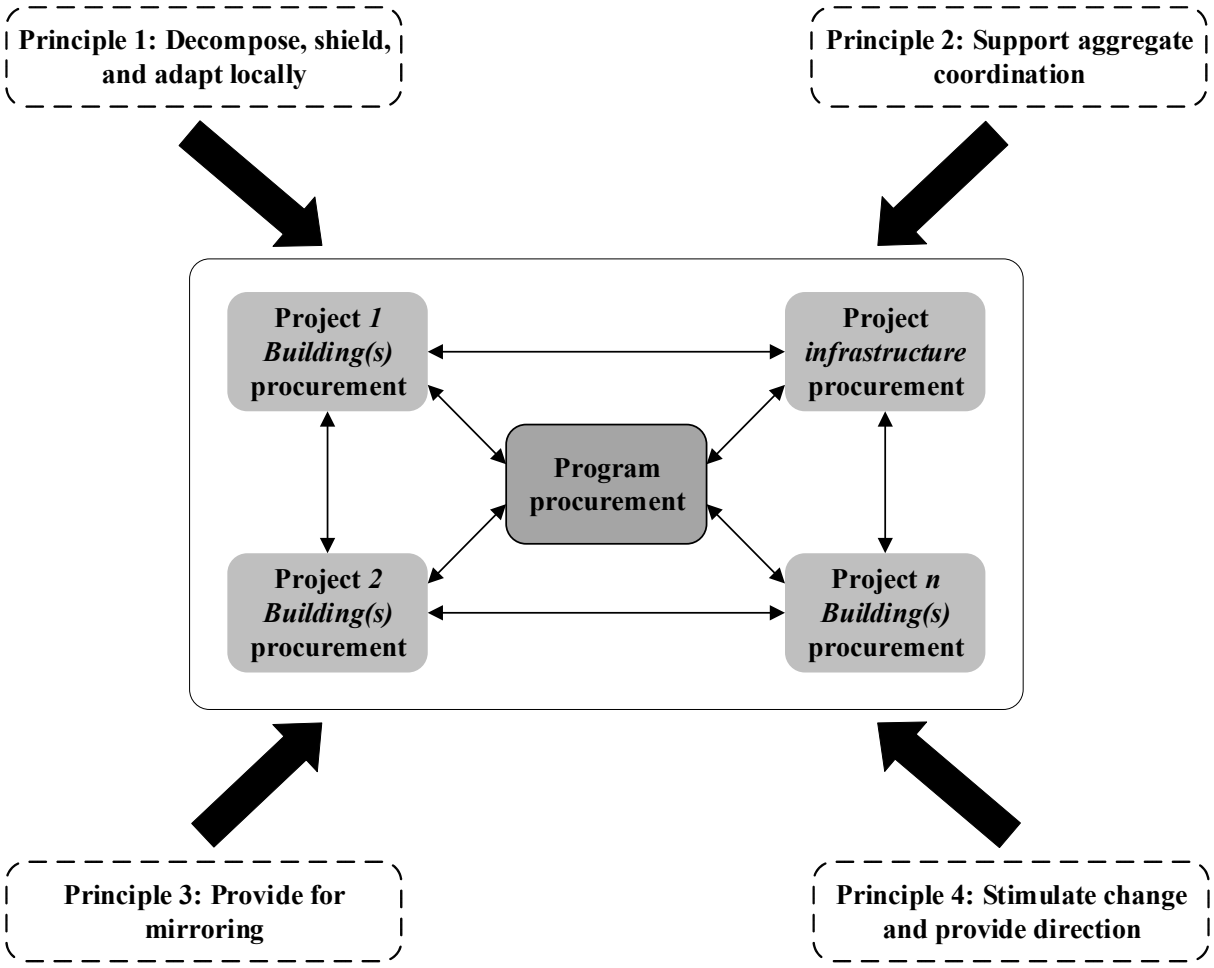

Figure 6. Conceptual model of green procurement for sustainable neighborhood (SN) programs.

Second, there has to be a certain degree of coordination and communication between projects, allowing for harmony at the neighborhood level. Thus, the various project procurement cannot be treated as isolated islands. Previous research shows that projects organized in programs suffer from competition or project rivalries [8], making the job of coordination between projects more challenging in programs. Our findings unveil several procurement levers that can support coordination at the program level. These are infrastructure procurement, masterplans, dialogue opportunities, and the program manager's multiple modes of involvement. Typically, an infrastructure subsystem will physically connect several other subsystems, involved actors will perceive the combined features of the neighborhood, sharing procurement knowledge across projects. Masterplans provide standardized understanding of what green stands for or a coherent set of green [39], guiding and aligning the projects at the program level. Dialogue opportunities helps build a consistent SN understanding across the projects and reduces the number of interpretations associated with the masterplan. Moreover, maintaining various involvement modes reflects positively on learning and information exchange between projects, especially in SNs initiated and managed by public clients with mixed land ownerships.

Third, mirroring the organizational structures with the technical and physical structures provides for suitable module decomposition. For example, the complexity of the development process and challenges associated with building laws and public procurement

have made the municipality create separate organizational entities to establish and develop specific physical parts of the SN job.

Last, but not least, each subsystem must be subjected to pressures towards a common goal, e.g., zero emission, with the type and level of stimuli attuned to each subsystem. For example, a masterplan developed at the program procurement level creates consistency in the procurement criteria used across the projects yet allows for local adjustments at the project level. In this way, program procurement provides the driving force and the overall direction for the entire SN, but catering to different speeds of progress.

In essence, our model points to the vital role purchasers or purchasing departments could play in the development process. While we do not provide detailed design principles, we offer guidance that could help purchasers work systematically with the decomposition and SN program's green procurement. Understanding how decomposition works could help purchasers understand the game's rules and take better procurement decisions that benefit both the projects and the program.

6. Conclusions

We started our paper by observing that the neighborhood scale is crucial for sustainable transition and stressed the procurement role in achieving sustainability and zero-emission goals. The purpose of this paper has been to explore the organization of green procurement and its potential for coordination in SN programs. Overall, our findings suggest a hidden potential for green procurement in SN programs and demonstrate that theory from nearly decomposable research can be conducive to advance our understanding of procurement in complex projects and programs. There are several contributions to this paper.

First, it provides a fresh look at SNs using the notion of program management and the principles of nearly decomposable systems. Combining program management with nearly decomposability principles is particularly novel and can help understand the added complexity found in SNs. In general, the nearly decomposable view helped us realize that the decomposition process could influence the organization of procurement, adding another dimension to green procurement practice in complex projects and programs.

Second, we contribute to the growing literature on procurement to achieve sustainability [12,48]. For years, green procurement research has been focusing on how green criteria and requirements can be addressed in project design and implementation [11,14,15]. This study delivers a different perspective on procurement and presents a novel contribution to the ongoing research streams on green procurement. We propose a conceptual model of green procurement for SN programs (Figure 6), and provide new insights about the organization of procurement and its potential for coordination. Our findings demonstrate that green procurement can create better conditions for coordination in SN programs. Furthermore, this study contributes to advance procurement issues in complex projects, an area that has received little attention in complex product system (CoPS) literature [49], and lays the groundwork for new procurement research focusing on a different type of complexity derived from structural challenges, namely 'structural complexity' [50].

Third, our main practical contribution is that the decision that purchasing departments or purchasers take cannot only be about individual projects when involved in multi-project contexts, such as programs. The need to devise a procurement strategy at the program level seems to be outside the purchasers' regular focus. This finding necessitates the purchasers to orchestrate their procurement processes and decisions between the program and project levels. Hence, purchasers should think like architects to better grasp the various levels and make better decisions in complex projects and programs. The four principles outlined in Figure 6 serve as implications for program managers and purchasers to consider when devising a green procurement strategy for SN programs. This requires from program managers to engage purchasers early on to develop workable and procurement-friendly overarching concepts and masterplans, and thus enables purchasers to play a prominent role in environmental projects and programs [51]. Moreover, previous

research has discussed purchasers' capabilities concerning the complexity of environmental requirements [52]. However, our study informs purchasers about complexity derived from structural challenges. In this sense, purchasers may seek to acquire new capabilities to deal with the variety of tendering and contracting conditions in complex projects and programs [53,54].

This study is limited to a single case, and further research is needed to understand how procurement practices can be designed and implemented to improve coordination and collaboration in complex projects and programs. Although the single case approach was useful in exploring this relatively new phenomenon, a multiple case approach could have benefitted the study in verifying the findings and uncovering new ones. For example, a comparison between a program that adopts a modular structure and a program that adopts an integrated structure could reveal a wider understanding and more generalizable implications about the organization of the purchasing function. Another limitation to the study comes from the long duration of SN developments. Such developments could last for several years and sometimes decades. Whilst difficult to undertake because of the long duration and resources needed, long-term research could be conducive to capture the procurement outcomes and measure their performance in achieving sustainability at the neighborhood level.

In regards to future research, we see two main research avenues. First, we identified 'nearly decomposability' as a promising and potentially rewarding theory for procurement research. As an integral activity in inter-organizational collaborations, procurement deserves attention from the modularity scholars, especially from the advocates of the mirroring hypothesis. Colfer and Baldwin [33] described different mirroring types and recommended strategies, depending on the rate of technical change and the growing complexity (i.e., slowly or rapidly) and the composition of the system (i.e., physical, digital, or both). For example, when technologies are relatively stable, and complexity is growing slowly, mirroring is common and cost-effective for physical systems. While this can be true and beneficial, we still know very little about mirroring and its impact on procurement in projects and programs. This observation warrants further investigation of the decomposition process and the relationship between mirroring and procurement. Hence, we encourage procurement scholars to investigate further how the decomposition process in complex collaborations can influence green or sustainable procurement practice.

Second, research should explore the potentials and risks of using decentralized modes of procurement in sustainable urban development projects, especially in the wake of decentralized energy systems in neighborhoods and cities [55]. For example, designing and implementing the procurement as a group of loosely coupled procurements may help disperse some of the uncertainty associated with the housing market and complex sustainability goals. This could also raise a broader question about the impact of the organization of procurement (whether centralized, decentralized, or hybrid) on sustainability. Vluggen et al. [56] found that hybrid organization of the public procurement function within municipalities seems to impede sustainability. Their study reported that large tenders, responsible for one third of the spend and managed by centralized purchasing departments, were subject to sustainability requirements. Smaller tenders, responsible for two thirds of the total spend and managed by decentralized groups, were subject to less sustainability requirements. Future research, thus, can draw on organizational experiences and insights from public procurement to inform the procurement practice in SN programs.

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References

1. Koch, A.; Girard, S.; McKoen, K. Towards a neighbourhood scale for low- or zero-carbon building projects. *Build. Res. Inf.* **2012**, *40*, 527–537. [CrossRef]
2. Luederitz, C.; Lang, D.J.; Von Wehrden, H. A systematic review of guiding principles for sustainable urban neighborhood development. *Landsc. Urban Plan.* **2013**, *118*, 40–52. [CrossRef]
3. Sharifi, A. From Garden City to Eco-urbanism: The quest for sustainable neighborhood development. *Sustain. Cities Soc.* **2016**, *20*, 1–16. [CrossRef]
4. Grazieschi, G.; Asdrubali, F.; Guattari, C. Neighbourhood sustainability: State of the art, critical review and space-temporal analysis. *Sustain. Cities Soc.* **2020**, *63*, 102477. [CrossRef]
5. Nielsen, B.F.; Baer, D.; Lindkvist, C. Identifying and supporting exploratory and exploitative models of innovation in municipal urban planning; key challenges from seven Norwegian energy ambitious neighborhood pilots. *Technol. Forecast. Soc. Chang.* **2019**, *142*, 142–153. [CrossRef]
6. Shi, Q.; Yu, T.; Zuo, J.; Lai, X. Challenges of developing sustainable neighborhoods in China. *J. Clean. Prod.* **2016**, *135*, 972–983. [CrossRef]
7. Davies, A.; Gann, D.; Douglas, T. Innovation in megaprojects: Systems integration at London Heathrow terminal 5. *Calif. Manag. Rev.* **2009**, *51*, 101–125. [CrossRef]
8. Lycett, M.; Rassau, A.; Danson, J. Programme management: A critical review. *Int. J. Proj. Manag.* **2004**, *22*, 289–299. [CrossRef]
9. Tanguy, A.; Breton, C.; Blanchet, P.; Amor, B. Characterising the development trends driving sustainable neighborhoods. *Build. Cities* **2020**, *1*, 164–181. [CrossRef]
10. Cheng, W.; Appolloni, A.; D'Amato, A.; Zhu, Q. Green Public Procurement, missing concepts and future trends–A critical review. *J. Clean. Prod.* **2018**, *176*, 770–784. [CrossRef]
11. Varnäs, A.; Balfors, B.; Faith-Ell, C. Environmental consideration in procurement of construction contracts: Current practice, problems and opportunities in green procurement in the Swedish construction industry. *J. Clean. Prod.* **2009**, *17*, 1214–1222. [CrossRef]
12. Sterner, E. 'Green procurement' of buildings: A study of Swedish clients' considerations. *Constr. Manag. Econ.* **2002**, *20*, 21–30. [CrossRef]
13. Shen, L.; Zhang, Z.; Zhang, X. Key factors affecting green procurement in real estate development: A China study. *J. Clean. Prod.* **2017**, *153*, 372–383. [CrossRef]
14. Kadefors, A.; Lingegård, S.; Uppenberg, S.; Alkan-Olsson, J.; Balian, D. Designing and implementing procurement requirements for carbon reduction in infrastructure construction–international overview and experiences. *J. Environ. Plan. Manag.* **2021**, *64*, 611–634. [CrossRef]
15. Igarashi, M.; De Boer, L.; Michelsen, O. Investigating the anatomy of supplier selection in green public procurement. *J. Clean. Prod.* **2015**, *108*, 442–450. [CrossRef]
16. Flyvbjerg, B. Survival of the unfittest: Why the worst infrastructure gets built–and what we can do about it. *Oxf. Rev. Econ. Policy* **2009**, *25*, 344–367. [CrossRef]
17. Shenhar, A.J. One size does not fit all projects: Exploring classical contingency domains. *Manag. Sci.* **2001**, *47*, 394–414. [CrossRef]
18. Zamora, E.C.; Carballo, Á.G. The failure of eco-neighborhood projects in the city of Madrid (Spain). *Urban Sci.* **2018**, *2*, 111. [CrossRef]
19. Simon, H.A. The architecture of complexity. *Proc. Am. Philos. Soc.* **1962**, *106*, 467–482.
20. Davies, A.; MacKenzie, I. Project complexity and systems integration: Constructing the London 2012 Olympics and Paralympics Games. *Int. J. Proj. Manag.* **2014**, *32*, 773–790. [CrossRef]
21. Engwall, M.; Jerbrant, A. The resource allocation syndrome: The prime challenge of multi-project management? *Int. J. Proj. Manag.* **2003**, *21*, 403–409. [CrossRef]
22. Brady, T.; Davies, A. Managing structural and dynamic complexity: A tale of two projects. *Proj. Manag. J.* **2014**, *45*, 21–38. [CrossRef]
23. Tee, R.; Davies, A.; Whyte, J. Modular designs and integrating practices: Managing collaboration through coordination and cooperation. *Res. Policy* **2019**, *48*, 51–61. [CrossRef]
24. Gray, R.; Bamford, P. Issues in programme integration. *Int. J. Proj. Manag.* **1999**, *17*, 361–366. [CrossRef]

25. Orton, J.D.; Weick, K.E. Loosely coupled systems: A reconceptualization linked references are available on jstor for this article: Loosely coupled systems: A reconceptualization. *Acad. Manag. Rev.* **1990**, *15*, 203–223. [CrossRef]
26. Glassman, R.B. Persistence and loose coupling in living systems. *Syst. Res. Behav. Sci.* **1973**, *18*, 83–98. [CrossRef]
27. Parnas, D.L. On the criteria to be used in decomposing systems into modules. *Commun. ACM* **1972**, *15*, 1053–1058. [CrossRef]
28. Yakob, R.; Tell, F. Managing near decomposability in complex platform development projects. *Int. J. Technol. Intell. Plan.* **2007**, *3*, 387. [CrossRef]
29. Sanchez, R.; Mahoney, J.T. Modularity, flexibility, and knowledge management in product and organization design. *Strat. Manag. J.* **1996**, *17*, 63–76. [CrossRef]
30. Ashby, W. *Design for a Brain: The Origin of Adaptive Behaviour*, 2nd ed.; Chapman and Hall: London, UK, 1960.
31. Schilling, M.A. Toward a general modular systems theory and its application to interfirm product modularity. *Acad. Manag. Rev.* **2000**, *25*, 312–334. [CrossRef]
32. Campagnolo, D.; Camuffo, A. The concept of modularity in management studies: A literature review. *Int. J. Manag. Rev.* **2009**, *12*, 259–283. [CrossRef]
33. Colfer, L.J.; Baldwin, C.Y. The mirroring hypothesis: Theory, evidence, and exceptions. *Ind. Corp. Chang.* **2016**, *25*, 709–738. [CrossRef]
34. Tee, R. Benefiting from modularity within and across firm boundaries. *Ind. Corp. Chang.* **2019**, *28*, 1011–1028. [CrossRef]
35. Davies, A.; Macaulay, S.; DeBarro, T.; Thurston, M. Making innovation happen in a megaproject: London's crossrail suburban railway system. *Proj. Manag. J.* **2014**, *45*, 25–37. [CrossRef]
36. Hofman, E.; Halman, J.I.; Van Looy, B. Do design rules facilitate or complicate architectural innovation in innovation alliance networks? *Res. Policy* **2016**, *45*, 1436–1448. [CrossRef]
37. Uttam, K.; Roos, C.L.L. Competitive dialogue procedure for sustainable public procurement. *J. Clean. Prod.* **2015**, *86*, 403–416. [CrossRef]
38. Sparrevik, M.; Wangen, H.F.; Fet, A.M.; De Boer, L. Green public procurement–A case study of an innovative building project in Norway. *J. Clean. Prod.* **2018**, *188*, 879–887. [CrossRef]
39. Igarashi, M.; De Boer, L.; Fet, A.M. What is required for greener supplier selection? A literature review and conceptual model development. *J. Purch. Supply Manag.* **2013**, *19*, 247–263. [CrossRef]
40. Alhola, K.; Nissinen, A. Integrating cleantech into innovative public procurement process–evidence and success factors. *J. Public Procure* **2018**, *18*, 336–354. [CrossRef]
41. Edquist, C.; Zabala-Iturriagagoitia, J.M. Public Procurement for Innovation as mission-oriented innovation policy. *Res. Policy* **2012**, *41*, 1757–1769. [CrossRef]
42. Hamdan, H.A.M.; De Boer, L. Innovative public procurement (IPP)–Implications and potential for zero-emission neighborhood (ZEN) projects? In Proceedings of the 1st Nordic Conference on Zero Emission and Plus Energy Buildings, Trondheim, Norway, 6–7 November 2019; IOP Publishing: Bristol, UK, 2019; Volume 352, p. 12013.
43. Yin, R.K. *Case Study research and Applications: Design and Methods*, 6th ed.; SAGE Publications, Inc.: California, CA, USA, 2018.
44. Miles, M.; Huberman, A.; Saldana, J. *Qualitative Data Analysis: A Methods Sourcebook*, 3rd ed.; Sage Publications, Inc.: Thousand Oaks, CA, USA, 2014; ISBN 978-1452257877.
45. Dubois, A.; Gadde, L.-E. Systematic combining: An abductive approach to case research. *J. Bus. Res.* **2002**, *55*, 553–560. [CrossRef]
46. *Elverum Kommune Anskaffelsesstrategi 2020–2023*; Elverum Kommune: Elverum, Norway, 2020.
47. Tomteselskap, E. Konseptutredning Ydalir–Sluttrapport til Enova. 2017. Available online: enova.no/bedrift/bygg-og-eiendom/tema/konseptutredninger/ydalir/ (accessed on 4 May 2020).
48. Meehan, J.; Bryde, D. Sustainable procurement practice. *Bus. Strat. Environ.* **2011**, *20*, 94–106. [CrossRef]
49. Caldwell, N.D.; Roehrich, J.K.; Davies, A.C. Procuring complex performance in construction: London Heathrow Terminal 5 and a Private Finance Initiative hospital. *J. Purch. Supply Manag.* **2009**, *15*, 178–186. [CrossRef]
50. Williams, T. The need for new paradigms for complex projects. *Int. J. Proj. Manag.* **1999**, *17*, 269–273. [CrossRef]
51. Gelderman, C.J.; Semeijn, J.; Bouma, F. Implementing sustainability in public procurement: The limited role of procurement managers and party-political executives. *J. Public Procure* **2015**, *15*, 66–92. [CrossRef]
52. Jenssen, M.M.; De Boer, L. Implementing life cycle assessment in green supplier selection: A systematic review and conceptual model. *J. Clean. Prod.* **2019**, *229*, 1198–1210. [CrossRef]
53. Davies, A.; Brady, T. Explicating the dynamics of project capabilities. *Int. J. Proj. Manag.* **2016**, *34*, 314–327. [CrossRef]
54. Davies, A.; Brady, T. Organisational capabilities and learning in complex product systems: Towards repeatable solutions. *Res. Policy* **2000**, *29*, 931–953. [CrossRef]
55. Orehounig, K.; Evins, R.; Dorer, V. Integration of decentralized energy systems in neighbourhoods using the energy hub approach. *Appl. Energy* **2015**, *154*, 277–289. [CrossRef]
56. Vluggen, R.; Gelderman, C.J.; Semeijn, J.; Van Pelt, M. Sustainable public procurement—External forces and accountability. *Sustainability* **2019**, *11*, 5696. [CrossRef]