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Can We Do More with Less? Analyzing the Organization of Flexibility of Space and Infrastructure at UDCs: A Case Study for Food Center Amsterdam

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Abstract: *Background*: How can flexible applications of the space and infrastructure of urban distribution centers (UDCs) be organized to help lower demands on space and infrastructure in cities? The application of flexible use of space and infrastructure can improve the efficiency of a UDC, but the challenge lies in the organization of the application of flexibility. *Methods*: The goal of this research was to identify how flexibility can be organized to impact overall societal benefits for the stakeholders in UDCs. This explorative and qualitative research was applied to the case of Food Center Amsterdam. *Results*: The results show that stakeholders have a limited understanding of the potential that flexibility can offer; that there is a need for an independent organizing capability and responsibility for collaboration on flexibility; and that a clear way to divide costs, benefits, risks, and opportunities in relation to stakeholder interests is required. *Conclusions*: Overall, flexibility shows potential to improve the efficient use of infrastructure and space. Further research avenues include the initiation of an organizing capability and distribution method for costs, benefits, risks, and opportunities between stakeholders. The remaining question is, can we get this organized in order to do more with less?

Keywords: flexibility; forms of flexibility; flexible infrastructure; flexible space; organizing capability; urban distribution centers

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1. Introduction

The continuous "battle for space" between housing, businesses, public space, etc. in cities puts pressure on existing and new to develop space. This, combined with growing demands for space [1] and infrastructure (such as charging infrastructure for electric vehicles) [2] and developments in the accessibility of cities due to vehicle restrictions in central areas caused by zero-emission zones [3,4], limited time windows for delivery [5], and car-free zones [6], introduce new preconditions for logistics in cities. Urban distribution centers (UDCs), as part of the logistics in cities, require space for their building, operations, parking, etc. With the pressure for space increasing and new preconditions arising, this emphasizes the need for efficient use of the space of UDCs, in order to better deal with the overall battle for space in cities.

A possible way to improve the efficiency of space for UDCs is to apply flexibility in their development and use. Flexibility is defined as "the ability to be easily modified" [7]. It can exist in different forms, such as flexibility of physical infrastructure, management, stakeholders, and goals [8]. Furthermore, flexibility contains elements such as resilience, adaptability, and robustness [9]. This shows that both the form of flexibility and the applied elements can differ, indicating the broadness of the topic of flexibility. Examples of flexibility applications include the shared use of charging infrastructure of electric buses by logistic

vehicles, and the shared use of parking areas between companies during different time periods. As indicated in the World Cities Report 2022, urban spaces are in general not flexible enough [10], which indicates that there is room for further application of flexibility. Since flexibility can have a positive impact on the efficient use of space and infrastructure for UDCs, it could help alleviate a UDC's demand for space.

The scientific literature on urban logistics, hubs, and UDCs is growing rapidly [11–13]. At the same time, the literature on the application of flexibility for UDCs is limited, and an overview of the possibilities of flexibility in the development, use, and management of infrastructure and space for UDCs is missing. Since there is a potential positive societal impact from the application of flexibility for passenger transport hubs [14], this brings up the question of if this is also the case for UDCs. Furthermore, given the number of stakeholders involved in UDCs [15,16] and the importance of continuously updating the understanding and collaboration between these stakeholders [17], a full understanding of stakeholder perspectives on collaboration is needed, in order to build an understanding of the potential of flexibility and its required organizing capability.

The goal of this explorative research was to develop a qualitative understanding of how the forms of flexibility in the use of space and infrastructure of UDCs can be organized for societal benefit. This is given form in the following research question: how can flexibility be organized to impact the overall societal benefits for stakeholders in urban distribution centers? This research gives a qualitative indication of the concept of flexibility and the potential approach to incorporating flexibility into infrastructure development and use for UDCs. Its novelty is in showing how the potential of flexibility can be unlocked in the current approach to space and infrastructure development and use of UDCs.

This research focuses on utilizing space and infrastructure as a dynamic shared space and infrastructure for different goals over the day/week regarding UDCs. The focus is on urban distribution centers as specific hubs, given their presence in urban areas where space is under pressure, as well as their role in reducing the impact of other preconditions (such as bundling freight) [18]. A UDC is defined as "a facility [. . .] that performs consolidation, warehousing, packaging, decomposition, and other functions linked with handling freight" [19]. Within this research, the focus is on UDCs with multiple users and not on single-user UDCs (such as dark stores for fast grocery delivery services). The timeline for the research is set from current to future developments for the period until 2050, to fully take into account any developments and potential changes in demand and supply. The flexibility of the network and/or the full origin–destination of products is outside the scope of this study.

This paper is structured as follows: After the introduction, a literature review of flexibility and collaboration between stakeholders for UDCs is given, from which a framework follows. This is followed by an introduction of the methodology and a case study object. Next, an overview of the results and their analysis is given. The paper finishes with the conclusions.

2. Literature Review

2.1. Aproach to the Literature Review

The literature review focused on the current knowledge about the organization of forms of flexibility for UDCs. The literature was collected using (1) a search on Google Scholar and Scopus for (combinations of) the words "Urban/city distribution/consolidation centers/hubs", "flexibility", "infrastructure/space" and "organizing ability/cooperation/collaboration/stakeholder"; (2) references in the papers found; and (3) authors and papers as indicated by experts. Papers were subsequently selected based on their relevance in regard to the topics. The review was structured by starting with a review on flexibility and subsequently on collaboration between stakeholders on UDCs. This was followed by a framework being derived from the literature review.

2.2. Literature Review of Flexibility and Collaboration between Stakeholders for UDCs

2.2.1. Forms of Flexibility of Space and Infrastructure

Flexibility of space and infrastructure exists in a variety of forms, including flexibility in the physical infrastructure (and space), management of infrastructure, changing goals for space and infrastructure over time, and stakeholder involvement, as indicated for passenger transport hubs [8]. From the perspective of UDCs, a variety of literature related to specific forms of flexibility exist for logistic hubs, including shared space in UDCs [20] and automation in warehousing [21]. These applications of flexibility entail one or several forms of flexibility but lack an overview of the forms of flexibility for UDCs. To fill this gap in the overall view, the forms as identified by Pennings et. al. were further applied [8].

In regard to the application of flexibility in collaborations, limited knowledge on the topic of flexibility and its application exists among stakeholders [8,9,22]. Furthermore, challenges in the integration of flexibility in projects limit its actual application [23]. This hampers its application and shows a gap in the understanding of what flexibility can bring to a project and how it can be applied.

Although the application of flexibility is seen as showing potential for lowering overall societal costs for passenger transport hubs, the challenge lies in the valuation of the added value of flexibility [14]. For UDCs, which similarly to passenger transport hubs are also battling for space, the question is whether there is also added value in the application of flexibility. Decision-making on whether or not to apply flexibility in projects is hampered by uncertainty about life cycle costs [9], the risk of entrenchment [24], and the costs (both financial and in time) in applying flexibility [23]. These elements indicate a gap in the valuation of flexibility and thereby the challenge in the trade-off of its application in projects.

To conclude, the literature shows gaps in the overview of what forms of flexibility exist for UDCs, the limited understanding of flexibility by the relevant stakeholders, and the challenges in the valuation of flexibility for UDCs.

2.2.2. Collaboration on UDCs

Collaboration in the logistic sector already exists in many forms, in order to improve efficiency by sharing available resources (such as warehouse space, vehicle load space, and personnel). This can bring financial, environmental, and social benefits, such as lower costs, less congestion, and lower CO_2 emissions [25,26]. An important aspect of collaboration is that it should bring stakeholders extra profits, greater than the value when a stakeholder acts alone [26]. For UDCs, the literature shows that these can offer overall benefits compared to situations where every party works for themselves [13,15], which indicates a potential driver of collaboration. At the same, limited examples of successful multi-user UDCs exist, which in turn brings the question of to what extent multi-user UDCs are successful in practical application, or whether acting alone provides more benefits. As seen in examples of operating UDCs [13,27], there is a strong dependency on government support and subsidies for these UDCs to continue operating. With growing demands on overall delivery and service levels, expenses can be overcome to create and maintain logistic facilities in urban areas [28], which indicates the potential business case for UDCs, especially in the changing landscape of preconditions for logistics in urban areas. Overall, this shows potential for collaboration on UDCs. It shows that, in theory, much potential is seen, but at the same time the limited examples of successfully operating UDCs indicate that thresholds exist for the development of UDCs.

An essential element in order to make collaboration work is a viable value case (from a combined financial, environmental, and social perspective) and a working business case (from a purely financial perspective). The challenge in sharing (parts of) a logistic chain is that the value proposition is based on collective savings, instead of higher customer prices, which means that investment costs need to be compensated by operational efficiency and positive societal results that do not directly impact the financial benefits [29]. This highlights the challenge in satisfying the financial side as well as the environmental and social side. The challenge with the environmental and social parts is to find a willing stakeholder—e.g.,

local authorities—to pay for these benefits [29]. Different methods such as a business model canvas and business model analysis can help stakeholders in their assessment of decision-making [29,30] and help show whether benefits are financial, environmental, and/or social. Overall, a business model analysis can help to clearly demonstrate the financial, environmental, and social potential of solutions to each stakeholder, but challenges exist in finding a suitable and willing combination of stakeholders to form a beneficial combination. This includes the question of to what level are governments and other stakeholders willing to pay for social benefits while commercial parties can still make a profit. Furthermore, collaboration requires long-term commitment and aligned information and communication between partners [31], which might be in contrast to the short-term needs and agility a stakeholder requires. Overall, these challenges show the need for an understanding of the focus and willingness for stakeholders to invest in these different types of benefits and how suitable solutions can be found to overcome these challenges.

The literature shows a number of challenges for the development of collaboration on UDCs. These include the diversity of stakeholders and their objectives, and potential conflicting and common goals [16,32–35]; the conflicting interests of stakeholders [16,36]; lacking collaboration, the involvement of stakeholders and gaining stakeholder support [15,37]; the difference between the level of maturity of stakeholders for sharing, liability, insurance, transparency, and regulation frameworks [22]; the undefined overall problem owner [32]; the required neutrality of the person managing the process [37]; the timing of implementation [13]; the dispersed costs and benefits [38]; and the division of these costs and benefits between the stakeholders in collaboration [32]. Given the variety of possible challenges for stakeholders in collaborating, the question is which challenge(s) are the main issues hampering collaboration on UDCs and how (and whether) these can be overcome from each stakeholder's perspective. This highlights the importance of investigating stakeholders' interests and needs.

The literature shows possible solutions in a dedicated approach to identifying the value proposition(s) [31], as well as the setup of an agreement between the partners on how to fairly allocate profits gained from the collaboration between stakeholders [26]. These solutions require significant up-front knowledge of unique local situations, which highlights the required effort to make these work. This furthermore requires combining physical, financial, and information flows [13], while this introduces the challenge of the willingness of potential competitors to share information. As can be seen in other sectors—for example, in the case of the construction sector—solutions lie in the authorization of an independent authority to facilitate the collaboration process, acknowledging interdependencies between stakeholders (which requires an holistic view), and creating awareness between stakeholders [39]. Overall, this shows solutions to the challenges in setting up and managing a collaboration, and highlights the need for different parties to make trade-offs. What is of interest here, is what the different stakeholders see as possible solutions to their (and other's) challenges.

For UDCs, the stakeholders involved can include municipalities, city regions, logistic service providers, retailers, user associations, the UDC management, and wholesalers [16,33]. At the same time, the specific stakeholders are case-dependent. Cities can play a key role as infrastructure providers, coordinators for stakeholders to work together for efficient logistics [40], and in allocating costs and benefits [38]. This shows the puzzle of aligning stakeholders with common goals and bridging conflicts of interests to come to collaboration. Overall, this shows the importance of a full understanding of stakeholder involvement, interests, and drivers, in order to set up a successful collaboration and the potential role of a city/government.

A variety of stakeholder management methods exist, based on topics such as engagement, decision-making, relationship-management communication, and innovation [41,42]. In regard to flexibility in UDCs in this research, the focus is on the stakeholder approach, since this contributes to the active integration of the interests of stakeholders [43], as indicated by the challenge in the development of collaborations. From the point of individual

interests versus collective maximum value creation [44], the setting up of stakeholder governance (central to shared) is taken into account, to build on the understanding of the required organizational capability and the preferences of stakeholders.

Overall, this shows the importance of building an understanding of the ways in which collaboration between different stakeholders can be set up for UDCs. A combination of challenges and solutions can possibly be made into a positive business and value case. This requires clear insights into the interests of the different stakeholders involved.

2.3. A Framework for the Application of Flexibility and Its Added Value for UDCs

Based on elements from the literature review, a framework was developed. This framework—as shown in Figure 1—indicates the relations between the assets, stakeholders, and the financial benefits, based on the current situation (approached individually per stakeholder). It furthermore shows the approach to which forms of flexibility are applied in a collaboration between stakeholders for UDCs, with a subsequent influence on the financial, environmental, and social benefits. This shows the starting point for the application of flexibility, with the different forms of flexibility, which in turn sets a basis for a collaboration, with subsequent added societal value.

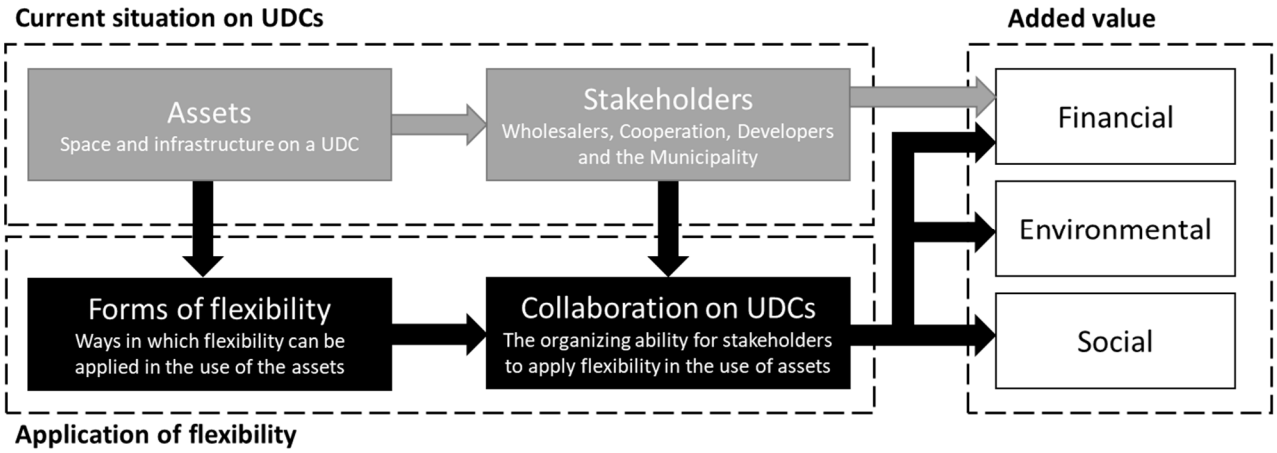

Figure 1. Framework for the application of flexibility in UDCs.

3. Method

This research is aimed at giving a qualitative indication of the concept of flexibility and potential approaches to incorporating forms of flexibility into infrastructure development and use in logistic hubs. A case study is applied, in order to build an in-depth understanding of the processes [45]. This can help analyze what gaps exist and give insights into important aspects of the topic [46]. The information required for this qualitative approach was obtained through interviews with relevant stakeholders. This approach was chosen since it can gather detailed information from different stakeholder perspectives.

The data collection consisted of four steps: (1) the determination of the relevant stakeholder types for the case, (2) the determination of suitable parties and roles to interview, (3) conducting of the interviews, and (4) the analysis of the output of the interviews. This analysis consisted of (i) in-depth thematic analysis of the collected output per interview and the identification of themes, (ii) the determination of common themes between the stakeholders and types of stakeholders, (iii) the identification of similarities and differences between stakeholder's perspective per theme, and (iv) the processing of the information into the results, based on the structure of the framework.

The scope of this research was focused on a single urban hub location with a physical area as a common asset. Food Center Amsterdam (FCA) was chosen as the case study, since (1) it is an existing UDC in an urban area that is under pressure from the demand for space, (2) it has clear transport and data flows for specific products (perishable products),

(3) its users make shared use of limited space, and (4) there is easy access to stakeholders for research purposes.

The case study was based on a set of representative interviews with stakeholders with specific knowledge and experience. To decide on the number of stakeholders, two criteria were used: (1) having at least two interviewees per stakeholder type (as indicated in Figure 1), and having saturation in input from the interviews. In total 17 people were interviewed during the period January–April 2023. Their roles and organizations are indicated in Appendix A. The interviews consisted of an explanation of the case study, the involved stakeholders, and the introduction of the forms of flexibility. All stakeholders were asked to answer the questions from their single stakeholder's perspective.

Based on the framework, the interview questions were classified as

1. What is the understanding of flexibility and its forms?
2. What is the perception of the potential added value of forms of flexibility, both in general and case-specific?
3. What interests do stakeholders have in relation to flexibility applications?
4. In what way can collaboration be organized to achieve the potential value of flexibility?

4. The Study Object: Food Center Amsterdam

4.1. The Context of Food Center Amsterdam

Food Center Amsterdam (FCA) is a physically enclosed (gated) wholesale market for food located in Amsterdam West. It houses approximately 70 companies, supplying retailers, the catering industry, supermarkets, and more. It was established in 1934, further developed over time, and is currently being restructured [47,48]. The restructuring means that part of the area is being redeveloped as a residential area. FCA is located within an area where no extra electricity grid capacity is available, which means that they cannot obtain additional grid capacity on top of their current grid capacity [49]. Overall, it represents an existing urban UDC under redevelopment with certain preconditions. The focus of the research was on the sharing of infrastructure and space, and not the redevelopment per se, although this does offer new opportunities for applying flexibility.

4.2. The Physical Object Aspects of FCA

Regarding the physical development of the business area, this means that the available space will be reduced by approximately 35%, but a similar capacity of business is planned. This implies a more compact business area, with new and up-to-date infrastructure. Figure 2 shows the division of the area into residential and business areas. Part of the existing buildings in this area will be demolished and redeveloped, and part will be retained [50]. Overall, this indicates a growing pressure on available and new business infrastructure and space, all as part of the battle for space in Amsterdam.

4.3. The Stakeholders and Their Relations at FCA

The relevant stakeholders for FCA and their responsibilities are indicated in Table 1, and the relations between these stakeholders are indicated in Figure 3.

The relations between the stakeholders indicate different stakeholder positions, which in turn lead to different interests per type of stakeholder. These different interests can lead to different preferences in the way collaboration is organized and the desired outcome of the collaboration. These stakeholder interests and preferences on how the collaboration can be organized were incorporated into the question list for the interviews.

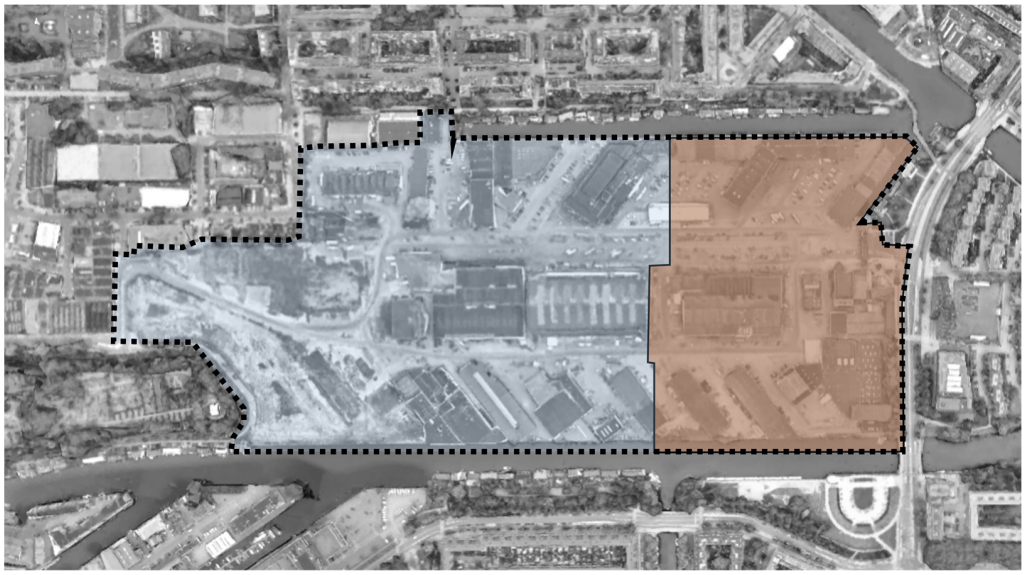

Figure 2. The zoning plan for the FCA viewed from the west. The current area is encompassed by the dotted line, the future business area is in blue, and the future residential area is in orange. Adapted from Google Earth (Map data: Google © 2019).

Table 1. Overview of the stakeholders and their responsibilities.

Stakeholder Type	Responsibilities
Wholesalers (Users of FCA with their own physical location; companies)	This includes major (e.g., BidFood) and smaller companies (e.g., companies in specific perishable goods). These companies are all member of the cooperation. The wholesalers are mainly business-case driven.
Cooperation (Area management: includes both Vereniging Herstructurering and Coöperatie FCA)	The cooperation represents the interests of all (member) companies in the FCA-area and is responsible for the management of the area. It coordinates collaboration on, e.g., collective garbage disposal, collective energy approaches, and charging infrastructure. Vereniging Herstructurering exists to support the wholesalers with the process of the restructuring of the area.
Developer (consortium Marktkwartier)	Developers are responsible for the redevelopment of the area. The consortium Marktkwartier holds the concession. The consortium is a joint venture of Ballast Nedam Development BV and VolkerWessels Vastgoed BV.
Municipality (Gemeente Amsterdam)	The municipality is responsible for public space, land, and transport infrastructure, and is the commissioning party for the Marktkwartier (concession). The municipality is owner of the land of FCA, and part is under leasehold (‘erfpacht’) [48]. Relevant departments of the municipality include Verkeer en Openbare Ruimte, Ruimte en Duurzaamheid, Economische Zaken, Grond en Ontwikkeling, and Deelnemingen. These departments can have different interests, therefore the municipality can be seen as a number of stakeholders. The focus of the municipality has both societal and financial perspectives.

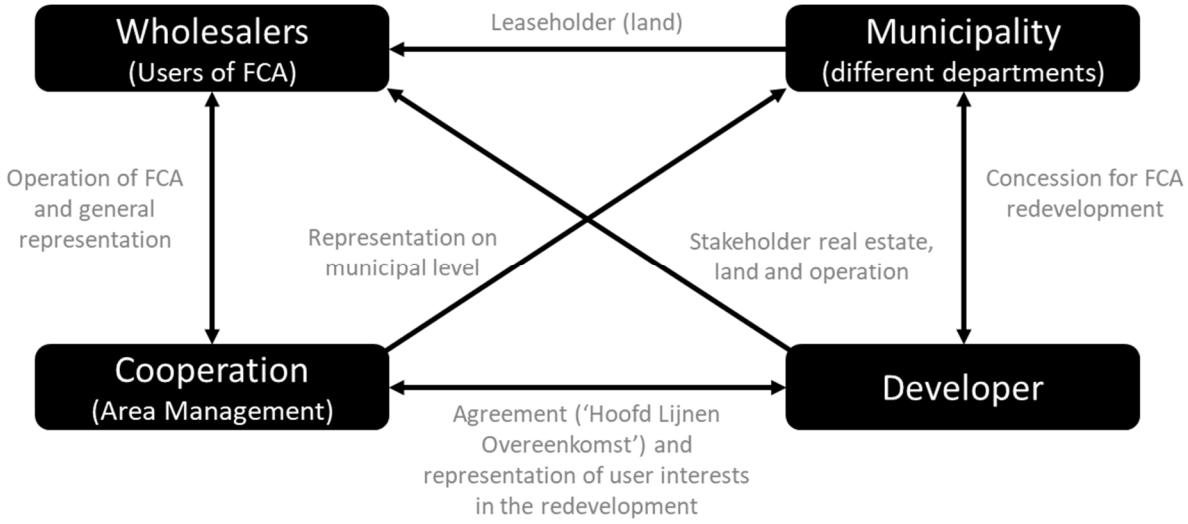

Figure 3. Simplified relations between the stakeholders.

5. Results and Analysis

5.1. Results and Analysis of Organizing Collaboration on Flexibility

In the part below, the main results of the interviews are elaborated and discussed per topic, based on the structure of the framework shown in Figure 1. This starts with the forms of flexibility, followed by the perceived added value of forms of flexibility, the alignment of stakeholders, and the organization of flexibility between stakeholders.

5.1.1. There Is a Limited Understanding of What Flexibility Is and When to Apply It

When asked what applications of flexibility are seen, interviewees indicate shared parking, collective cooling and heating, collective solar panels and energy storage, shared charging infrastructure, and shared space and storage. Based on these four forms of flexibility [8], most interviewees indicated that they see flexibility in the physical domain, and to lesser extent over time and in management. Flexibility of actor involvement was hardly mentioned, and when it was mentioned, it was seen in strong relation to management flexibility. This shows a limited application of the different forms of flexibility. This is not surprising per se, since these forms of flexibility are not generally applied. It does, however, show that—from this perspective of "unknown unknowns"—much potential can exist in making the potential of different forms of flexibility known to the stakeholders involved. Furthermore, the interviewees indicated that path-dependencies and the increased impact of combined forms of flexibility can bring added value. Overall, this shows a lack in overall understanding and overview of the forms of flexibility, which can lead to a bias in decision-making [8,9,22]. With this limited knowledge on, and overview of all, options of flexibility, the application of flexibility is currently hampered. This indicates a need for a better understanding of flexibility by the stakeholders, in order to make appropriate trade-offs in flexibility.

The timing of application of flexibility also has a strong influence on its effectiveness. The interviewees indicated that when initial plans, policies, and (long-term) contract requirements do not give sufficient space for flexibility in the initial stages of a development, this limits the options for flexibility in later stages of a project, where progressive insights into flexibility become visible and applicable. At the same time, uncertainty at the beginning of the project, limits this application. This is in line with the literature [13] and indicates a chicken-and-egg situation. Overall, this shows the strong interlinkages between the different forms of flexibility and the limitations in application due to uncertainty and lack of clarity on where to start.

5.1.2. The Potential for a Value Case for Flexibility Is Seen, the Business Case Is More Difficult

Almost all interviewees saw a strong value case (combination of social, environmental, and financial elements). These drivers were seen as lowering the overall space and infrastructure needed, lowering vehicle movements, and reducing the pressure on the electricity grid, as well as developing a possible showcase for the application of flexibility collaboration in hubs. Note that these drivers all look beyond the area of the UDC. This requires a clear overview of possible costs and benefits, which is currently lacking. As stated by the interviewees, "It is important to have a clear answer on why stakeholders should move from 'what's in it for you?" to "what's in it for us all?" and "we need to go from our focus on optimizing costs to optimizing benefits together".

For the business case, the interviewees indicated that they saw a business case to a lesser extent. As the main reason, they showed a limited understanding of the full potential added value of the application of flexibility, in line with the earlier findings in this research and the literature [14]. This does not mean that there is no positive business case, but it does indicate that an overview for developing one is missing. As drivers for the business case, interviewees saw reductions in costs for the use of infrastructure, storage and distribution, timely access to sufficient electricity grid capacity, and adding value to real estate and land. Challenges are identified in whether the business case of flexibility is more beneficial than other business cases (for example, it might be more beneficial for a real estate party to bring their own business models), in the balance of power between short-term profit and long-term interests, and in changing external priorities and needs over time (for example, when the concession for Marktkwartier was given, the issue around limited grid capacity was far less pressing). This requires a good understanding of costs, benefits, risks, opportunities, and the minimum required stake for each stakeholder in order to participate, in line with the existing literature [32]. This stakeholder mapping could help build a good understanding of each type of stakeholder interest (financial, environmental, and/or social) and thereby find combinations to collaboratively unlock the potential of flexibility.

Overall, the potential of the value case was seen, but for a business case was seen to a lesser extent. This was partly due to limited insights into its actual added value, which in turn highlights the limited understanding of stakeholders about what flexibility can bring. In order to make this more visible, this requires clarity before a project starts on what added value can be attained. This highlights a current lack in the approach towards projects.

5.1.3. A Challenge Lies in the Alignment of Stakeholders' Interests to Come to a Win-Win

In regard to stakeholders' own interests, these showed a range between purely financial to a combination of financial, environmental, and social. Wholesalers saw the continuity of their business as their main interest, which shows a strong financial drive. For the municipality, the interests were more from a social and environmental point of view. Developers indicated the need for a positive business case as their interest, together with the value of their real estate, which also indicates a strong financial drive. For the cooperation, the main interests were the representation of their members and the logistics system, as well as creating and maintaining a positive business climate. This makes this an indirect financial drive. This variety in interests between the types of stakeholders and the potential of conflicts of interests are in line with the literature [16,33,34]. This underlines the importance of building a full understanding of these positions, in order to address the mismatches and motivate stakeholders to collaborate.

In regards to motivating stakeholders to collaborate, a project developer put this as follows: "The biggest value is for stakeholders to understand their interest in adjusting their existing business cases to make use of the potential of flexibility". This understanding is further needed to better understand the trade-off between individual and collective flexibility for each stakeholder. The interviewees saw possible returns for collaboration in lower costs, since the costs would be shared between more parties and with quicker access to limited assets (such as charging infrastructure), but they would have to forfeit part of

their own flexibility. As the main challenges for collaboration, interviewees indicated that each stakeholder focuses on their own interests, has a limited sense of urgency, and does not yet see the value of collective interests, as well as each party having their own beliefs and culture. Furthermore, the trade-off between individual versus collective flexibility was indicated as a challenge, since a stakeholder needs sufficient reassurance and benefits to make the decision towards collective flexibility. The question here is when the collective approach towards flexibility will be positive enough for stakeholders to overcome the risks. A challenge that needs to be overcome is that positive societal results do not directly impact financial benefits [29], therefore introducing a further challenge to make this puzzle fit. The understanding of this turning point is key to finding a balance in the system to realize a win-win situation for all. Overall, this shows a number of thresholds that should be overcome. This indicates the need for a distribution method for financial and societal costs and benefits between stakeholder types with different interests, to come to a win-win situation in the application of flexibility.

5.1.4. The Organization of Collaboration on Flexibility Requires Initiation, Independent Au-Thority, and a Fair Division of Costs and Benefits

When asked about the best way to organize collaboration on flexibility, the interviewees indicated several elements of importance:

First, they indicated the importance of an initiator to start up the collaboration and an independent authority to protect the interests of all stakeholders and to develop and run this collaboration. For the initiator, the interviewees described this role as a stakeholder responsibility and a number of competencies a person executing this role should have. As the most logical party to do this, opinions differed between a governmental responsibility, the existing cooperation, and a combination of users. The argument behind these choices all came from the financial and/or societal responsibilities of each of the parties. For the competency specifics, this required people who are intrinsically motivated and driven to achieve development or change. This was indicated as going further than solely having a role and responsibility. It indicated both the complexity in the fragmented stakeholder field, which is in line with the literature [8], and the specific demands stakeholders had for the actual person(s) executing this role. For the independent authority, the goal is to protect the interests of all stakeholders and to develop and run the collaboration. Some interviewees also indicated that this should be combined with a counsel consisting of stakeholders and independent experts, to protect the continuity of the collaboration and limit opportunism. This is in line with earlier findings for flexibility for passenger transport hubs [8] and further emphasizes the challenge for setting a clear scope for flexibility, as also indicated by the fragmented application of the literature to specific forms of flexibility [23]. The need for a neutral party to take charge is in line with [32,37] and highlights a current missing role within the stakeholder landscape. Interviewee answers on which party should be in the lead varied between the cooperation and the municipality. Arguments for putting the municipality in charge were based on its broader societal and geographical focus. Arguments for the cooperation or single users were based on a positive business case as a driver and the need for the involvement of the members of the cooperation. A possible way to fill this role is by giving a mandate or a concession to a specialized and neutral third party.

Second, the interviewees indicated the importance of maintaining fairness regarding who is going to invest at what time and how costs, benefits, risks, and opportunities will be divided. In regard to setting up the allocation of costs and benefits, most interviewees indicated that this should be coordinated by the municipality, since it sets the rules and regulations, while the executing party could be a different party than the municipality. For the operation, the costs should be paid by the parties who make use of it. This requires that it should bring more benefit to use it than to approach this individually. This motivates the system to keep costs low. The challenge in the dispersed costs and benefits, and the division of these costs and benefits between stakeholders in collaboration, are in line with

the literature [38] and the division of these factors [32]. For the allocation of benefits, the interviewees indicated that the benefits should be used to lower the costs of the service, to keep the service as attractive as possible. Part of the (initial) benefits could go to the party who set this up and took the risk. It was seen as important that the benefits returned back to the users. One way to achieve collective buy-in of flexibility would be to get the involved stakeholders to put skin-in-the-game by investing in the initiation. However, this relies on a widening of the scope of responsibilities of the stakeholders involved, which of course would introduce its own challenges.

Furthermore, as other elements of importance, the interviewees indicated the importance of setting clear goal(s) together, clear agreement on the collective way of working, and clarity and commitment on the rules and regulations from the government. Overall, this is in line with the expectations from literature [16,31,33,34,36,39]. This highlights the complexity of the puzzle to deal with the broad variety of preconditions, since it requires both stakeholders to align their goals, a long-term commitment, and clarity from the government on rules and regulations.

Challenges for the feasibility of a collaboration were seen in the required number of parties in the collaboration. As questioned by one interviewee: "does flexibility need to fully involve all stakeholders or will a combination of a smaller number relevant partners work better?" The interviewees indicated the risk of smaller collaborations forming between users, with possible consequences for other users such as not receiving enough charging infrastructure in time for the application of the ZE-zone. To counter this fragmentation, several interviewees emphasized the importance of involving all stakeholders and that this could be handled through a collective approach. This would require the participation of each stakeholder.

Overall, the lack of full ownership and a clear collective goal limits the potential for organizing ownership to add more value. This shows the complexity of developing an organizing capability to setup a collaboration on the application of flexibility. It is recommended to build further understanding on how to initiate collaboration between stakeholders in collective value and business cases in complex multi-stakeholder environments in relation to flexibility.

5.2. Reflection on the Case and Its Added Value

Currently limited flexibility is being applied in the FCA case. Although with the redevelopment there is much potential for further collaboration by sharing infrastructure and space, the question remains whether this will happen and to what extent. The way this will be organized is still unclear, although different options exist and some are partly in place. The case study showed a complex situation, due to the redevelopment of the area. In the interviews, it was already seen that, when flexibility is applied, this is expected to mix with other discussion points in relation to the redevelopment, thereby enlarging the discussion. The complexity of the issues facing users might overwhelm them, which leaves no or limited capacity to also initiate a collaboration focused on flexibility. An exception is where flexibility can help directly solve existing issues. This raises the question of whether the addition of flexibility will help or disturb the redevelopment process.

An added value of the case study is in giving a real-life picture of the application of flexibility in an environment with a wide variety of stakeholders, each with different interests and as potential competition for each other. This shows the potential struggle in aligning stakeholders in common interests and similar timelines, while at the same time proposing changes in their way of working. Although this case is not seen as the standard situation of UDCs, it does give an in-depth picture of the challenges ahead for applying flexibility to existing UDCs, with their own unique setup, challenges, and opportunities. One question that arose here is whether the benefits and opportunities of flexibility will outweigh its costs and risks. Flexibility is not a goal in itself but a means to an end, and it is important to keep this nuance in mind.

Since the case study was based on interviews, there was potential weakness due to the potential bias in the actual relationships between stakeholders [45]. In total, 17 interviews were conducted with a variety of stakeholders. The number of interviews was decided through having at least two representative stakeholders per stakeholder type and for achieving saturation of interviewee input. Although this number was seen as sufficient for explorative and qualitative research, it indicates limitations in the robustness of the case study. For validation of the research, it can be seen that much of the findings were topic specific, in line with the existing literature. Given the context-specific and explorative nature of this research, this also indicates the limitation of the case study in extrapolating its findings to general cases.

6. Conclusions

The main question in this research was how can flexibility be organized to impact the overall societal benefits for stakeholders in urban distribution centers? The research showed, for the case of Food Center Amsterdam, that this requires sufficient understanding by stakeholders of what flexibility is, in what forms it can be applied, and what added value it can bring. The main points of attention in making this work are seen in how to initiate a collective business and value case in complex multi-stakeholder environments, and the need for a distribution method for the financial and societal costs, benefits, risks, and opportunities between stakeholders with different interests, in order to come to a win-win situation in the application of flexibility. This requires a party to initiate and take ownership of the overall opportunity of applying flexibility, which in turn highlights the need for a new and neutral organizing capability. The case study showed a strong resemblance to specific findings in regard to collaboration between stakeholders [16,33,34]. It showed that, as long as an overall responsibility in facilitating the application of flexibility is not taken by a party, the solutions remain limited to known applications, leaving a vast area of opportunities to make better use of space and infrastructure untapped. This, in turn, can hamper relevant transitions, such as the one toward zero-emission vehicles, and negatively impact the business and value cases of the different stakeholders involved. This shows the novelty of this research, since it highlights the potential of applying flexibility, but at the same time indicates the limitations in the current approach towards space and infrastructure development and use for a UDC. Although this explorative research focused on a single case, its findings are relevant for the application of flexibility to UDCs in general. This leaves the questions of to what level the application of flexibility can be brought into practice on UDCs in general, and who is going to take the lead to do this? With the growing pressure on space and infrastructure, it is clear that flexibility can help us to do more with less.

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Appendix A

Table A1. Overview of the interviewees for the FCA case study.

Interviewee Type	Organization	Role
Users (Companies present at FCA)	Bidfood	Branch Director
	Jan van As Vishandel	Director
Area management	Vereniging Herstructurering FCA	Chairman
	Vereniging Herstructurering FCA	Former coordinator negotiation and planning
	Coöperatie FCA	Project lead
Municipality	Gemeente Amsterdam, Verkeer & Openbare Ruimte	Strategist
	Gemeente Amsterdam, Economische Zaken	Spatial economic advisor
	Gemeente Amsterdam, Programma Logistiek	Senior advisor logistic hubs
Developers/advisors	Intospace	Project manager CLIC
	STEC Groep	Director
	n/a	Development Manager
Transport Authority/Metropolitan Region Amsterdam	Vervoerregio Amsterdam/Metropoolregio Amsterdam	Network director
Knowledge Institutes	Hogeschool van Amsterdam	Professor in City Logistics
	Hogeschool van Amsterdam	Lector/Researcher Food Logistics
	BUAS/TNO	Lector/Senior Scientist
Experts	ALICE	Director
	Leen Menken Foodservice Logistics	Founder/Advisor

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