Citizen engagement with waste management processes, future-oriented or misplaced concepts together?

A Dutch case study about citizens perspectives living in newly developed high-rise rental apartment complexes, what their view is on citizen engagement with waste management processes in their living environment

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Colophon

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Executive Summary

Decision-makers like municipalities and experts are active and steering stakeholders of household waste management processes. What these processes lack is the engagement of local actors like residents. Therefore, this research aims to understand the obstacles and perspectives of residents involved with waste management processes in their living environment and the integration of citizen engagement in the waste policy domain. Therefore, the question is how municipalities, waste collectors and project developers can adapt the current waste management process by incorporating a citizen engagement process with new urban planning projects. This research focuses on newly developed high-rise apartment complexes in Delft. The subject is analysed through a single case study of the 'Volt' complex in Delft. The theoretical framework integrates two theories: the policy arrangement of Tatenhove et al. (2000) and the Social Practice Theory by Shove et al. (2012). Data is retrieved from scientific publications, project documents, semi-structured (expert) interviews with the municipality of Delft, the waste collecting organisation, project developers and residents of the complex. Additionally, residents shared photos of their daily obstacles with the system. The Volt residents indicate that the current system is not harmonised with the users, leading to a flawed waste management system. Moreover, insufficient information is provided about the waste management system, which means the residents are responsible for understanding the system by themself. Because the initiative rests with the residents, the residents' confidence in the system and its administrators decreases. To improve this trust and make it more transparent for residents, residents attach significant importance to an engagement process to get more information about the system and the impact of their actions. The experts are in line with this. However, for them, the difficulty is in dividing roles per party. Who is responsible for informing and involving residents in the waste management process? There are opportunities to insert the information and engagement procedure in the residential app created by Area of People. Furthermore, after this study, the main recommendation is to investigate the specific role division of all stakeholders regarding the information and participation process for the residents living in such complexes. The most critical limitation is the size of the case study and research samples. One single case study with few respondents cannot make statistically relevant conclusions. Even though this was not the aim, it is still valuable to address and underline how this affects the data and conclusions.

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List of abbreviations

ABBREVIATION	MEANING
AOP	Area of People
OAT	Underground Waste Transport System
OPK	Old paper and cardboard
PMD	Plastic, metal, and beverage packaging
PAA	Policy Arrangement Approach
SPT	Social Practice Theory
WM	Waste Management

1. Introduction

This chapter provides the introduction. Paragraph 1.1 describes the research context on citizen engagement and Waste Management (Hereafter WM) processes in urban districts. Next follows the research aim and questions. Paragraph 1.3 provides this study's scientific and societal relevance, and paragraph 1.4 provides the report reading guideline.

1.1. Research context

The awareness of the importance of considering all stakeholders with WM processes is rising. Residents are non-ignorable stakeholders in daily WM processes (Garnett & Cooper, 2014). However, decision-makers like municipalities and experts are still the most active stakeholders who lead and steer WM processes and systems (Prendeville, Cherim & Bocken, 2018). Nevertheless, public awareness is WM's most desirable driving factor, rather than public health, resource scarcity or climate change. However, WM systems are often established with new construction projects at the end of the design phase, leading to a short consultation phase for external stakeholders like residents. This is indicated by a project developer from Kondorwessels, as she is saying that residents are not involved or informed about the type of waste system in their living environment (H. Luijt, full interview transcripts are presented in research data files, February 3, 2022). The process misses the engagement of local actors like residents (Prendeville et al., 2018). As a result, the systems lacks the coordination of the users, leading to misfitted waste systems. This is a missed opportunity in the process because there is sufficient time in the design, implementation and user phase to involve these actors.

This research area is vital as Dutch citizens have become wealthier, citizens can afford more products leading to increasing household waste. Not only the amount of consumption has changed, but also the type of consumption is different. Furthermore, products have a shorter lifespan or are for single-use and disposable purposes (Malinauskaite et al. as cited in Rusman, 2020). This transition leads to environmental and social challenges at different policy and organisational levels, including WM structures and systems (Rusman, 2020; Shmelev & Shmeleva, 2009). Next to the production and consumption of waste, there is another growing element in cities. The growth of cities is partly due to the increasing demand for available and affordable housing, leading to the transition of high-rise rental apartment complexes as the new way of living. However, various studies show that high-rise apartment residents are poorly concerned with the well-being of their living environment and do not separate their waste compared to other living environments (European Environmental Bureau, n.d.; VANG, 2020). Poor waste separation behaviour in high-rise rental apartment complexes has been an international issue for a long time, with various studies trying to improve this WM behaviour (VANG, 2020).

A study is conducted in the municipality of Delft to differentiate the waste separation behaviour from standard housing types compared to high-rise rental apartments. In 2013, citizens living in standard houses had an average above 65% waste separation. High-rise rental apartment residents had lower than 45% waste separation of all household waste (Mantes, 2015). The government tries to increase this waste separation percentage yearly to meet the European requirements and objectives (VANG, 2020). To meet the objectives of the EU Circular Economy Action Plan, Dutch public parties changed their vision by prioritising the quality of waste flows over the quantity of waste collection (VANG, 2020). Therefore, in 2014 Dutch public parties joined forces to arrive at concrete actions to increase the waste separation behaviour of residents of high-rise apartment complexes. Subsequently, the Ministry of Infrastructure and the Environment, Rijkswaterstaat, the VNG and the NVRD initiated and drafted the Household Waste Implementation Program, referred to as 'From Waste to Resources' (Van Afval Naar Grondstoffen - VANG) (NVRD, 2019; VANG, 2020). This implementation program aims to stimulate, motivate and facilitate stakeholders in the chain, with the municipality as the central stakeholder. The program consists of four action lines, one of which is about motivating residents to contribute to waste separation (NVRD, 2019; VANG, 2020). Many Dutch municipalities are ambitious in this regard and increasingly see the need for suitable raw materials management from an economic and ecological point of view. Large cities such as Amsterdam, Utrecht and Rotterdam are already performing well, but there is still room for improvement in smaller urban municipalities, such as the Municipality of Delft (NVRD, 2019; VANG, 2020). The question is, therefore, how public parties such as the small-scale municipalities and waste collectors, in combination with private parties such as project developers and housing corporations, can change the current WM process to create a waste-minimising living

environment in consultation with citizens. With this focus, the study is a case study of a residential complex in Delft where WM processes are studied without incorporating a citizen engagement process.

1.2. Research aim & questions

Research to date has not yet empirically researched how Dutch residents from rental apartments in high-rise complexes deal with WM processes without incorporating a citizen engagement process. Therefore, this contribution aims to understand residents' obstacles, perceptions and practices of their WM behaviour and if the current system and process influence their WM practices. A secondary purpose of this paper is to research leads in the policy arrangement to insert a citizen engagement process in the design of the WM system. The objective is that this insight can be used as a starting point for small-scale Dutch municipalities like Delft and urban planners to improve the engagement with residents from newly developed urban districts and increase the quality of waste streams in high-rise apartment complexes. This leads to the research question: *'How does the waste management process function in a newly developed high-rise rental apartment complex without incorporating a citizen engagement process, and what are the lessons from the Volt complex for new development plans?'* The following sub-questions are formulated to answer the research question:

1. What are the (in)formal waste management and participating procedures of the Volt complex?
2. What is the residents' interaction with waste and discourse on the current waste system and participating procedure?
3. What are the prognostic discourses of the residents and experts on the current system and procedure?

1.3. Societal & scientific relevance

Scientific research increasingly emphasizes the relevance of local governance procedures, including citizen practices (Mattijssen et al., 2019). To explain and predict the sustainable behaviour of citizens and to inform policymakers, various behavioural models and frameworks have been developed, such as the Com-B model, the Triad model and the Fogg's Behaviour Model (Fogg, 2009; Poiesz, 1999; van Stralen & West, 2011). The Social Practice Theory (hereafter SPT) also belongs to a theory of understanding the practices of citizens (Shove, Pantzar and Watson, 2012). From a different perspective, the theory of the Policy Arrangement Approach (hereafter PAA) looks at actors and structures surrounding a policy arrangement (Tatenhove, Arts & Leroy, 2000). The SPT and the PAA are both still under development and benefit from further methodological and empirical development. The field of citizen engagement processes can give both theories the expansion they currently miss independently. Both theories can investigate connections that play a factor in the residents' willingness to engage in citizen engagement processes with WM (Knickmeyer, 2019). Where do policy arrangements lack the insight or integration of citizens' practices in the field of WM, and where does practical theory misses the organizational structure of the policy arrangement initiated by policymakers? Focusing on just one theory when examining citizen engagement processes leads to a misleading answer to why citizens participate in a particular process. Therefore, integrating the theories can lead to insight into the (inadequate) performance of a citizen engagement process (Bertens, 2021; Raats, 2021; VANG, 2020). As a result, this research will broaden the theory of Van Tatenhove et al. (2000) and van Shove et al. (2012) by focusing on citizen engagement processes in which the theories are empirically evaluated and extended in the field of WM.

In Western societies with fast-growing urban areas, there is a demand for citizen engagement with urban planning processes in which the interest in short-term solutions in the environmental policy domain should decrease (Khan & Islam, 2017; Rathi, 2006). At the macro level, it is crucial to evaluate new developments in neighbourhoods, cities, and other spatial scales to provide policymakers with feedback on the robustness of innovations and policies (Ghisellini, Cialani & Ulgiati, 2016). Moreover, involving citizens can lead to better identification of problems, insight into idiosyncrasies and discovery of the obstacles that hinder achieving sustainable processes at the local level. It can be an innovative way to define appropriate solutions for specific problems and increase the chance of actual implementation of innovations. The social relevance of this research is that the specific case in Delft can provide the municipal WM system a reflection on how the current policy and the associated system work out in practice. This case can show why the current policy process does not work sufficiently without the engagement from its residents (Shmelev & Shmeleva, 2009). Moreover, through the

integration of the SPT and the PAA, the study provides different stakeholder perspectives and visions for a new procedure by organizations such as the Municipality of Delft, waste collectors such as Avalex, and housing associations such as Amvest (Obersteg, Arlati & Kneeling, 2020). As a result, this insight can serve as a starting point for public and private parties to improve the relationship with citizens and to involve them in the WM processes in their living environment. Furthermore, since the Volt complex is a small part of the large urban development plan, 'Nieuw Delft', it provides lessons in plans where there are still opportunities to incorporate citizen engagement processes like the projects in Nieuw Delft and 'Kabel district'.

1.4. Outline

Chapter 2 provides a literature review on the concept of citizen engagement. Chapter 3 describes the theories of the SPT and PAA and the integration of both theories and the conceptual framework. Hereafter, chapter 4 describes the methodology with the research strategy, the sampling method, and the data gathering and analysis method. At the end of this chapter, validation and reliability are described. Chapter 5 describes the case study's findings, which are later theoretically evaluated in chapter 6. Therefore, in this chapter, the research questions are answered. In the end, in chapter 7, the conclusion is provided, including the recommendations, discussion and reflection of this research.

2. Literature

This research contains literature on the concept of citizen engagement. Therefore, first follows a general explanation of the concept. Hereafter, principles and factors that are important in initiating a citizen engagement process are described.

2.1. Citizen engagement

Citizens are influential actors with valuable information and resources to contribute to a resilient community. Recognizing citizens as the community's most valuable resource unleashes creativity and recognizes collaboration as the critical catalyst to innovative communities. Therefore, citizen engagement has become an essential consideration in urban planning processes. It has shaped governance structures such as co-design and co-production (Mees, Uittenbroek, Hegger & Driessen, 2019). With the emergence of new governance structures, there is a shift of responsibility for public goods and services from government organizations and businesses to citizens. The waste policy domain is an example of an emerging public policy area encouraging citizens to take responsibility for the associated processes. The shift of responsibility means a difference in the division of roles of public parties, from regulating and steering to a cooperative, responsive government. It enables leaders of organizations and governments to accept the role of facilitator, supporter and collaborator, enabling them to integrate the voice of citizens in the process (Aylett, 2013; Mees et al., 2019). Citizen engagement enables citizens to play a meaningful role in the deliberations, discussions, decisions and implementation of integrated WM projects and programs that affect them. It allows them to learn the complex dynamics associated with the design and use of a technical system, giving them a better understanding of the system and increasing their likelihood of accepting new innovative solutions. Moreover, using local knowledge from diverse groups creates practical and effective solutions for each type of living environment (ITF Waste Workgroup, 2017; Shukor, Mohammed, Sani & Awang, 2011).

There is no fixed definition which can clearly describe the concept of citizen engagement because many researchers interpret the goal of the concept with different views. The concept can be linked to all forms of 'citizens and public participation' elements (Shukor et al., 2011). What this research uses as a guideline is the definition of The ITF Waste Workgroup (2017) as "Citizen engagement is the process of building relationships between public and private parties with citizens to work together for the long term" (p.5). In other words, building a coalition of support for integrated WM policies, programs and service issues to protect the environment and care for the community. It encompasses a wide range of interactions between government and community, ranging from information exchange to consultation, thinking along, and in some cases, active participation and investment in decision-making processes (ITF Waste Workgroup, February 2017; Sanders & van Timmeren, 2016; Shukor et al., 2011). Passive forms of engagement are thinking along in which citizens reflect, advise and support government initiatives. Active forms of participation are investing time in the project, where citizens take responsibility for initiatives related to the project (Sanders & van Timmeren, 2016).

Citizen engagement processes have four principles which are essential to a good process. The first principle is integrity. The process must be transparent and have a clear purpose and scope. Inclusiveness is the second principle, where engagement must be accessible, balanced and encompassing a complete set of values and perspectives. The third is dialogue, where engagement opens an honest discussion between all stakeholders. The last principle is influence. Therefore, the outcome of the engagement process must be reflected in the results. Citizens must be able to see and understand the impact of their involvement (ITF Waste Workgroup, February 2017).

2.2. Citizen engagement processes factors

To initiate a citizen engagement process, it is location specific which factors can influence the number of involved citizens. It depends on the type of resident, region, culture and acceptance of the community (Shukor et al., 2011). However, studies have examined common factors that can be generalized to each type of community. These factors are intertwined and have a unique relationship as they can influence the success of other factors (Shukor et al., 2011).

The first factor to consider is to embrace participation and to give citizens the feeling that they are welcome in the process and can have a form of ownership. According to Reid (2000), people feel welcome by an open form of introduction. In processes in which people do not get the feeling that they

are welcome, few people want to contribute. Welcoming participation requires opening the process to newcomers and inviting their active participation in the project in question. Additionally, by providing them with a sense of ownership, communities have the power to have a voice and can invest their time and interest in the process. Hence, it is not easy to have community willingness when they do not feel welcome or have ownership in the WM process (Reid, 2000). The second factor is the cooperation and partnership between the community and initiators. Many researchers agree that collaboration or partnership between the community and initiators is essential to the success of participation (Reid, 2000). All information and activities should be transparent, as the community will be more open to participating in transparent and fair cooperation. A third factor is the communication between stakeholders. Effective communication can develop a broad understanding of a problem among community members. Through clear communication and better understanding, the community will see that a performed project or service will benefit them, which leads to a feeling of responsibility to participate in the project (Shukor et al., 2011; Xiao et al. 2017). Two-way communication is also vital as it identifies conflicts and limitations. The increase in community awareness of the subject is related to this factor. When a strategic communication plan is in place, it enables the community to understand the problems, cause and effect, and expand their role in household WM (Sanders & van Timmeren, 2016). The last factors are information and knowledge. Opportunities to involve people in local environmental issues must provide understandable and meaningful information to ensure successful participation. People need information that allows them to understand the goal of the project and potential opportunities (Shukor et al., 2011; Xiao et al., 2017).

Once the principles and factors of the process are mapped, different methods can be applied to approach citizens. Methods that can be used for any community engagement process are 1) display via posters or signs; 2) newsletters; 3) hotlines; 4) web-based announcements or social media; 4) public exhibitions; 5) surveys and questionnaires; 6) public meetings; 7) interviews 8) open day sessions; 9) community fairs or events; 10) workshops; 11) waste audits and 12) focus groups (The ITF Waste Workgroup, 2017).

3. Theory

Much academic research and literature on participatory processes apply institutional approaches to analyse, understand and explain the success and failure of such processes (Ayana & Arts, 2015). However, Bourdieu, as cited in Ayana & Arts (2015), points out that the logic of practice is an essential element in researching such processes. Consequently, this research uses the theory of SPT from Shove et al. (2012) and the PAA from Tatenhove et al. (2000), described in paragraphs 3.1 and 3.2. The different angles are integrated and explained in paragraph 3.3. Hereafter the conceptual framework is described in paragraph 3.4.

3.1. Social practice theory

Many theories focus on social patterns and practices in societies, known as 'Social Practice Theories'. Practice theory is defined as "practices are socially recognised, routine and embodied enactments, in which bodies are moved, objects are managed, things are described, and the world is understood" (as cited by Reckwitz in Ahva, 2016, p.1526). It is a 'block or pattern' of bodily and mental activities, things and their use, knowledge, understanding, and 'states of emotion and motivational wisdom' to tangible and practical levels of practice such as the disposal and separation of waste streams (van Klink, Wiering, van Eerd & Schoor, 2022). They emphasise that understanding the elements of practice and their interconnectedness should be at the heart of spatial planning and participatory policy initiatives. As a result, SPT provides a conceptual and intellectual basis for developing action plans and policy interventions to address complex challenges, such as creating an engaged society regarding WM (van Klink et al., 2022). SPT takes a middle position between the actions of individual humans and the influence of external structures or institutions on human behaviour. It argues that social reality must be understood through the empirical analysis of social practices, which includes agents and structures. The elements of a practice acquire their social significance through the practice as a whole (Mattijssen et al., 2019, p.3). As such, one can see that social practices address the debate on agency structure by incorporating individual, intersubjective and institutional factors (Maas, Pauwelussen & Turnhout, 2022).

With the Shove et al. (2012) definition, SPT can be characterised by four key elements. First, the basic unit of analysis is neither the social system nor individual agency but the intermediate social practice where agency and structure are intertwined. Second, to understand human behaviour, the focus lies in looking at social practice as a whole rather than single factors such as power, norms, incentives, rules, resources, or interests. Therefore, a holistic approach is more appropriate than a reductionist approach (Shove et al., 2012). Third, social practices encompass not only how humans relate to other humans but also things, artefacts, and other forms of life in their environment, like the creation and management of waste. Therefore, social practice is defined as a set of doing, saying and things in a specific field of work (Ayana & Arts, 2015). Although social practices are considered stable by internal logic and routine, they could be different from a historical perspective. Therefore, 'contingency' is an essential aspect of SPT (Ayana & Arts, 2015, p.3).

3.1.1. Dimensions of SPT

The dimensions of SPT are summarized and condensed into a combination of material, competence and meaning. Material consists of things and objects, the human body, devices, tools and infrastructures. Competence is a combination of practical knowledge and different levels of understanding. Finally, meaning is the merging of mental activities, emotions and motivational knowledge into one and refers to ways of thinking and feeling in certain 'time-spaces' (van Klink et al., 2022, p2-3). The material world is an important dimension and integral part of social practices, as non-human elements such as natural objects and technological artefacts play a constitutive role in the production of social life. Practices change as soon as an item is replaced by something different. The material world is not only the substrate of social practices but actively shapes them. For example, waste separation practices of citizens living in a specific living environment are partly produced by the material characteristics of their living space. Therefore, people's agency is intertwined with the material and social situation in which they find themselves. This is called 'situated agency' (Mattijssen et al., 2019). However, not only the material element has the upper hand in influencing practices. The three elements have equal weight and must be

present to perform the practice. The elements are spatially, causally, intentionally or prefiguratively related, allowing or limiting each other when performing an exercise, as illustrated in Figure 1.

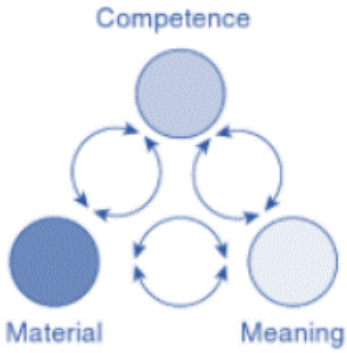

Figure 1: Elements of practice theory (Shove et al. 2012. p.32)

3.2. The policy arrangement approach

Given the focus on the process behind citizen engagement in WM processes, an institutional policy analysis helps understand the dynamics of the current arrangement of regulating citizen engagement in WM policy, its structures and systems over time. Therefore, the Policy Arrangement Approach (PAA) is applicable. The PAA is defined by van Tatenhove et al. (2000) as "the temporal stabilization of the content and organization of a particular policy domain on a particular policy level or across multiple policy levels" (p.54). The PAA aims to understand and analyse the ongoing institutionalization of policy arrangements because of the interplay between, on the one hand, the interactions of actors participating in the realization of policy in everyday life and, on the other, processes of social and political change (Wiering & Arts, 2006). It combines managerial insights with sociological and political theories and builds on the multi-actor policy network mode and pays more attention to (1) institutional contexts in which policy actors must operate, (2) the content of policy making and (3) power relations between the involved policy actors (Wiering & Arts, 2006, p.328). In this way, the PAA can serve as a framework for investigating the interaction between actors and structures and the content and organization in policy domains. It can help to connect day-to-day policy practice and broader structural societal changes.

The draft policy arrangement has two essential aspects, namely substantial (principles, objectives, measures) and organization (departments, instruments, procedures). Moreover, a time-space notion that bounds the policy arrangement is part of the definition. Policy domains are only temporary because regulations are under pressure from the constant change of policy innovations on the ground or from political modernization (Arts & Van Tatenhove, 2004).

3.2.1. Dimensions of PAA

The substantial and organisational features are specified in four dimensions. Where the organisation in policy arrangements is distracted from actors who are embedded in the structure of rules and resources, forms discourse the basis of substance in policy arrangements (Arts & Van Tatenhove, 2004).

The actor dimension encapsulates the involved actors and coalitions within a policy domain. Moreover, it is possible to see changes in how these actors interact and, consequently, find emerging coalitions or oppositions (Wiering & Arts, 2006). According to Arts & Tatenhove (2004), “a policy coalition consists of several players who share resources and interpretations of policy discourse in the context of the rules of the game. These coalitions identify similar policy goals and engage in policy processes to achieve those goals” (p.342). Rules of the game encapsulate ‘the humanly devised constraints that shape human interaction’ (as cited by North in van den Berghe & Vos, 2019). These are (in)formal social and economic decision making-and production procedures. The word game means the setting of how the actors interact with each other. It consists of legislation, procedures, and political culture. The legislation refers to the formalisation and transposition of the policy discourse into binding law (Wiering & Arts, 2006). Both in terms of actual rules for political and other forms of interaction and formal procedures for pursuing policy and decision-making. Resources refer to the resources that the actors can use. This dimension is intrinsically related to ‘power,’ where power is the mobilisation,

division and deployment of resources and influence on who determines policy outcomes. Arts & Tatenhove (2004) state, "Policymaking presupposes power, in which policy domains agents need to mobilise resources to act and intervene. At the same time, the structural properties of the arrangement in which they are embedded (unequally) constrain or enable them" (p.346). Discourses encompass narratives and ideas of every actor. Moreover, how actors see certain elements, how they define solutions and problems and what their values and norms are (van den Berghe & Vos, 2019). Wiering & Arts (2006) describe and distinguish three theoretical layers a discourse consists of, which are ontological, normative and strategic. The first layer, ontological, deals with paradigms and world views of the actors. How do we see reality, or how do we define our problem? An essential part of this type of question is the concept of framing. In policy, literature framing is defined as a concept used to give meaning to fundamental processes that influence the situation from a particular perspective or reference point. Incompatible frames often form a barrier to collective decision-making. There is not only a disagreement on what to do but also a more fundamental level of insight into the ontological nature of the problem (Vink & Dewulf, 2015). When perspectives disagree in this ontological area, meanings and interpretations could end up opposites of each other, leading to the ambiguity of the problem (Vink & Dewulf., 2015). The discursive space is simultaneously filled with the normative layer. This layer contains the values at stake and the goals that are set. Ambitions, utopias, or ideals of policy actors are overseen within this layer. The third layer of discourse concerns the route or 'road map,' the path from problem to solution. Central to this indication are the policy programs of policy actors (Wiering & Arts, 2006).

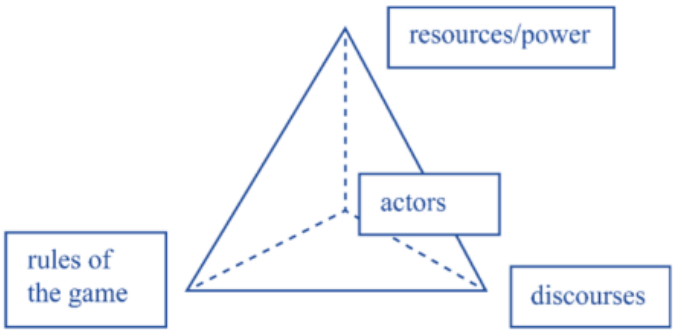

Figure 2: Tetrahedron from Liefferink (2006) (van den Berghe & Vos, 2019, p.6).

To symbolise the relationship between the dimensions, the PAA is illustrated as a tetrahedron, where each corner is one dimension, as depicted in Figure 2. The dimensions are interrelated. Therefore, when one-dimension changes, the other dimensions change accordingly, leading to institutional change (van Tatenhove et al., 2000; van den Berghe & Vos, 2019). The tetrahedron can be entered via each of the four dimensions (van Klink et al., 2022). This research enters the tetrahedron via the actor and discourse dimension. The actor dimension can characterise the influence differences and each party's roles within the arrangement. The discourse dimension strongly relates to meaning making in social practices, so what are the current perceived obstacles in the engagement process and what are the solutions to improve the process? The other two dimensions are to receive a holistic understanding of the playing field in the current initiation of the WM process and control of all actors.

3.3. Integration of theories

Theoretically, institutional and practice theories substantially differ. However, methodically, practice theories do not necessarily exclude an institutional analysis (Ayana & Arts, 2015). Rules, principles and conventions are part of social practices, although they fail to capture human behaviour and social patterns (Shove et al., 2012). Secondly, it is necessary to analyse the institutional arrangement of participation processes to confront it with the practical logic at work in this case. Therefore, the PAA is necessary to get hold of the institutional arrangement. There is a change in the arrangement when there is a shift in one or more practice dimensions. Although dynamic in principle, social practices often stabilise and reproduce themselves. Elements commonly reproduced in practices are considered to be institutionalised. Examples include laws, cultural traditions, and standardised ways of working. Such institutionalised elements often span various social practices. Hence, these institutionalised elements

function as 'glue' between practices, reinforcing their stability or instigating renewal once they change. A change in institutions can be understood as a change of institutionalised elements across practices (Mattijssen et al., 2019). Only through their embedding in concrete practices, institutions continue to exist. To study the potential of active citizen engagement with WM processes, it is necessary to understand how citizens, as situated agents, bring change in discourse, actors, rules, and resources across WM practices.

The integration of the PAA with the SPT provides a possibility to investigate if WM processes would benefit when citizen engagement is incorporated within the policy arrangement. Citizen engagement processes can be researched in the field of WM via the middle position between the actions of individual humans and the influence of external structures from the SPT and investigating interactions between actors and structures and the content and organisation in policy domains from the PAA. The four PAA dimensions provide insight into the ideas and discourses that have shaped the institutional structure; the 'rules of the game' form the core of the arrangement; the actors and their networks who are 'the players of the game' as mediated by the rules at hand; and resources and power relations (co)determine outcomes in terms of winners and losers of the game (Ayana & Arts, 2015).

By taking a step further than the PAA, SPT confronts the project design with the daily waste-related practices in the case study. As this research emphasises understanding the practice of waste separation by citizens and involving them in the general policy domain, this integration is the link between individual practices and institutional change in the waste policy domain. Although participatory projects might be well designed in terms of general principles from institutions, their effectiveness remains to be seen. Humans might act upon the new incentives, rules and norms differently than expected, or not at all, given their local, situational logic of action (Ayana, Arts, 2015, p.3). Investigating the interactions between policy and practice will unravel the possibilities for interventions to improve citizen engagement processes regarding waste separation practices in newly developed high-rise apartment complexes.

3.4. The conceptual framework

This paragraph outlines the conceptual framework, in which the theoretical concepts are translated into dimensions and the associated variables, as shown in Figure 3. First follows a description of the conceptual model, hereafter the operationalisation of the concepts.

3.4.1. Conceptual model

The model illustrates two access routes that lead to a path of realizing a WM system that incorporates a citizen engagement process in the development and implementation phase. The two entry points are the theoretical design of the WM system illustrated with the PAA, and the other entry illustrates the designed system used in practice by the residents through the SPT. Both trajectories together are necessary to design a process that leads to an operational WM system that fits the type of users of the system. Both trajectories interact and have a relationship between the dimension of the PAA and SPT, which are marked in the same colour (yellow, dark and light grey). For example, when the theoretically designed system has a limitation on the amount of available infrastructure for a resident (no built-in bin with separate openings), it can lead to a particular waste separation behaviour (too much effort to buy a trash can with separate openings by themself, which prevents waste separation). Conversely, the theoretically designed system is influenced by stories from users of other housing complexes (when designers see incorrect practices such as packed waste containers caused by inappropriate waste separation behaviour). Therefore, the interplay between theoretical and practical WM systems opens a citizen engagement process in designing a WM system in newly developed high-rise apartment complexes.

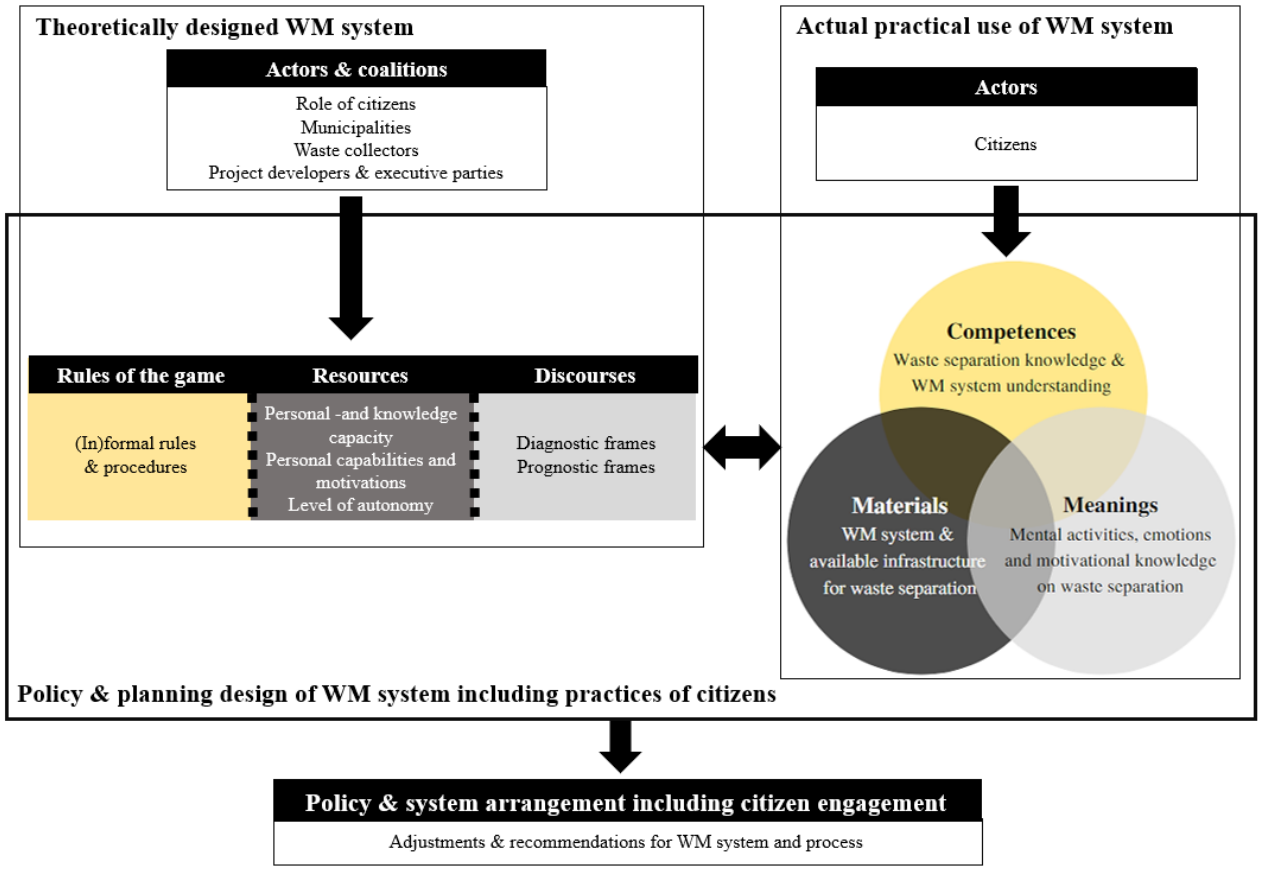

Figure 3: Conceptual model (Made by author, 2022)

3.4.2. Operationalisation

The operationalisation of the concepts is necessary to use the theoretical concepts from the conceptual model in empirical research. The operationalised concepts are based on the theories discussed in paragraphs 3.1 and 3.2. The concepts have been operationalised into dimensions, variables, indicators and question types, as shown in Tables 5 and 6 in Appendix 1. The question type marked in blue is for residents, and the question type marked in grey is for experts. The indicators were also partly examined with background information from other sources, as presented in the last column.

The theoretical trajectory has the four dimensions of the PAA. The first dimension of actor and coalitions consists of four variables: residents, municipality, waste collection organisation, and project developers with the associated executive organisations. The indicators associated with these variables are each actor's current role and what the required role should be in the WM process. The rules of the game dimension consist of two variables: the formal and informal rules and procedures of the design, implementation and use of the system. The resource dimension consists of three variables: personal and knowledge capacity, capacities and motivations, and autonomy level. Indicators related to these variables are the personal and knowledge capacity or ability to use the installed WM system or whether they have a specific right to control the WM system itself. The last dimension of discourses consists of two variables which are diagnostic and prognostic frames, which investigate the perceptions of the problem and the preferred solutions to the current WM process and system.

The practical use trajectory has four dimensions that come from the SPT. The actor dimension consists of one variable, which is citizens (residents of Volt). The indicator associated with this variable is what type of resident it is. The competence dimension has the variable knowledge of waste separation and whether the resident understands the designed WM system. The material dimension has the variable of the WM system's appearance, what the infrastructure and what the available materials are. The meaning dimension is the variable about mental activities, emotions and motivational knowledge on WM and why residents think they need to be more involved in the WM process.

4. Methodology

This chapter describes the methodology used to answer the main question. First, the research strategy is described, which discusses the research philosophy and why a single case study approach is chosen. Subsequently comes the data collection method. Hereafter the data analysis paragraph explains how the information is processed and analysed. In the end, a paragraph on the validity and reliability of the study is provided.

4.1. Research strategy

This research has its philosophical ontology in relativism which means each resident has a specifically constructed reality. Therefore, they have multiple realities as elusive constructs in their minds. The epistemology dimension is subjectivism, which is about a resident's meaning to a particular element The methodological position is hermeneutical and dialectical. Therefore, findings arise in the interaction between the researcher and residents through the dialectical exchange (Guba & Lincoln, 1994; Moon & Blackman, 2014). These positions lead to the research paradigm of constructivism where the nature of knowledge is created by the individual reconstructions assembled through consensus. This paradigm is appropriate for this research because it intends to understand a residents' position on the specific topic of WM in their living environment. This paradigm leads to reliable and authentic results and insights into the current misconceptions about why waste management is lacking in this type of living environment (Guba & Lincoln, 1994).

With the paradigm and philosophical position, a qualitative design is appropriate to obtain a bottom-up perspective and a deep understanding of the residents and policy structures. Qualitative research has an interpretive, naturalistic approach to the world. Studying processes around citizen engagement with WM processes gives an interpretive image that makes the world visible. It involves reporting from multiple perspectives, identifying involved factors, and sketching the bigger picture. This comprehensive approach in qualitative research helps identify the complex relationship between citizen engagement and WM processes in high-rise apartment complexes. Because of these complex concepts, which are difficult to describe quantitatively, the research is focused on words than numbers when it comes to data collection.

With this qualitative approach, empirical and desk research is applied. With empirical research, the researcher retrieves data in the field. Desk research is the opposite, as the scientific data is retrieved and gathered by other researchers. Additionally, a background study is done on the information on alternative WM systems that would attract residents to be more involved with WM processes. The application of empirical research is to determine the residents' obstacles and perspectives on waste systems. This is important because this case reflects how WM processes in newly developed complexes operate without citizen engagement.

Besides the qualitative approach of this research, it involves a single case study. A case study aims to develop an integral and gain in-depth insight into a particular process (Verschuren & Doorewaard, 2010). Case studies explore societal obstacles and commonly overlooked dilemmas (van Thiel, 2014). They provide opportunities to study and analyse the complexity or specific nature of cases in their context (Yin, 2014). This line of thought is in line with the formulated research question. Since this study is cross-sectional, data is gathered for more than one phenomenon in one single moment. Because of the limited study period, a single case study is most suitable for this study.

Lastly, this study has a combination of inductive and deductive theory orientation. Inductive research is about developing theories where empirical data is collected to generate a theory (Saunders, Lewis & Thornhill, 2012; van Thiel, 2014). Deductive research uses existing theory where literature is first analysed and later evaluated empirically (van Thiel, 2014). It leads to a mixed deductive and inductive approach as concepts from the literature are collected to reflect and explore the existing theory of citizen engagement in WM in urban districts. Additionally, the theory is expanded with insights from interviews with residents from Delft.

4.2. Sampling method

For this research, a case selection is made for the single case study explained in paragraph 4.2.1. Hereafter the respondent selection is described in paragraph 4.2.2.

4.2.1. Case selection

Via non-probability sampling, a purposeful sampling is applied in selecting the case. With the help of Stantec B.V. and the Municipality of Delft, a selected case is chosen that meets the criteria as displayed in Table 1.

The nationality of the urban municipality is from a practical view. The researcher, scientific institute and internship are Dutch. Therefore, it is practical to focus on a case in the Netherlands. The second criterion is the household, source separation waste system. This project is limited to source separation of waste flows because of the focus on the resident's capabilities and perspectives. Therefore, post-separation is not part of this project. Since household and industrial waste systems in the Netherlands are separate, this study will focus on the household system to maintain the study's validity. The third criterion is also based on a practical view. The internship organisation is linked with the waste collection company Avalex. Therefore, it is practical to find a municipality which is a member of the Avalex municipality area. This led to a selection of six municipalities, which are Delft, Leidschendam-Voorburg, Midden-Delfland, Pijnacker-Nootdorp, Wassenaar, Rijswijk. The fourth criterion about the size of the city is a middle-sized city on a Dutch scale because larger cities like Amsterdam, Rotterdam and Utrecht already have a well-operationalised system and experience compared to middle-sized cities, as explained in the introduction. The internship organisation chooses the fifth criterion that the case has an urban district density with a minimum of 100 buildings per hectare. Therefore, three municipalities were left that were Delft, Rijswijk and Leidschendam-Voorburg. Delft was the most practical city as the internship organisation was operating in Delft. From a different angle, Delft is an interesting city as there are many development plans in the upcoming years that can apply the lessons of this research. To maintain the studies' validity, a choice is made between newly constructed buildings or older existing buildings. Therefore, the sixth criterion is newly constructed buildings that are newly developed with moved-in residents. This choice is made on the lessons that could be learned for newly developed plans in the Delft. The case fulfils these criteria as the building was developed in May 2019, and residents already moved in more than two years ago. The seventh criterion about high-rise apartment complexes is that this is the new way of living in cities. Moreover, high-rise apartment complexes have the lowest waste separation percentage of all building types and are an interesting subject for empirical research. To specify this category further, the building needs to have a minimum of five floors with an elevator in the hallway. The eighth criterion about the type of residence is because many studies show rental housing has a lower waste separation rate than owned residential houses. Moreover, the municipality of Delft stated they have difficulty in participation processes with the free sector rent housing types. The last criterion is because there is an increase in the diverse number of residents that live in high-rise apartment complexes that are not only Dutch citizens. Therefore, the target audience is a diverse and multi-cultural complex.

Table 1: Case study criteria

Criteria case study	***Unit of measurement***
Country	Netherlands
Waste system	Household waste – source separation
Waste collecting organization	Part of Avalex municipalities
Size of city	Middle-size city on Dutch scale
Urban district density	50 – 100% of total buildings are high-rise apartment complexes
New constructed building with residents	Developed maximum 2 years ago (latest in 2019), residents already moved in the building.
Building type	High-rise apartment: non-grounded homes in buildings of five or more floors, with elevator
Residence type	Free sector rent residence
Target audience	High diversity and multi-cultural household types

4.2.3. Respondent selection

The selection of experts is through non-probability and snowball sampling after the case selection. After reviewing the project development plans and conversations with the internship organization, the expert selection came. This led to expert interviews with members of the municipality of Delft, Avalex, the waste collecting organization, Amvest, the housing corporation and other accompanied organizations. Citizens from the Dutch case were approached via stratified sampling.

4.3. Data gathering

As this research is a case study, there are several possibilities to apply types of methods to collect data. To receive data triangulation, the study has a mixed approach through (expert) semi-structured interviews, less structured participant observation and document study. These approaches are further explained below.

4.3.1. Document study

To formulate an answer to the main question and sub-questions scientific knowledge from a document study is necessary. Documents can be analysed to interpret their content to provide specific insight into policy and project documents of the case, municipality of Delft and scientific articles on citizen engagement in spatial planning processes. By studying these documents, developments of new policies or systems of waste collection processes can be investigated in which roles or actors are essential. A chronological reconstruction is applied to study these documents by phase of the policy development case (van Thiel, 2014). This data collection is helpful because it provides stable and broad information about each case (Yin, 2014). Next, scientific sources were consulted in drafting a waste system menu card to evaluate elements with residents in the second interview (this is explained in sub-paragraph 4.3.2. Residents). Information on the menu card comes from living labs, scientific studies, best practices, international WM platforms and seminars.

4.3.2. Interviews

Semi-structured interviews make it possible to ask the residents and experts open questions, revealing contextual backgrounds and in-depth knowledge of the case (van Thiel, 2014). Before the interviews were conducted, an interview manual was drafted and used as a guideline containing the questions. The structuration of the questions in the interview are based on the operationalisation of the conceptual framework. Additionally, the questions have a colour coding scheme to indicate which question is linked with the conceptual dimensions, as shown in Appendix 2.

Residents

The first form of contact with the residents was via an information letter prepared by the researcher that is checked for validation by the internship organization. The residents' letter was drawn up in Dutch and English to appeal to the largest number of residents. The resident letter contained a first option to send an email to the researcher to participate in the study. This resulted in two participants. The second option was that the researcher would come by four days later on a Monday. Four days after the resident letter was sent, 130 addresses in total were visited in a three days between 9:00 AM and 5:00 PM. In the end fifty addresses opened the door. Every address that did not open the door received a second information letter with contact details to participate in this research.

A total of twenty-five people indicated that they were interested in participating to the study. However, some of the interested had withdrawn their interest. Different tactics were used in approaching residents and collecting data via a passive and active manner. The active approach took the form of asking for an interview at the resident's home on a day that suited the resident, the appointments were arranged at the door or via WhatsApp. Hereafter an interview was conducted at the residents' apartment. The passive approach was that residents could send an email themselves to indicate that they wanted to participate. Moreover, and option was provided that the residents could fill in a questionnaire that would later be shared with the researcher via mail. In total, five of the twenty-five interested residents were interviewed, and three persons filled in an open questionnaire of the interview questions, as described in Table 2.

The residents had two interviews with an interval of fourteen days. The reason for two interviews is with the first interview, inductive questions were asked about the contextual setting of the waste system, their waste separation practice and what their perception is of the current decision-making process. The second interview had a deductive approach and questions were asked about the waste menu card. Additionally, the fourteen days between the interviews gave the respondents time to become aware of their waste separation behaviour and the waste system, which could lead to a deeper insight in their obstacles and perspectives on the waste system.

Table 2: Resident data collection overview

Resident Nr.	*Household type*	*Data collection method*	*Date(s)*	*Specialties*
1	Young professional, lives with partner, Dutch women	Interview 2x	04-04-2022 25-04-2022	None
2	Young professional, lives with partner, Dutch women	Interview 2x	04-04-2022 09-05-2022	Went on holiday between interviews
3	Young professional, single, Dutch women	Interview 2x	04-04-2022 25-04-2022	None
4	Retiree, single, Dutch man	Interview 2x, participant observation	11-04-2022 25-04-2022	Shared many photos of system
5	Young professional, single, Dutch man	Interview 2x	12-04-2022 26-04-2022	None
6	Professional, single, Dutch man	Questionnaire 1,5x	06-04-2022 22-04-2022	Second questionnaire was partially filled in
7	Young professional, lives with partner, international man	Questionnaire 1x	07-04-2022	Second questionnaire was not filled in
8	Professional, lives with partner and child, international woman	Questionnaire 2x	05-05-2022 05-05-2022	Questionnaires are filled in without two weeks interval

Experts

The experts were approached via snowball sampling through the network of the municipality of Delft and Stantec and through organizations' website contact forms. The details of the expert interviews are described in Table 3. Only two interviews are conducted with the approached experts with a deductive approach. First, an online expert interview was held with a project developer of Kondor Wessels, to estimate how the participation processes and WM processes function in the municipality of Delft with new-developed areas. Moreover, questions were asked about which parties are actively involved in the design of a waste system and what the division of roles are in the process. Following, two municipal workers from the waste department were interviewed. From this interview a deeper understanding about the contextual WM system of household waste in Delft was formulized. Moreover, the case was selected which is explained in the paragraph 5.1. Furthermore, they could support with approaching Amvest, the project developer of the selected case. Amvest preferred to have an informal phone call, of which no approved conversation report was made. This actor was crucial, as they have the facilitating role in providing a WM system in the residential complex. The waste collecting organization, Avalex, was approached via an online contact form on the website. Avalex responded via an informal telephone call, without a conversation report. This actor was important for the study as they form together with the municipality the key stakeholders in informing residents about the WM system in their living environment. In the end, the organization, Area of People, who manages the resident app has been contacted via an online contact form and personal email address. An informal telephone conversation was subsequently held within the end an approved conversation report. This actor provided information on the manner how residents and property owner communicate with each other on facility issues and other topics.

Table 3: Expert data collection overview

Experts	*Organization*	*Role*	*Interview form*	*Date and time*
Heleen Luijt	Kondorwessels	Project developer	Online via Teams with transcript	03-03-2022 10:00 – 11:00
1. Pauline Lasterie *2. Matthijs Pijnacker*	Municipality of Delft	1. Project leader waste separation 2. Policy advisor waste collection	Online via Teams with transcript	29-03-2022 09:00 – 09:50
Phillippe van Gorp	Area of People	Commercial Director	Informal phone call	13-04-2022 12:40 – 12:52
Not shared	Avalex	Not shared	Informal phone call	13-04-2022 16:13 – 16:28
Marieke Ranzijn	Amvest	Asset manager of Volt	Informal phone call	20-04-2022 10:46 – 11:11
Rens Huybregts	Area of People	Asset manager of Volt	Formal phone call with conversation report	21-04-2022 14:00 – 14:34

4.3.3. Participatory observation

In this study, a participatory observational approach is applied to the residents. With participatory observation, human behaviour is observed in real life while continuing their daily practices in which the participant is informed and knows the identity of the researcher (van Thiel, 2014). When making the observations, a less structured format is used with no coding scheme. Between the two interviews, the residents are asked to share their experiences via e-mail, photos, and short memos with elements they encounter in conducting their daily waste separation practice or obstacles with the current conventional waste system. One resident did this as shown in Table 2. The photos allow these elements to be transcribed and subjected to detailed analysis.

4.4. Analysis

After the information was collected the conducted interviews were transcribed by using the audio tape (with permission of the interviewee) and program oTranscribe. Hereafter came data analysis. Analysing data is an iterative process. It is a sequence of selecting, reading, interpreting, reflecting and again selecting new material to create patterns in the material (van Thiel, 2014). The systematic iterative process was done in the Atlas.ti software program. The coding continued until there was a moment of theoretical triangulation of the data, which is described in paragraph 4.5.1. The literature studies are analysed by reading the studies and relevant documents. The interviews were analysed through coding, which is a tool to find patterns in material. The purpose of coding is to simplify the information by subscribing the information divide into parts making it a workable quantity (Akinyode & Khan, 2018). By coding the interviews, it is easier via the operationalisation to see which elements arise from the obstacles and wishes regarding the residents about waste separation behaviour and what the current obstacles are regarding the participation process. Therefore, codes are assigned to the dimensions of the conceptual model and associated indicators such as obstacles, rules and perceptions. Here, the coding process is deductive at the beginning and inductive later in the process when codes do not correspond to the operationalized concepts (van Thiel, 2014). The first cycle coding is the summary of data segments (Miles, Huberman & Saldaña, 2015). This is done by structuring data through in open and vivo coding and labelling. This kind of encoding means that text is tagged and text fragments with relevant information are selected (Akinyode & Khan, 2018). After the primary encoding, sub-coding is applied to detail the data entry. The second cycle coding is identifying categories, themes and constructs of the first cycle (Miles et al., 2015). Hereafter, data from heterogeneous sources are matched with appropriate categories to integrate them. After the first descriptive and situational coding scan, the process of axial coding follows. Axial coding means that the labelled text is accommodated in core labels that overlap, therefore, analytical categories are further developed to identify patterns and relationships. After this step, propositions are developed and, finally, conclusions are drawn and verified (van Thiel, 2014). To maintain reliable findings, memos were created to keep track of the overall encryption process.

4.5. Validity and reliability

Validity and reliability are important criteria in establishing and assessing the quality of research. In principle, the findings of a single case study will be valid only for the case in question, yet often findings

can be regarded as representative for other situations in the same research domain, even when these have not been studied (van Thiel, 2014, p.89).

4.5.1. Validity

With validity, there are multiple fields of validation. One of them is construct validity which is about making sure there are no systematic measurement mistakes. It concerns whether the research is clear and specific (Yin, 2014). It is vital that the operationalisation of the theoretical construct is correct and that the assumed relationship between the variables exists. This research considered important indicators and inserted them within the conceptual model. Moreover, the internal and external supervisors were asked to comment on the chosen operationalisation and sampling method to ensure construct validity. The data triangulation is received by retrieving data from various data sources. After the five interviews with the first respondents, extra data was received by providing other residents with the option of a questionnaire which led to extra data from three respondents. After transcribing, a layered design of subunits was created. In the end, four main categories resulted from the coding process, showing data triangulation. These categories are further explained in the findings in paragraph 5.3.4.1.

Internal validity refers to whether the researcher measured the effect he intended to measure, thus the quality of the research results (van Thiel, 2014). Therefore, the conclusion from the research must not derive from other factors outside the scope of the research. Guaranteeing this element is difficult because of the cross-section, single case study method. However, with the addition of a literature study, relations between the elements are argued. Nevertheless, the internal validity of exploratory studies is not relevant as the aim is to understand certain phenomena.

External validity indicates how far the research results can be generalised to other populations in different circumstances. The higher the external validity, the greater the applicable scope is. In constructivist case studies, this element is limited because each case is unique, and the aim is to understand a certain situation, not to generalise them. Therefore, this is not included (van Thiel, 2014).

Because of the constructivist approach and the single case study as a research design, the role of the researcher is an important aspect (Yin, 2009). Awareness of the researcher's values and assumptions and how this influences the research is necessary. In the reflection regarding this research, the values and assumptions of the researcher are discussed. Moreover, the ethics regarding the participants are essential. Every interview began with an introduction to the research. Thereby, the interviewees were informed about the study's content and the methods used, so the respondents knew with which aim the data was used.

4.5.2. Reliability

A study becomes reliable when the research strategy is applied consistently, and interviews occur in the same setting (van Thiel, 2014). This research does this by interviewing residents in their living rooms as much as possible and interviewing experts by telephone or online. Moreover, the interviews have the same structure by assigning codes to the questions in the interview manual. The accuracy and consistency in which variables are measured must also be considered (van Thiel, 2014). Accuracy is about the measuring instruments and how they are performed (interviews, observations and policy documents). Consistency is the idea of repeatability. However, because people are the research element in this study, repeatability is difficult to guarantee because people learn from past experiences (van Thiel, 2014). Nevertheless, reliability is difficult to achieve in research using semi-structured interviews due to the lack of consistency. To increase reliability, it is essential to document the research strategy, methods used and operationalization of the theoretical concepts. Therefore, it is essential to maintain a database of all findings and research steps. By explaining every decision and documenting adjustments in memos and the reflection of the report, the research remains transparent, which improves reliability. (Yin, 2009).

Another element to consider is the confirmability of qualitative research. This ensures sufficient distance between the observer and the observed, so the observer is not influencing the subjects' perspective (Ulin as quoted in Watkins, 2012). By applying reflexivity, it contributes to this element when the researcher acknowledges personal assumptions, biases and responses that may influence the collection or interpretation of data (Watkins, 2012, pp.157).

5. Findings

After outlining the theoretical concepts and elaborating the research strategy and methods, this chapter describes the case study's findings. First, a general description of the Volt residential complex and its WM system is provided, which is explained with policy documents of the municipality of Delft, the VANG documents, and interviews with the municipality of Delft. Hereafter follows the practices of the interviewed residents and the PAA dimensions of the conceptual model with input from the interviews with experts and residents, project documents and shared photos.

5.1. Case study: Volt residential complex

The case study is part of a new urban development plan called 'Nieuw Delft.' Next to the historic city centre, the new district used to be a railway viaduct and is transformed into a new city hub, as displayed in Figure 4. Around 2025, Nieuw Delft will consist of 24 hectares, 1,200 homes and more than 40,000 m² of urban functions. The vision of Nieuw Delft is that it is the neighbourhood of the future (Gemeente Delft, 2013). The Volt residential complex is part of Nieuw Delft, one of the district's first developments and was ready in May 2020 (Gemeente Delft, 2013). The Volt ensemble is located at the Van Leewenhoekkwartier, next to the future Van Leeuwenhoek Park, De Groene Haven and Ireneboulevard in Delft. The complex is marked in blue in Figure 4. 130 apartments in three sustainable complexes have been realized in the project. The apartments are 50 to 90 m², and each has one or multiple storage units within the apartment and in the basement. Between the complexes is a courtyard and each building has a separate entrance. Under the complex is a shared parking garage for all three complexes. The plinth has space for cafes, a fitness studio, offices, and other shops. The architect, ERA Contour, developed the project together with project organization Nieuw Delft of the Municipality of Delft and project developer and investor Amvest. The head project developer of ERA Contour stated that with the development of Volt, attention is paid to themes such as sustainability, mobility and the changing climate. Volt is an all-electric and all-LED in which the public areas and parking garage are equipped with dynamic lighting. Moreover, as Treuren states, "We do this by applying geothermal heat and installing solar panels on the roofs. The low roofs will be covered with green moss-sedum, and sustainable materials will be used as much as possible" (Treuren as cited in Stedenbouw, 2019). The development plan focuses on water, biodiversity and sustainability (Gemeente Delft, 2013). However, within the project development plan of Nieuw Delft, the only element they are referring to as waste is:

> Closed cycles encourage sustainable use of raw materials and energy sources. The use of 'new sanitation' in Nieuw Delft aims to limit the amount of wastewater from homes, to collect waste streams separately and to treat it in the area. (Gemeente Delft, 2013, p.77).

With this element they are referring to the new way of sanitation with the possibility to use a shredder (A innovative way to dispose vegetable, fruit, and food scrape waste) which is already a standard way of disposing food waste in Amerika. Moreover, this way of waste processing system is not installed in the Volt residential complex. Therefore, they leave out the WM process, design and use in the new developed district and complex that is referred as the neighbourhood of the future.

The target audience of Volt was aimed at a specific group of international knowledge workers and young professionals. Moreover, the complex was intended to be a short-term location. Due to covid-19, the target group and its transfer location purpose changed as explained by resident nr. 4 "Initially it was called a complex for knowledge workers. However, then you also must get it full in corona times... So, at a certain moment, many other people were also admitted. So that initial thought was removed." Therefore, the current residents form a diverse group of residents that is beyond young professionals and knowledge workers. However, since the pandemic is diminishing, the dynamic changes as more people leave and new residents move in. The increase in dynamic can be linked with the increase in waste production of the complex.

Figure 4: Overview development plan Nieuw Delft (https://media.xkp.nl/PZH/nieuwdelft/, 2022)

5.2. Waste management practices

This paragraph contains the dimensions of the WM practices of the residents in the Volt residential complex. First, the type of residents is explained, followed by the competences, materials and the meaning of WM.

5.2.1. Type of residents

Residents who participated in this study have specific characteristics in common. The type of residents, including the contextual setting, and living conditions, can be found in Table 4. The characteristics that link together are that all residents are highly educated, meaning they have a University of Applied Sciences degree or higher. Additionally, all residents are physically healthy and have no complaints about separating and depositing waste. The differences are in the type of gender, origin, age, size of house and household and the sustainable attitude. Of the eight interviewed residents, four are men, and four are women. Next to this, most of the residents are Dutch. Only two participants are from abroad, one with an American background and the other from the Middle East. The age ranges from young adults who have just started working around 25 to a retired man of 66. Some participants have a family, live with a partner or alone, or their household is changing. Another shared characteristic is that they all have a sustainable attitude and consider WM a vital topic. However, the degree in attitude differs per person.

Table 4: Background information residents

Resident Nr.	***Gender & nationality***	***Apartment type***	***Age (years)***	***Education/work***	***Size household***	***Physical health***	***Sustainable attitude*** *(+ = Good, ++= Very good)*
1	Dutch Women	Rent, House 80 m2, Storage 4 m2	27	Doctor in hospital	Lives with partner	Healthy	(+) Supports source separation with current amount of waste streams
2	Dutch Women	Rent, House 56 m2, 4 m2 storage	28	Interior stylist	Lives with partner	Healthy	(++) Supports source separation with extra separate waste streams
3	Dutch Women	Rent, House >70 m2, Storage 4 m2	28	Creative design in fashion, interior & media	Lived with partner, but went to single	Healthy	(++) Supports source separation with extra separate waste streams
4	Dutch Man	Rent, House 75 m2 Storage 4 m2	66	Retired, Director of several schools	Single	Healthy	(++) Supports source separation with extra separate waste streams
5	Dutch Man	Rent, House >70 m2, Storage 4 m2	25	Software engineer	Lived with roommate, but went to single	Healthy	(+) Supports source separation with current amount of waste streams
6	Dutch Man	Rent, House 77 m2, Storage 5 m2	37	Computer science, strategic advisor	Single	Healthy	(+) Supports source separation with OPK and Glass. Other streams are for post-separation

7	International (Middle East) Man	Rent, House 70 m2, Storage 4 m2	32	PhD Student	Lives with partner	Healthy	(+) Supports source separation with two waste streams: None & Recycle
8	International (American) Woman	Rent, House 90 m2, Storage 4 m2	36	Travel, University degree	Lives with partner and child	Healthy	(++) Supports source separation with extra separate waste streams

5.2.2. Competence

There is no formal information or participation procedure to involve or increase the WM awareness of the residents living in the Volt complex. The few elements' residents receive about the WM process is an introduction letter from the municipality, where a reference is made about the new way of separating waste in the municipality of Delft. However, this is indicated by the municipality themselves. The residents indicated they received an introduction letter from Avalex when they moved into the apartment with basic information on the collection days. Additionally, via the website of Avalex, residents can get insight into the WM calendar of their complex. However, this webpage is in Dutch, without the possibility of translating to English or other languages. Via the local newspaper they communicate this information with citizens in Delft as explained by resident nr. 4 and displayed in Figures 5, 6 and 7.

> I took a photo from above on such a lid, which showed the dates when the household waste was collected... That is, the collection schedules around holidays, so they shift. However, they stick them on top of the lid of the container. When people come, they open that lid and leave it open, and no one knows, and no one sees it... Moreover, Delft still has a free door-to-door newspaper, delivered everywhere, but not in this complex. Because by default, everyone has a 'no no' sticker on their letterbox. That means that you miss this. However, I do get to the supermarket, and there is a whole pile of them. I took it with me, so now I discovered certain things because I had this with me. So, this is how Avalex communicates with residents.

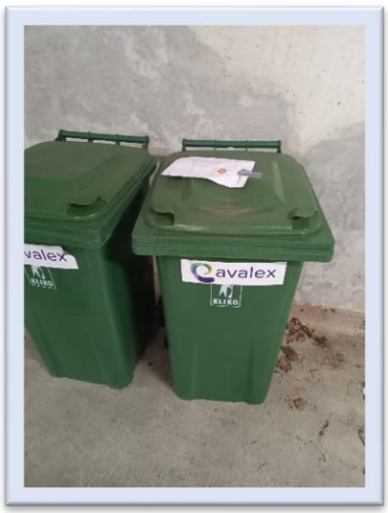

Figure 5: Information paper (Author, Monday 25 April 2022)

Figure 6: Information paper (2) (Author, Monday 25 April 2022)

Figure 7: Newspaper (Author, Monday 25 April 2022)

5.2.3. Materials

The Volt complex applies Delft's waste policy where PMD (plastic, metal, and beverage packaging), GFT (vegetable, fruit and garden waste) and OPK (paper and cardboard), are deposited indoors, and residual waste is deposited outside in an underground container. The glass container is 250 metres from the complex, next to the canal. Residents can access the garage via an elevator. The complex's garage has four closed and private container areas, each with a PMD and OPK roll container of 1100 litres. The private spaces for the 130 residents living in Volt. Therefore, approximately 30 to 40 residents use a private container space. All residents have a key to access their specific container space. Additionally, a communal waste area is placed next to the cars. In this open space, one PMD, one OPK roll container

of 1100 litres and four GFT roll containers of 240 litres are located. The GFT containers are in the open space, as there are ventilation openings in this area. The underground containers for residual waste are located outside on the corner of De Groene Haven and Engelsstraat. Next to the residual containers, the residents have created a bulky waste area, which is, according to the Avalex website, 50 meters further on, as shown in Figure 8.

The flows are collected at the beginning of the week by Avalex and are picked up and emptied next to the garage exit outside. When they are empty they are placed on the sidewalk.

In the apartments, residents have a storage cupboard of 4 m2 to store waste streams. They do not have a built-in bin and must create waste storage places for every stream within the apartment. Several residents indicate that their OPK stream and PMD stream is the largest of all streams. As resident nr. 5 explains, "cardboard is the most in terms of volume. I also notice that I order more things often. So, you often get cardboard."

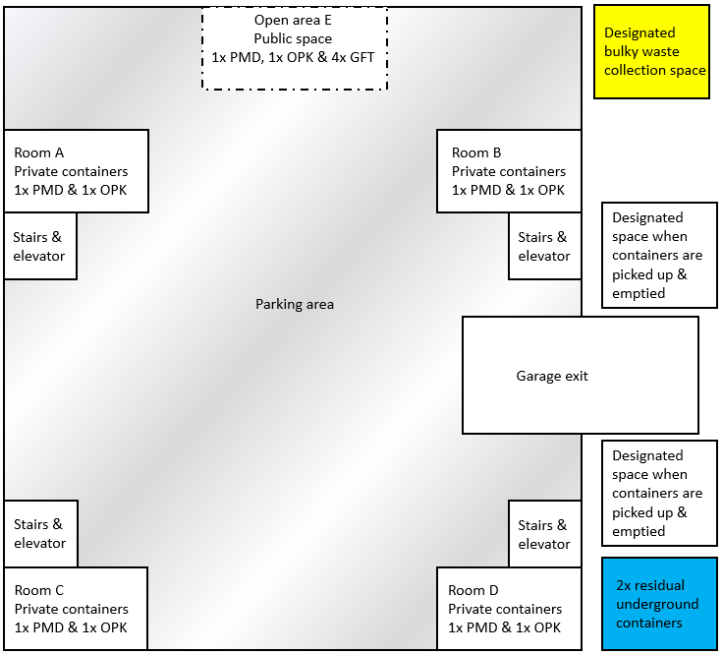

Figure 8: Schematic layout of garage and outside area (created by author, 2022)

5.2.4. Meanings

The Volt complex has a diverse group of residents with multiple ethnic backgrounds. With this diversification there are many different meanings on WM involved. Resident nr. 7, with an ethnic background, indicates that the waste separation process in the Netherlands is very complex. The other residents indicate that it is a relevant topic. It differs here that some residents are closely involved with it, and some not and have no interest in participating in the process. Like resident nr. 6: "Relevant subject, but I am little involved in it, no interest in participating in the consultation process." Next to this, resident nr. 5 indicates it as "I think it is an important subject… But what do I think about it... It is a necessary burden to call it something." This is in comparison to the more involved residents like nr.1: "I am working on it every day because I have a trash can with two compartments, so when I throw something away, I need to think carefully about what I have in my hand and where it should be." Resident nr.3 is quite enthusiastic about the municipality of Delft because, in her former city where she lived, it was more challenging to separate waste: "I notice that the municipality facilitates quite well. For example, you can separate your GFT waste in a bin on the street. That is a big difference compared to Rotterdam, where I lived before. There it was not possible." However, resident nr.4 indicates that there is a significant difference between the residents living in the Volt residential complex as he notices: "Look, I see people parking cars in the garage which have been to McDonald's and open the doors of the car and just throwing everything in the garage. Not everyone is equally interested in the subject." This viewpoint is similarly shared in the urban planning field as project developers often consider waste systems after the rest of the design of the urban planning project is on paper. As Heleen points out: "You

see in a development that developers think at the end 'oh, people also throw things away' so something has to be arranged for that." With these many perspectives and waste separation behaviours, Matthijs from the municipality of Delft indicates what the situation of WM in high-rise apartment complexes is:

> I must say that waste collection in high-rise rental complexes is an age-old problem. There are several studies that we have worked on. It is a common research question because it looks like Columbus's egg. If you can find the solution, you are in. It is a problematic issue. There is a lot involved, and implementation is complex.

5.3. Policy arrangement approach

This paragraph contains the dimensions of the policy arrangement of the WM system in the Volt residential complex. First, the actor dimension is explained, followed by the rules of the game, resources and, in the end, the discourses.

5.3.1. Actors

The actor dimension is divided into four actors and their accompanying roles. First, the residents are described, followed by the municipality, the waste collecting organization Avalex and lastly, the Volt complex ´Amvest´ project developer and their executive organizations. Data sources used are Dutch literature studies on WM, interviews with residents and experts and policy documents of the municipality of Delft.

5.3.1.1. Residents

Residents are currently not involved in the WM process of the Volt residential complex. Nothing is asked from residents to control their waste separation behaviour or to engage in the process. This type of management is opposite to what residents think the role should be for them regarding WM. However, there is differentiation between residents in the degrees of willingness to do source separation of waste. One resident finds it necessary but prefers to do as little as possible to source separation, compared to one who prefers to separate each type of waste stream and participates in weekly litter rounds in his living environment. As resident nr. 5 explains, "It is important people have to do their part, but there is also a limit." In his eyes:

> The ideal solution is, I think keep it simple. You must find a balance in that for what is actually as simple as possible, but in general can have a major effect on the post-separation and therefore, makes post-separation easier. But indeed, extra source separation you should not put on the citizens.

However, some residents point out that residents play an essential role in WM processes as resident nr. 1 state, "the responsibility lies with both... Both source and post-separation, I think we as citizens and consumers must be held accountable. In the end, we are all the system and politics." Most residents' perspectives are that they feel they have a role in source separation with WM processes and can advise the designers and owners on how this system needs to function.

5.3.1.2. Municipality

The municipality is the decision-maker about the type of waste system that is installed in new-build complexes when it comes to household waste. They are responsible and the key stakeholder in this process. They draw up the municipal policy, which is aligned with the Netherlands' national directives on household WM. They formulate waste separation objectives, advise other stakeholders on municipal waste separation policy, and guide partners in sustainable practices. The project developer must meet the municipality's requirements concerning the realization of indoor container spaces with four types of waste in the residential complex. The municipality then checks whether these spaces meet the standard set concerning the size of the spaces. Moreover, the municipality is responsible for the collection schedules for all waste streams they share with the waste collector. Civil servants from the municipality of Delft think the municipality could be more active as initiators in citizen engagement and information provision.

5.3.1.3. Waste collecting organization

The municipality is currently the client for Avalex to indicate how and when they should run the waste system at a newly developed high-rise complex. They do not know in advance how many residents live there. As a result, there is no coordination with the amount of waste produced in the first few weeks. Additionally, the provision of information to residents is minimal, and it is unclear to Avalex which party is responsible for what. The possibilities are that they can provide information with communication means in the format of flyers and have colleagues who physically share information at an information booth or workshop. The information about the collection days is communicated via letters on containers and when residents move into a home. With the information letter, residents receive a waste pass that they need to deposit bulky waste at the environmental street. Additionally, Avalex has developed an app and website that explains the types of waste flows, products, and return points for specific flows, such as clothing.

5.3.1.4. Project developer & executive parties

Amvest is the project developer and property owner of the complex. The role of the project developer is to realise container spaces in a residential complex that meet the municipal policy directions. According to the municipality, owners of residential complexes need to provide tenants with information about WM directions within the complex. However, it is not obliged to prescribe a plan to manage this information process. Therefore, this led to an information deficit on WM in the complex, as this process is not mandatory to fulfil by the owner, or they need to follow strict directions.

The executive organisations that keep the complex in order and work under the direction of Amvest are the relationship manager MVGM and the residents' app creators' Area of People (Hereafter AoP). MVGM has contact with the residents and working staff like the cleaners and takes care of all matters concerning complaints and housing-related aspects on behalf of Amvest. The current position they have is passive and reactive. Resident nr. 4 points out they need to have a more proactive position in WM by:

> Look, MVGM speaks to their cleaners and people from MVGM regularly visit the building. They know this, so they could act if they see this mess. I think you should intervene when you see this. This only attracts pests.. We have had a rat infestation here.

AoP is the creator and manager of an independent resident platform for the Dutch residential areas. They created an app which is a facility product for real estate managers such as Amvest. AoP was commissioned to create a micro-island that serves as a residential community for the Volt complex. Amvest uses this platform to get a better grip on what is happening among residents and MVGM to communicate with the residents. The residents' community provides information about the complex and residents' movements with specific themes. Additionally, on the platform, residents communicate with each other about everyday subjects, questions, and obstacles in their living environment. Features in the app are interest groups like Marketplace, Sports and Pet Care. Moreover, it contains service pages, contact details and lists the most important documents for residents related to their homes, such as house rules and material manuals. At the Volt complex, Amvest did not give AoP an assignment to think about the theme of WM. Therefore, this has not yet been taken up within the app. It shows that AoP has the same reactive position as MVGM, as AoP indicates that as soon as residents indicate in the platform that it is not clear how the waste system works, or if Amvest indicates that they want to manage this subject better, they are taken this subject up.

5.3.2. Rules of the game

The rules dimension contains two variables. First, follows the formal rules and legislation and next, the informal rules and procedures. Used data sources are policy documents of the municipality of Delft, literature studies and interviews with residents and experts.

5.3.2.1. Formal rules & procedures

The formal legislation of WM comes from directives of the EU level. Every EU member state must adopt the Waste Framework Directive (WFD) before 12 December 2010. The amending WFD had to

become legislation in the Member States by 5 July 2020, a part of a package of measures on the EU Circular Economy Action plan. Linked to the Green Deal Commission, the WFD is the EU's legal framework for treating and managing waste in the EU (https://ec.europa.eu/environment/topics/waste-and-recycling_en). It sets objectives and targets to improve WM, stimulate recycling innovation and limit waste to landfills. In 2025 the municipal-waste-recycling targets are higher than 55% of municipal waste, which raises to 60% by 2030 (UNEP, 2013; Rusman, 2020).

The municipalities in the Netherlands have a legal obligation to collect waste, but they can determine how they shape this obligation. Therefore, there is a great diversity among the municipalities in the Netherlands concerning the approach to collection of waste, as explained by Matthijs, from the municipality of Delft:

> Every Dutch municipality has a different policy approach to waste collection... It is a patchwork of initiatives in which everyone has their approach, also applied to the demographics found in a municipality as the percentage of high-rise buildings differs, like the number of multicultural residents. Ultimately, every municipality will have a tailor-made system to determine how this is managed... The advantages here are that the best ideas or initiatives will float to the surface in the long term... The approach to high-rise buildings is assessed within each municipality within its boundaries, following the creation of a strategy plan.

Within the municipality, the essential departments in WM processes are spatial planning, circular waste and the operational management of the technical waste systems. With the help of these departments, at the end of 2020, the Nieuw Delft district switched to The New Waste Collection approach, which means waste separation of PMD, OPK, GFT, glass and residual waste is necessary. Moreover, the municipality implemented source separation in all nine urban districts. The municipal WM procedure works with indoor roll containers and underground glass and residual waste containers. The household waste system is kept under control by the municipality, as stated by Heleen, a project developer of Kondor Wessels:

> Household waste is entirely dependent on the municipal system. The municipality has made agreements with Avalex, the waste collection party, and they are not very innovative. We have advised innovative press containers, but the municipality is putting their heels in the sand and indicating that they want old-fashioned roll containers.

5.3.2.2. Informal rules & procedures

The information procedure is informal. Some residents indicate they received information from Avalex when they moved into the apartment. However, they cannot remind what kind of information was in the flyer. Overall, residents must take the first step to find information about the WM system. Avalex informs residents by their website and their self-created app. They refer to these platforms by using an advertisement with a QR code found in the local newspaper of Delft. However, the local newspaper does not reach the residents of the Volt complex as all mailboxes have a standard 'no no' sticker for advertisements and folders because of the informal anonymity rule that belongs to the complex. As resident nr. 4 states:

> You come to live here, but nothing is asked of you. Nothing is explained or said. However, you find out that there are four places to leave paper, plastic and organic waste in the parking garage. And then you also have something as residual waste. But then you must find that there are residual waste containers on that side of the building. But nothing is said, nothing is explained, nothing is told. You must find that out for yourself.

Next to the informal information procedure by the municipality and Avalex, Amvest communicates with the residents via AoP and MVGM. Therefore, they use the residential app of AoP as explained in paragraph 5.2.1.4. However, this app is currently not used to communicate on waste-related matters. The leading information in the app are technical related subjects like ventilation, as displayed in Figure

9 and told by resident nr. 4 "Here you will find all kinds of information about the complex and you can also communicate with each other. But there is absolutely nothing about waste. Which is a missed opportunity." As depicted in Figure 9, the app's primary language is Dutch. However, AoP indicates that the messages shared on the app in the name of MVGM are Dutch and English. Nevertheless, MVGM has a reactive position regarding problem-related elements in the residential complex. For example, residents first need to send a complaint about full containers before MVGM steers the process. Residents hope this would become a more proactive role instead of reactive.

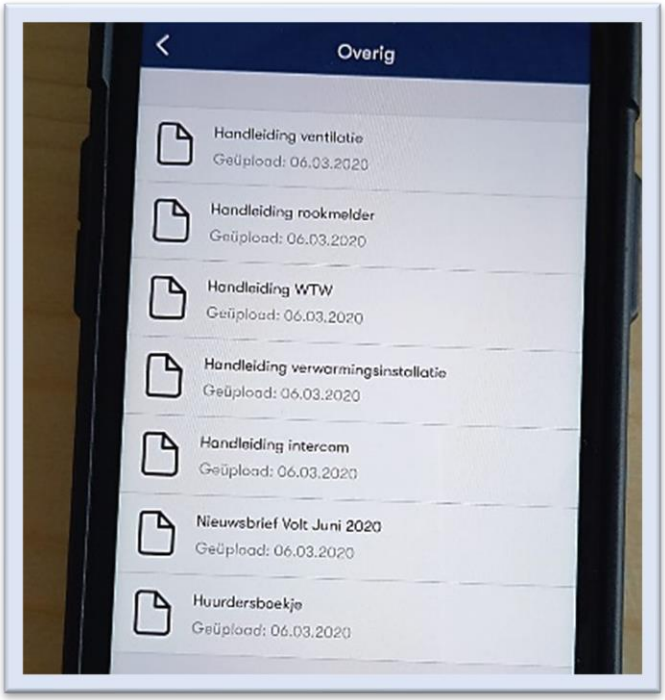

Figure 9: Overview of house service pages in resident app (Author, Friday 25 April 2022)

5.3.3. Resources

The resource dimension contains three variables. First is the personal and knowledge capacity necessary to use the waste system. Hereafter, personal capabilities and motivations for engaging in the process and, finally, the residents' level of autonomy. Used data sources are policy documents of the municipality of Delft, literature studies and interviews with residents and experts.

5.3.3.1. Personal & knowledge capacity

The personal and knowledge capacity of the residents differs, which influences their waste separation behaviour. Nevertheless, all residents indicate they are physically healthy in separating waste properly with the current system. They indicate it helps that there is an elevator in the complex. However, several residents find it disturbing that the residual waste container is outside. As a result, they are less inclined to separate waste because of the different deposit places. Another capacity element stated by resident nr. 2 is:

> Sometimes I find separating waste challenging because they dispose everything together in the city centre. So sometimes I am in such a mood, 'yes hello, everything comes together anyway,' and I need to do my best while I do not know what it should be used for or ends up.

Another capacity obstacle is a one-person household. As resident nr. 6 raises, "As a 1-person household, I produce too little waste, which means that the waste starts to smell quickly before I have enough to take it away. So, I often throw PMD and GFT in the regular waste." This view is being shared with resident nr. 5, as he explains that GFT waste stream smells in summer after one day of storing it within the apartment. Moreover, in his view, WM needs to fit into his routine. It is a daily activity, and it must take as little time and consideration as possible. As he puts it: "You do not have to have an education to be able to separate your waste. That is not something you can ask an average citizen." Therefore, he only separates OPK, PMD and glass. The reason why he and others are not separating GFT in the containers in the garage is:

> I throw it with other waste because I find it difficult. I might be able to do it independently, but that will stink quickly. So, I would rather throw it away. I do have a separate container for organic waste, but that is more for cooking or something. Then I throw it in there first and later in the residual container.

The installed WM system also influences the separation behaviour of residents, as explained by resident nr. 5 “I adjust according to the system. So indeed, what goes in bin one, I do in bin one.. I would probably have used it differently if that had been classified differently.”

This element links with the knowledge capacity. When people have insufficient knowledge about a product, they have less separation behaviour than when it is clear to them how to separate it. Resident nr. 7 immediately indicates that he has insufficient knowledge to properly separate waste in this process as there was no information on how the system works. The other residents indicate that they have sufficient knowledge, as illustrated by resident nr. 5 “If you live here for two years, you will eventually have it. That is not the case in the residential tower for people who have just started to live here.” However, with probing questions about mixed packaging materials or plastic flows, residents indicate they start to doubt their knowledge like resident nr. 1:

> If I have a package of two parts, I will take it apart. However, sometimes you have a packaging that partly contains paper with a plastic layer over it, then I do not know where to add it, so I will just do what I think it has to.

At that moment, when in doubt, they throw in the bin what makes the most sense from the packaging material. Two of the eight residents have indicated that they sometimes look up information if they do not know about the product. Other residents do not take the initiative to look up information if they have insufficient knowledge. Therefore, the responsibility lies entirely with the residents and their capacity to separate waste.

5.3.3.2. Personal capabilities & motivations

In the process of involving residents in WM in newly developed high-rise complexes, there is no specific division of roles with all parties involved in Delft. As the municipality indicates, there is currently little or no opportunity for residents to participate in the system with WM processes “It is a one-way street now, we send a lot, but we receive little... Within Delft, the waste sector is not really on the back burner concerning citizen interaction and participation processes. So, there are still improvements.” The municipality does indicate that, since the new collection approach, they have been trying to implement participation processes. The point they ran into with Volt was that it was developed during the Covid-19 pandemic. As Matthijs from the municipality of Delft indicates, "We were unable to do this for the past three districts because of Covid-19. What we have done then is not participation but communication. So one-way traffic with customized communication and we developed a flyer."

Moreover, the municipality indicates that new free sector rent complexes are developed monthly. Therefore, if they need to arrange a participation process for every complex, it would be a high intensity of work to arrange all processes. The opposite goes for social housing complexes, as Pauline from the municipality of Delft points out:

> Things go better with social housing because the complex manager asks the municipality if they can support with flyers to inform the residents. This does not happen in the free sector complexes as it is problematic regarding the number of letters that must be sent, and that does not happen either. So that might be an improvement.

The municipality indicates they try to challenge project developers to think more actively about how they want to organize their waste with support from the residents. However, the municipality often sees the project developer choosing the most accessible way, and they build a container space following the standard procedures as explained in paragraph 5.3.1.4. Stakeholders like the municipality, Avalex and AoP have an issue. They only have contact with residents now when they move into their homes. They would prefer to know this earlier in the process, like Amvest, so they can coordinate with the residents and let them participate within the WM system. However, Amvest indicates that they are only aware of the contact details of the registered tenants three months before the complex is completed. This makes it difficult for them to arrange a participation process. This view is the opposite with the municipality as they see possibilities in participation processes that can take place as soon as the building is completed and residents move in, as it often takes a month before all residents are settled.

When looking at the residents' perspective, 7 out of 8 indicated that they found it a pity that they could not have a say in the process. As resident nr. 1 state, "Yes, I always like to think along about policy matters and especially because you have to implement it yourself, so you are the one who has to use it, so yes, I think that is useful." Therefore, they thought it was a shame that the only means they received was a letter to residents from the municipality with almost no information that the residents could remember. The ideal situation from the resident's perspective would be a participation process initiated and led by the municipality and property owner.

5.3.3.3. Level of autonomy

The level of autonomy is high for the residents as they all have the autonomy to create waste places in the house and have the freedom to use the waste system as they like. They have the choice of how to separate and where they dispose the waste. This freedom in autonomy is partly caused by the information deficit on the waste system and the lack of incentives and control over residents. However, when asking the residents about incentives and if the Pay As You Trow system would solve this issue, they are unanimous as they think this system has a deficit as there is no control on the residents, which leads residents to get creative and dump there waste at other places. Next, residents need to inform themself how the system works and where the containers are placed, as this information is not provided in the Volt residential complex. Resident nr. 5 indicates he knows the system by "Walking by and find it yourself." This level of autonomy can also be seen in the bulky waste area created next to the residual containers, which is in principle elsewhere. Figure 11 depicts the bulky waste area created by the residents marked with the blue dot. However, the official Avalex spot for bulky waste would be at the yellow dot, as explained by resident nr. 4 and shown in Figure 10:

> Residents have tried to put old washing racks in underground residual containers. Of course, that does not work either. But people do not know where to put it, so of course, you get that.. Additionally, if you look at that Avalex app, there is another corner where residents need to dispose of their bulky waste. What is currently lying next to the residual containers is not the intention.

Moreover, some residents indicate that when waste streams like glass and GFT are small compared to the other waste streams, they become lazy in separating these streams as GFT is a high maintenance stream, there is no close-by glass container, or they do not have the information on the places of containers. Another element of autonomy is the possibility of disposing of the waste early in the week, as resident nr. 5 indicates:

> I have seen it once in the past that you come down and the cardboard box bulges out all the way, and you see that there are things next to it.. However, I must say that in my routine, I empty my waste at the beginning of the week because then I know that they have just been emptied, and I do not have those problems. I think they are emptied on Monday. So I usually go Monday, Tuesday or Wednesday. So I never have a problem with it. If you do it at the end of the week, you will have a problem, and they will be full.

Figure 10: Lay-out Volt complex (https://www.hureninvolt.nl/, 2022)

Figure 11: Residual underground container (Resident nr. 4, Thursday 21 April 2022)

Resident nr. 3 indicated that because she has no faith in the system within the complex, she disposes her waste somewhere else close to the complex:

> Yes, we now separate PMD, GFT, cardboard, glass and residual waste. We actually can place everything except glass in the garage. However, I rarely do that. Usually, I go around the corner, next to the water. In those bins, you can put it properly. I do this because, in the beginning, I noticed that everything did not end up in the right place, so what happened with GFT, it was no longer taken and left standing in the parking garage, so that is not fresh either.

5.3.4. Discourses

The discourse dimension contains two variables. First, the diagnostic discourse is provided about the obstacles of the process. Hereafter the prognostic discourses follow about the solutions to the problems. Used data sources are Dutch literature studies and interviews with residents and experts, as described in Table 5 and 6 in Appendix I.

5.3.4.1. Diagnostic frames

The residents and experts have several diagnostic frames of the installed WM system and the accompanied arrangement in the Volt complex. The diagnostic frames contain four main categories that emerged after the coding process, from the interviews with all residents and the expert interviews. The four emerging categories are the behaviour of residents, the role division between the stakeholders of the WM process, the information and engagement process and the related technical elements of the current WM system. The categories do not have a specific order from the highest to the lowest obstacle. However, there is a link between the four categories as they all influence each other.

Behaviour of residents

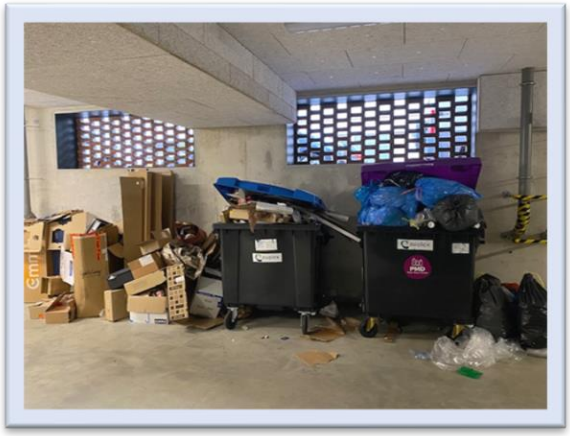

Figure 12: Storage inside (Resident nr. 4, Thursday 21 April 2022)

Pauline and Matthijs from the municipality of Delft note that residents with an ethnic background often separate less than people with a Dutch background. They think these residents are busy with other things or have insufficient knowledge of how the system works. This view is shared by resident nr. 2 as she says: "I just know that there are quite a lot of internationals living here and there is not enough explanation, so other things end up in the waste bins… they do not understand new complex systems." As resident nr. 4 states: "I see Chinese residents who walk through the building with leaking garbage bags. But has anyone ever explained that to them?" Same for resident nr. 3: "It may not be clear to everyone. I can imagine that expats are used to other collection systems. I do not know the reasons, but someone had added their own vacuum cleaner at some point. “Another aspect that Amvest encounters is that they notice tenants have become conscientious in character, and as a result, large flows of OPK come from high-rise complexes. Moreover, because residents do not flatten the boxes, the system's capacity is incapable of functioning correctly, as displayed in Figure 12.Resident nr. 1 refers to residents who dispose of their waste quickly because of convenience or disinterest. Residents with busy jobs or children have other daily activities to do. It has no space in their daily routine. Via informal posters, people try to appeal to a better separation behaviour. However, residents do not care about this message because of the informal look, as displayed in Figures 13 and 14.

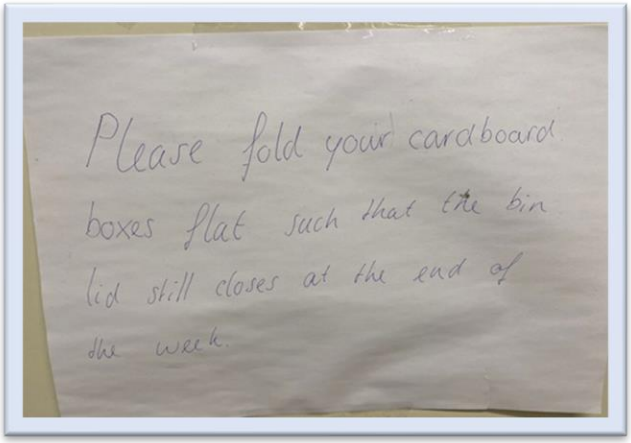

Figure 13: Informal information paper on waste separation behaviour (Resident nr. 4, Friday 15 April 2022)

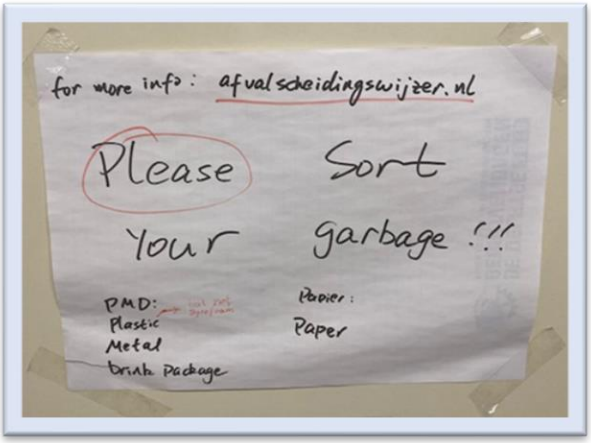

Figure 14: Informal information paper on waste separation behaviour (2) (Resident nr. 4, Friday 15 April)2022)

Some residents show a lack of waste separation because they lack the interest in separating waste because of the placement of the containers as stated by resident nr. 4 and displayed in Figure 15:

> On early Monday morning, those containers must go outside. Then those containers are sometimes outside for three or four days... So, what do people do, they do not walk out to the container, but they aim it at the place where the containers typically stand, while there are no containers. So, nothing will come of it from all that separation.

Figure 15: Storage inside (2) (Author, Monday 25 April 2022)

When providing furniture to tenants, such as built-in bins, Amvest indicates that residents who own an owner-occupied home deal with furniture differently than tenants. Tenants are often incapable of managing waste and built-in furniture well. That is why Amvest is hesitant about providing a bin in an apartment as they experience tenants managing trash bins poorly, leading to more investment, energy and time to maintain the apartments.

Another behaviour aspect is explained by the municipality and resident nr. 4 as they notice that collection locations used anonymously often look worse when there is no anonymity between the residents in a complex. As made clear in paragraph 5.3.2.2. the Volt complex has anonymity among the residents. As a result, the residential complex has no cameras or nametags at the front doors. The anonymity was partly done to the idea that the complex would be a transfer location. As a result, residents are completely anonymous when they deposit waste. Matthijs from the municipality of Delft thinks, in his view, anonymity needs to be tackled to improve the process. Residents must be called upon to direct each other and point out when they are not behaving well. However, he sees difficulty in solving this.

Role division stakeholders

The Project developer Kondor Wessels indicates that the agreements between the municipality and the waste collector form a blockage for new and innovative waste systems. The municipality and Avalex prefer to use the policy of roll containers in the municipality of Delft. This is because changing the financial agreements between both parties is difficult. However, project developers indicate roll containers are an old and misplaced concept with newly developed high-rise complexes. Pauline and Matthijs from the municipality of Delft share this viewpoint:

> I must say that we as a municipality are rigid. The waste organization in a new high-rise location is, in principle, up to the builder, but that must be compatible at the last minute with how the

> municipality collects it... We as a municipality are quite persevering in this, you can develop whatever you want, but if it does not match the municipal collection, that is not our problem.

Heleen from Kondorwessels explains the reason for the static position of the municipality as WM processes in high-rise apartment complexes is a complex process where expertise and resources are necessary to manage the process adequately:

> It is difficult because Delft is a small municipality with large tasks. The project teams are small and not experienced. I can imagine that Utrecht contains much more knowledge and that there is the power to make things possible. In Delft, we are simply working on an 'un-Delft' development, so the Municipality of Delft does not know what to do.

Another obstacle with the role division is in the phase when the complex is delivered and comes into use. As resident nr. 5 indicates, this phase was unclear, uncoordinated, and insufficiently arranged between all parties:

> Loads of people went in simultaneously, and then they did not consider that everyone arrived with boxes and construction waste. So that piled up very quickly. Furthermore, there were problems at the time because it was not adequately arranged with the waste collection.

This perspective is shared by resident nr. 2 as she explains that the role division and facility management tasks were not aligned between the managing parties. This led to the request that residents support the WM process: "At the beginning, they had problems with cleaners. As a result, they had made a call in the residents' app, who would like a side job to drive those containers out, so that was bad at the time."

Information and engagement process

The municipality points out that the information provision about waste separation from the municipality and waste collector is limited. As Pauline from the municipality of Delft indicates, "We do have brochures about separating waste, but that is fairly limited. There we see points that we like them ignore." As a result, limited information is available to the residents, and residents need to take the initiative to look up information on how the separation process works in the complex. Amvest confirms this by stating that the role division between the parties regarding the information provided to the residents is unclear to them. All residents share this viewpoint as they say they received some information from Avalex when they moved in. However, they do not remember what was in the information letter. But as resident nr. 3 points out: "I think you received such a standard message from Avalex. Nevertheless, it is true that you only look at it when you need it."

Among other things, resident 8 indicates that, as an international woman, she would prefer it if it were easier to find where other types of waste, such as textiles and batteries, can be dropped off. It is unclear to her, and she does not know where to go with these waste streams. This leads to the behaviour she reluctantly throwing these streams into the residual waste.

Technical waste system

Most residents think the current system is filthy, smells, has not the sufficient capacity and is unclear. Every resident indicates they reach the point where the current system lacks coordination with the users. The indoor roll containers are often full-on weekends, leading to waste placement next to the containers. Residents no longer flatten their boxes or put their bulky waste next to the containers, as displayed in Figure 16 and confirmed by resident 8: "My only concern is that the containers for paper and plastic are often full, and some residents do not sort them properly and efficiently (boxes not folded, for example)." Next to this, resident nr 5 states: "It is not always 100% insensitive how people use it. Because I often notice that the lids from the residual containers are stuck. So that is not ideal."

Another technical-related obstacle links with the GFT waste stream. GFT is a high-maintenance stream to separate from the residual stream, as confirmed by most residents. They find it too much trouble to deposit GFT in the garage because of the daily smell indoors. Some residents make it evident, like resident nr. 1, that their waste separation behaviour is negatively influenced because of the installed system:

Figure 16: Storage inside (3) (Resident nr.4, Sunday 10 April 2022)

> That influences my separation behaviour. In principle, I can deposit at the green bin, but then I must do that every evening, and that bin is somewhere else, so on the other side of the garage. Maybe if that bin was in that same loft, it was more accessible. If there were a glass container here, I would take it there. But apparently, I think it is too much trouble to drive another glass container somewhere. I still live here shortly, so I do not know where they are very well, but that is nonsense because you can look up a glass container like that. Moreover, in that sense, I am concerned about the system in place now, the idea is excellent and fun, but in practice, I think it does not work well enough.

This view is shared by resident nr. 3 as she indicates the waste separation behaviour and the system:

> You notice in practice that options are offered, such as in the basement that there are large bins where you can store cardboard, PMD and GFT. However, when the complex was delivered, most of it was waste, because everyone is new to it due to renovation and new stuff, it bulges in no time, or things end up in the wrong bin... It is offered, but in practice, it works not'.

Next to the technical system, residents indicated the design of the system was insufficiently developed and had many flaws. In residents' houses, there are spaces left in the kitchen that could be filled in with inbuild containers, but it is currently lost place as it is too small for an external object. Another resident indicates that the private waste area to dispose of PMD and OPK is dark and feels unsafe to walk through. Another obstacle resident nr. 5 indicated links with the roll containers outside the complex, which is displayed in Figures 17, 18 and 19:

> The only thing I can say about what they did not do well, and I wish they had done it differently, is that when they are going to empty the bins from the parking garage, they put them all at the entrance to the parking garage and that is just not convenient, and not safe. I do not have a car myself, but my roommate does, but if those bins were there and you drive out of here, you cannot see anything. And cyclists are coming from both sides, and he has had several times where he almost hit a cyclist. It is just not convenient. Even if the wind blows, those bins will start rolling on wheels, which is simply not done well.

Figure 17: Storage outside (Resident nr.4, Monday 25 April 2022)

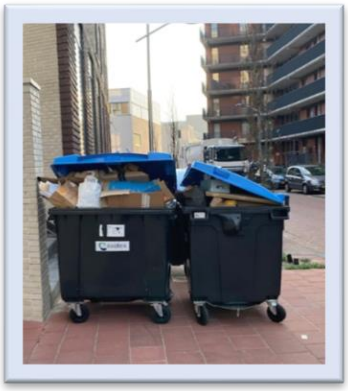

Figure 18: Storage outside (2) (Resident nr.4, Monday 25 April 2022)

Figure 19: Storage outside (3) (Resident nr.4, Monday 25 April 2022)

5.3.4.2. Prognostic frames

To solve the current perceived obstacles, residents and experts also have several prognostic frames on the four main categories explained in the former paragraph. The prognostic frames are about solving the obstacles to the current role division between the stakeholders of the WM process, the information and engagement process and the related technical elements of the current WM system. The prognostic frame on role division is mainly from the perspectives of the experts, as the residents are not aware what the current role division is between them, therefore, they are not taken in account with this category. The prognostic frame on the information and engagement process, comes from the first interview with the residents and the expert's interview. The last prognostic frame comes from the insight after displaying the menu card with the second interview with the residents. Adjustments to the behavioural aspect of residents have been left aside as this was not part of the menu card. However, residents think this aspect will change when tackling the other three categories. Like the diagnostic frames, the prognostic frame categories influence each other and do not have a specific order in prioritising the solutions.

Role division stakeholders

To solve the indistinctness of where to find waste-related affairs in the Volt complex, AoP indicates that integrating a waste service platform in the residential app is a change in improving this process. At this moment, it is not a standard part of the process. However, they are interested in developing this idea further, just like Amvest.

One element that needs to be clear for Amvest to incorporate this field in their process is when the role of division of information provision is evident among the stakeholders, including the municipality of Delft. The ideal citizen engagement process for AoP would be a form of a questionnaire which runs via the resident app, which Amvest has access to and where they communicate with the residents. This process can support Amvest where they can assess for themself whether adjustments need to be made in the complex. To realize this process, AoP needs insurance and explicit instruction from the municipality and Avalex to indicate the complex's WM process, adjustments and regulations. Hereafter, MVGM uses the platform to communicate this information directly to the residents, and in the end, the responsibility lies with the residents to keep each other's behaviour in order.

For Avalex, the problem with the role division is that they do not know how many residents move in when the residential complex is developed. As a result, the waste collection process is often poorly coordinated in the first three months of the residential complex. Their solution to this problem will be if they know how many residents are moving in earlier in the process to better coordinate the system with its users.

Information & engagement process

Every resident likes to have the opportunity to receive information about the WM system and get insight into the processing streams and the impact of incorrect waste separation on the environment. At this moment, residents have no view of the consequences of their behaviour. Most of the residents indicate that this insight can support them in stimulating their WM behaviour.

There is no unanimous answer on what the format of information provision needs to look like. However, when the format is formal and indicates it comes from the municipality or property owner, most residents consult these letters as explained by resident nr. 1:

> Yes, a flyer or an e-mail... An e-mail might be. If I had received your letter by e-mail, I thought that it was spam. However, the housing corporation has an official e-mail address, so I usually read it, but then you risk that people will throw it away sooner. Often if you now receive something by post, which is often nice because you only get a few things in the letterbox… A clear title will help, then you immediately know what your e-mail is about and that you mention participation or something in your title. I think that will help.

The municipality's perspective is that they communicate much when a neighbourhood is developed. However, this is not the case with newly constructed districts. As Pauline from the municipality of Delft states: "This could be an opportunity to tackle this further in the future. For example, in a passport that provides information about roll containers and communication to residents, Avalex can provide eight weeks before it is delivered."

AoP sees opportunities with a participation process as a short questionnaire, as explained in the sub-paragraph about role division. Therefore, residents living in the complex for six months can have a moment of reflection. Elements other than waste-related topics can be inserted with this. Example questions are 'What do you think about the WM system now? Do you feel that your neighbours know how the WM system works? What questions do you still have about the WM system? What are the most important improvements for the WM system?' Multiple residents share this viewpoint of AoP as they would have preferred to have an option to have a short survey via the resident app where the project developers indicate their intention, so residents can have a quick look and provide feedback if it is necessary. With the current process, as resident nr.5 points out: "Now it was just we will see what comes next. We will send in a complaint if we do not like it." Next to this perspective, resident nr. 2 indicates:

> We knew for a long time that we would live here, but it took quite a while before we got the key because the construction took quite a while. In that period, Amvest already knew that many people came to live here, so they could have sent all those people an e-mail from how do you see the system? That did not happen, so that is a shame.

To steer the waste separation behaviour of citizens and provide them information on the different streams, some residents think it would be nice if there were an information template as resident nr. 2 indicates:

> Somewhere I cleaned, a woman had been given a sticker with what should go where. Then I thought it was excellent that they give people something like that or a folder where they can find it. Because now I must search on google every time, and with some things, such as new packaging, I do not know very well.

Hereafter she explained this it would be helpful to have this kind of information in the residential app if it is updated when the policy is changed, or new kinds of material streams are created. This view is shared with resident nr. 4 in the way it would be incorporated in the resident app: "Yes, that is a good and smart idea... If this can be incorporated in the Area of people app, that would be a good concept." However, for him, the essential element to steer in the waste separation behaviour of residents is to: "For me, the most important thing is information. Permanent information and awareness among people.. Or you might have to look it up yourself, but if people have to take that step themselves, that can be one step too many." In his opinion, repetition is the most crucial aspect of using a technical system that is shared by multiple residents living in a high-rise apartment building:

> It is repeating very often, mainly because this complex is where a lot is moved... So, because you know this, and that it is such a varied group that lives here, you must repeat and ensure that it is constantly available... You need to have a system that informs your people well, in all kinds of languages. Because Korean, Chinese, English, Spanish, Portuguese and Dutch are spoken.

As residents indicate, the cruciality of information is especially important for innovative waste systems. Residents must know how the system functions and the vulnerability caused by human mistakes. An example is provided with the shuttle system in the hallway as resident nr.3 states: "I think there should be good instructions and not just an introduction letter, but maybe on the spot. That you understand why certain things cannot be done in it."

For some residents motivating factors to be more engaged in the process are like resident nr. 1 state: "When management approaches me... I will not take the initiative. So, the initiative must lie with the management of the complex." Next to this is the transparency of the outcomes from the participation process. Residents need to get the feeling that their contribution was not for nothing. As resident nr.3 clarifies: "There is extra motivation if you know where certain flows go. Suppose you know, for example, that the GFT is being used somewhere at a local project, then that provides an extra incentive." The format of engagement is different for the residents. Some prefer to have a resident meeting. Others prefer to have a questionnaire. 3 of the 8 residents do see that a questionnaire would be more accessible for most of the residents, but with a physical engagement format, there would be more impact as

experiences can be shared more in detail, and residents can meet each other which leads to a less anonymous environment.

Technical waste system

After displaying the Waste Menu card to the residents, the solutions on the WM system's technical-related elements differ per resident. For example, this difference is depicted in Table 4 about the number of waste streams. Resident 7 indicates that he prefers to separate two types of flows: non-recyclables and recyclables. Resident 6 indicates that he only wants to separate glass and OPK and that the rest is for post-separation. Moreover, if residents need to invest much effort to separate their waste, they refuse to do it. Waste separation, in his view, must be accessible. Next, two residents indicate difficulty separating GFT waste from the residual waste, and the other residents indicate that they are happy with the current form of separation. Even three residents indicate they prefer to have more waste streams they could recycle than the current system provides. This shows that each resident has a different preference concerning the number of waste streams.

An element where residents on align is on the depositing locations of streams. Residents like it when all waste streams are collected in one place or container closer to home. Therefore, the current system is not ideal as the recycle flows are inside and residual and glass stream is outside. As resident nr.3 makes clear:

> If you want to make it easier, you stimulate people if they can do several streams in one place. For example, if it is only residual waste, then it is, of course, quite a chance, then I throw everything in it if you need to walk for the other streams.. it becomes an extra step you must take. When all streams are together in one place, you have the best separation process.

Additionally, all residents find it essential that the waste system in the house is easy to clean and can be maintained, for example, with a carrying system to dispose of the waste in the containers. The system must preferably be concealed so it cannot be seen in the home, like a cabinet system in the kitchen. Residents think the essential aspect is that the system is not complex and easy to break. Therefore, the overfilled containers should not be possible, as people with this system can no longer dispose of their waste or it starts to smell. As resident nr. 2 makes clear: "I sometimes jump in the paper container because there is not enough space. However, that is quite dangerous because you do not know what people put in it... If a device does that, then I do not think much can go wrong." Therefore, she and other residents liked the idea of a press container system to improve the maximum capacity the system could hold. Residents have conflicting opinions about the food grinder. Residents indicate that they want to get rid of their GFT faster and easier and that it takes too much effort to bring it to the basement daily. On the other hand, they indicate that the food grinder is not a good idea. As resident 6 indicates, "A food grinder is a very American, dirty and unsafe system." Other residents are afraid that it costs much maintenance and gets dirty quickly or that it is a too expensive and significant investment for a small kitchen, and residents think WM systems are not important enough to invest in expensive systems. What residents do think is interesting is the GFT container. Therefore, they would be more likely to separate GFT from the residual waste if the complex's owner provides this container. If this system is linked to a local GFT compost container and a community garden, the people who do not separate GFT would change their behaviour. For innovative waste systems, they must match the interior of the residential complex. Additionally, it must be technically and spatially possible to use in the apartment. As many residents indicate, interim waste storage in the hall is not a clever idea because it takes up much space or it gives a nuisance when it starts to smell. Resident nr.8 linked this issue with the shredder in the kitchen and the chutes in the hall. She states that she has experience with chutes in America and that these are very susceptible to interference, so she does not expect that her separation behaviour would improve with this system:

> I used to have it in my childhood, but the pipe got stuck quickly and was never used again. No, I think it would only create extra problems and costs. I do not think it will motivate people to sort waste if you need to pay every time.

What is shared by the residents on the perfect WM system in high-rise apartment complexes is stated by resident nr. 1, in which the waste separation would be optimal is:

> For new construction, I would do such compartments as a storage box in the kitchen. However, the OAT (Underground Waste Transport System) or chute system is the most optimal. Then you only have GFT and glass, which you still must do. Then you could use the green container for that and then the compost container outside it, and then for glass, you have the glass spinner. That is the perfect solution.

6. Results

After outlining the findings, this chapter will answer the sub-questions stated in paragraph 1.2, 'Research aim and questions.' The research questions are answered by reflecting on the empirical data with the two theoretical frameworks of the PAA and SPT. Paragraph 6.1 focuses on the organizational dimensions of the Volt complex's WM system. Paragraph 6.2 emphasizes the resident's meaning of waste and diagnostic discourse on the WM system and participation process. Finally, paragraph 6.3 elaborates on the preferred solutions for the WM system by the residents and the experts.

6.1. Research question 1

The first sub-question, 'What is the (in)formal waste management system and the participation procedure of the Volt residential complex', is answered through the organizational dimensions of the PAA and the materials and WM competences dimensions of the SPT. As the most critical stakeholder, The Municipality of Delft, manages the WM system in Volt together with waste collection organization Avalex and property owner Amvest. In Volt, they use the new way of waste collection in which recycling flows OPK, GFT and PMD are collected inside in roll containers and residual and glass waste outside underground containers. At the beginning of the week, Avalex collects the waste next to the complex at the parking garage's exit. The cleaning staff whom MVGM controls mobilize the containers of the recycle streams from inside to the garage exit. The waste system complies with the formal Delft legislation, which the municipality checks.

The waste separation behaviour of residents is addressed in an informal way, where residents have substantial autonomy to take control of their separation behaviour. Residents send in complaints via the residents' app, which AoP manages. In response to this, the relationship manager MVGM has a reactive position in resolving these complaints. As a result, the initiative lies with residents to mobilize the system's controllers to improve the system. Additionally, the residents receive minimal information about the process, which leads to their WM competence of the system and separation behaviour is not directed via the waste policy arrangement. Moreover, Volt has not undergone a participation process. Therefore, residents are not involved in the management and design process of the system. The municipality, Avalex and Amvest have not taken the lead in this. All three parties indicate that they find this a complex issue regarding the role division in this process.

The PAA outlines the controlling stakeholders, and the Volt complex's theoretically designed WM system and procedure. Moreover, it shows the role division of all parties involved in the process. With the incorporation of the SPT, the practicability of the designed and implemented system illustrates which materials are available to support residents in their WM and how residents retrieve knowledge about WM in Volt. The integration of both theories provides, as a result, that the theoretically designed system does not align with residents' WM practices. Some state that their waste separation behaviour is negatively influenced by the designed and installed system and the information procedure. In addition, the WM separation practices are entirely in the hands of the residents. They are not guided in the process or given information about how the system works, so the theoretically designed system loses its effect because there is no engagement in the process.

6.2. Research question 2

The second question, 'What is the residents' interaction with waste and discourse on the current waste system and participating procedure' is answered via the PAA's diagnostic discourses dimension and the meaning dimension of the SPT model. The four main obstacles that influence the residents' waste interaction and separation practices are the behaviour of other residents, the unclear role division between stakeholders, the insufficient information and participation procedure and the technical system deficiencies.

In short, the interaction with waste per resident differs which can lead to frustration between residents. One resident makes it clear that she is aware of her purchases and tries to limit this to that extent. Three residents show their awareness of the waste separation behaviour. However, they do not want to make concessions in their purchases. Two residents find waste separation to a certain extent necessary so that they do not separate GFT from residual waste because they find it too much work to deposit daily. The other two residents indicate that waste separation belongs to the post-separation

process and that residents play a small role in the system. Because of these differences and the anonymity rule, residents are afraid to correct other residents incorrect waste separation behaviours.

Secondly the problematic role division between stakeholders and the information and participation procedure link with each other. There is no clear indication which party is responsible for the initiation of informing residents or the engage with them about the system. Because the division is not clear between the municipality, Amvest and Avalex, the process has little or no information which leads to residents must find out themself how the system works and are not guided in this process.

Lastly, when looking at the technical deficiencies the current system is scattered, causing some residents to neglect to separate waste because they must go to different places. Therefore, if the nuisance becomes too large, it is counterproductive in their motivation to separate waste. This is further explained in paragraph 6.3. Therefore, in the end the current system negatively influences the residents' interaction with WM because there is a knowledge deficit in the system, has unsuitable materials, no clarity and provides a nuisance. The flows that have this problem are PMD and GFT and are less managed due to the lack of knowledge, hygiene, and shortage of available storage space.

Because of the focus area on WM practices, the meaning of WM could be researched. The residents' interaction with waste provides a better understanding and substantiation of the diagnostic discourses on why the theoretically designed system lacks alignment with residents. Moreover, with the integration of the meaning of waste, the element of citizen engagement could be understood as why residents would like to play a part in the design and implementation process of a WM system, as they can provide an understanding of what is necessary to influence their WM practices positively.

6.3. Research question 3

Mixed answers arise on 'What are the prognostic discourses of the residents and experts on the current system and procedure', derived via the prognostic discourse dimension of the PAA. However, several elements correspond to the more significant part in terms of the wishes of the residents that will solve the diagnostic frames in paragraph 6.2.

The WM routine must balance the intrinsic motives for acting in a sustainable friendly way and the extrinsic motives with the accompanied situational factors. This can be improved when residents get transparency in the waste flows or are locally progressed. What links with this is the element simplicity and straightforwardness. Systems that can support this, such as incorporating explanations into the resident app, are embraced by many residents. Therefore the communication between stakeholders and residents need to be improved. Moreover, the municipality, Amvest and Avalex need to align who the responsible actor is in providing the communication of the system and who the initiator will be of the participation process.

Another factor is, the system must be aligned with the user's waste production behaviour. Often the size of waste flows is seasonal, which must be anticipated by Avalex. They indicate that Avalex is too static to anticipate the seasonal activities of organizing WM. Therefore, Avalex should improve its static character to a more dynamic one. Another aspect is that the system must be hygienic to separate waste. If the system smells or is dirty, they are less likely to separate, as seen in the GFT stream. If this flow is stored in a resident's home in a non-smelling way, people are more likely to do so. Sufficient capacity is another element it must meet. Systems that can improve this, such as a press container, are embraced by most residents. Finally, a frequently occurring element is accessibility. The plurality of residents indicates that if the system is closer to home, or whether all flows are collected in one place, the separation behaviour is positively influenced.

The prognostic discourses of the experts are similar among the actors. All actors indicate that they prefer coordination with residents to receive fewer complaints about their actions while also improving the separation behaviour of the residents. Additionally, they indicate to improve the complex commissioning period, they must be aware of the number of residents sooner, including the corresponding contact details. And lastly, all actors share that there must be a better role division between stakeholders, with the municipality taken up the lead. They believe that a passive citizen engagement process in the form of a semi-annual survey can be an exciting first step to receiving feedback on the process.

7. Conclusion

This is the last chapter of the report which includes the conclusion. After the conclusion, follow the recommendations and discussions. Lastly, a short reflection is described on the researchers' steps and decisions.

7.1. Conclusion

The aim of this research was to develop a sociological account of the necessity of engagement from residents living in newly developed high-rise rental apartment complexes. Therefore, one-side determinist approaches by the decision-makers are avoided with WM systems. It is worth mentioning that this shift is necessary to promote sustainable WM in high-rise rental apartment complexes. Integrating the theories of SPT and the PAA offers a fruitful starting point for such an shift because they focus on the WM system's policy arrangement and the agency and subjectivity of residents' practices. Therefore, these theories can support to answer the central question of *'How does the waste management process function in a newly developed high-rise rental apartment complex without incorporating a citizen engagement process, and what are the lessons from the Volt complex for new development plans?'*

According to the data, three main statements are formulized. The first is about how the WM process functions without engagement from its residents. Residents feel they are not a part of the design process, which leads to a coordination deficit with the theoretical designed system compared to the operational system. The system is incapable of coping with the user's waste production scheme. Secondly, when there is no engagement by residents, the communication process needs to be sufficient to steer residents in their WM behaviour. When this process is not in place, residents are clueless about how a system works. This is not a problem for many Dutch citizens as they are familiar with the Dutch WM system. However, international citizens living in the Netherlands cannot receive information as many platforms and guidelines are in Dutch. Therefore, this group is left out in the process, leading to an information deficit. Lastly, the miscommunication between the involved parties is also a consequence because of the inadequate planning process. The role division between the public and private parties is unclear with the information and participation process. Moreover, every party has a channel that is not aligned with the other parties' channels. Therefore, every platform misses its purpose as residents are ignorant in visiting these channels.

These three statements in misfunctioning the WM process in a newly developed high-rise apartment complex can lead to lessons that can be used for other new development plans. The first and most important lesson is to start a participation process for residents so they can engage and provide feedback in the process. The principles that need to be integrated within this process are integrity, inclusiveness, dialogue and influence. The form which is suitable to start the shift in planning these processes, is to insert a passive form of engagement. Moreover, provide residents with an opportunity to engage in the process via a two-way communication stream with the municipality or project developers as initiators. They can use several communication channels like face-to-face meetings, surveys and half-year questionnaires about the living environment with questions on what their perspective is on their living environment. The technical specification lessons about a WM system is location specific. The system needs to be tailor-made or aligned with the target audience of the building. Nevertheless the factors which are essential for every living environment are simplicity, accessibility, sufficient capacity, clear and hygienic. When these factors are missing in the system, residents tend to show less separation behaviour because they feel the system is not well-designed. The third lesson is about creating a community by reducing the anonymity of the living area. Embrace creative and local solutions for material streams by recycling the streams close to their living environment. Let residents know what is happening with the waste streams by being transparent. Residents like to know the results of their engagement effort.

These conclusions are retrieved with the integration of the SPT and PAA. The SPT has made it clear what the essence is of looking at citizen practices to gain insight into the obstacles that residents have with the current waste system. The PAA has identified which improvements are desirable and what the current playing field is for all involved actors. As a result, citizen engagement processes can be investigated through the middle position between the actions of individual people, the influence of external structures, the investigation of interactions between actors and structures and the content and

organization in policy domains. While participatory projects may be well designed in terms of general principles of institutions, their effectiveness remains to be seen with people's practices. This is because people may react differently to designed systems, rules and norms than expected given their local and situational logic. Research into the interactions between policy and practice will unravel the possibilities for interventions to improve the processes of citizen involvement with spatial planning processes.

7.2. Recommendation

A few recommendations follow after this study to investigate if the integration of the PAA with the SPT is applicable in studying multiple types of citizen engagement processes. First, this research focused on a single case study in Delft on the household waste stream without a participatory process. Moreover, the Volt complex is aimed at free sector rent with higher educated people. Research into multiple case studies in other types of housing and residents, such as social housing, ethnic backgrounds and studios, would be insightful to see whether other measures should be considered in designing the WM system and process. Secondly, the Volt complex did not use a participation process when Volt was developed. Therefore, other complexes with a participation process could be interesting to see if the lessons align with the case of Volt. Furthermore, to continue this case study, it may be helpful to investigate the role division of every stakeholder regarding the information and participation process provision towards the residents. Focus points can be on which channels and platforms can be used to direct and guide the engagement of residents.

7.3. Discussion

Several limitations must be noted as this research is a single case of four months. First, the research process's limitations are discussed and hereafter follows the data limitations.

7.3.1. Research process

This research initially had a broad orientation on the various international best practices in zero waste movements and participation process with WM. However, during the research, the minimum response from international experts and municipalities led to a change of direction, mainly to one case study in the Netherlands. The municipality of Delft struggled with the problem of citizen engagement with WM processes. With the change of direction later in the research process, much time had been lost in the beginning phase to investigate the case study in detail. When the research focus would be at the beginning of the internship, the single case study would have been researched more extensively, where the role division between stakeholders could be incorporated into the conclusions.

7.3.2. Limitations of the data

The most critical limitations come from the sample size, with 13 respondents divided into eight residents and five experts. Moreover, only five residents were interviewed, and three sent in a questionnaire. With the experts, only two did an online interview. The other three preferred to have an informal phone call. This number of respondents is not enough to make statistically relevant conclusions. Even though it was not the aim to be statistically relevant, it is still good to address and underline how this affects the data and conclusions. While the low sample size has been considered when looking for conclusions, it is still based on a small number of respondents. Next to this element is how data is collected. Several methods are applied, which lead to a bias in the data. With the respondents that had an interview, in-depth insight could be retrieved from their experience. Furthermore, these participants received background information of the waste menu card, therefore, had more insight into how the innovation could work. The respondents that filled in the questionnaire did not have this background information or could ask questions if a query was unclear. Therefore, the participants that filled in the questionnaire had a disadvantage. Moreover, only international residents filled in the questionnaire. This is a considerable limitation in the research as the Dutch residents explained that this group of residents have difficulty understanding the system. Therefore, insight into their obstacles was minimal. Nevertheless, the research attempts to use it to show how multiple possible perspectives influence the WM process in high-rise apartment complexes. These perspectives are the ones which the researcher finds to be most prominent from the data. It is not a complete set of perspectives but a set of ideas which can be used to

explain certain tendencies. It likely results in only a partial explanation of the trends shown but can nevertheless be helpful when looking at WM within daily routines.

7.4. Reflection

This research has provided me new skills and expertise in the field of scientific research. The skills that were essential are flexibility, patience, perseverance and adaptability, planning and the ability to work with diverse individuals. These skills are learned because of the obstacles and the shifts in the type of research. To reflect on this progress The STARR method is used (Benders, 2019).

To begin with the literature it provided insight into the concept of citizen engagement. The concept is a broad term and in order to use it, it had to be defined into an operational concept. The literature resulted in a definition that forms the boundaries of this research. In addition, it has provided insight into types of citizen engagement such as the active and passive forms, which has led to one of the recommendations. The theoretical framework has provided sufficient guidance to carry out the research. Citizens' practices could be examined just like the policy field of waste management in the Volt complex. However, because of the short time, it is still achievable to break down the individual contributions of SPT and the PAA with citizen engagement processes for other studies. Ultimately, the literature provided sufficient background information to allow this study to run smoothly. Therefore, the limitations do not reside with the literature study.

In order to be critical about the applied research and data collection method, there are a number of points for improvement. In retrospect, the single case study turned out to be a critical case study, because it focuses on the cause and consequences of poor waste separation behaviour in high-rise buildings. As a result, it can be questioned whether the single case study had sufficient focus on the study. Another element concerns the collection of data. Much of the information provided by experts is not valid because of the informal phone calls. An improvement here is that I should have been more firm and clear about the way of collecting data. Another option would have been to meet with the experts in person after the phone call. Due to time constraints, this was not taken up. The most instructive situation was approaching residents. Many residents find personal waste separation a difficult topic and dislike a conversation about the topic. There was a lot of resistance in first instance. Another pitfall was that I proceeded to work passively with some residents by making agreements. As an improvement, I have to actively approach the residents from the start who indicated that they are interested and take the initiative to make agreements. Nevertheless, due to the amount of approaches (letters, door contacts and addressing on the street), the residents have been well reached. A large number of residents showed interest. My task was to have at least 5 different residents participate in an interview. To increase the reliability of the small number of 5 resident interviews, I gave other residents the opportunity to complete a questionnaire. This allowed me to include two international residents, so that I could see if their practices matched the stories of the five Dutch residents interviewed. This has led to a broadening and confirmation of the previously received data. Therefore, by giving residents the opportunity to participate in different ways and by rewarding them with a small treat after the survey, it was still possible to recruit 8 people. Ultimately, through the multiple techniques, I managed to get the minimum number and variety of participants needed for the study.

The results of this study have led to recommendations for the parties involved to improve the process. The adjustments in the process can be easily applied without having to take substantial steps for improvements in the current system. At first I did not expect to get these results regarding communication and informational adjustments. The assumption was that the information and communication process would be in order with new projects. In addition, sustainability is an important topic, and waste was expected to be an element when it comes to the new neighbourhood of the future. This turned out not to be the case with the help of the theoretical framework. If the focus was on one theory, these results would probably be different. In the end, I am satisfied with the results of the study. I never thought I'd get results like implementing a garbage page in a visitor app. The essence that I have discovered is that you don't have to discover the egg of Columbus but take small steps with the resources you already have. Often parties that work together do not yet work well enough together. Communication and being open to the external parties is an important element. By listening to external groups, such as residents, it quickly becomes clear where the mismatches are between policy and individual practices.

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Appendix

I. Operationalization of conceptual model
II. Interview manual English format
III. Questionnaire English format
IV. Waste management system menu card

Appendix I: Operationalization of conceptual model

Table 5: Operationalization of conceptual model - theoretical trajectory

Dimension	*Variable*	*Indicator*	*Questions*	*Sources*
Actors & Coalitions	Residents	Current role(s) & Required role(s)	- Current role in waste separation process in living environment - Perspective question: what should be the role as a citizen	(Design Innovation Group, 2015) (Interviews experts & residents) (Midden, 2015)
	Municipalities	Current role(s) & Futuristic role(s)	- Role in realizing the WM system in living district - Which parties involved in process - Perspective question: what should be the role for the municipality	(Gemeente Delft, n.d.) (Interviews experts & residents) (Mansveld et al., 2014) (VANG, 2020)
	Waste collecting organization	Current role(s) & Futuristic role(s)	- Role in realizing the WM system in living district - Which parties involved in process - Perspective question: what should be the role for the waste collecting organization	(Interviews experts & residents) (VANG, 2020)
	Project developer & executive parties	Current role(s) & Futuristic role(s)	- Role in realizing the WM system in living district - Which parties involved in process - Perspective question: what should be the role as the project developer	(Gemeente Delft, n.d.) (Interviews experts & residents)
Rules of the game	Formal rules & procedures	Norms and standards, the formal policy procedures, and documents on waste systems in the urban district.	- Norms and standards with the current waste system - Decision-making process of implementing a waste system - Requirements and rules that the waste system must comply - Certain norms and standards imposed on the residents - How is waste separation behaviour controlled	(Gemeente Delft, n.d.) (Interview experts) (Mansveld et al., 2014) (Mantes, 2014) (Mantes, 2015) (UBAS Delft, 2020)
	Informal rules & procedures	Informal procedures with the WM system in the urban district (how is the system organized and politically managed).	- (In)directly influenced in waste separation behaviour caused by installed waste system - Informal rules regarding the separation and discharge of waste for residents - Form of influencing behaviour by the waste separation management system - Current waste system in district	(Design Innovation Group, 2015) (Gemeente Delft, 28, November 2013) (Interviews experts & residents) (Mansveld et al., 2014) (Mantes, 2014) (Mantes, 2015) (NVRD, 2019) (UBAS Delft, 2020)
Resources	Personal -and knowledge capacity	Personal and knowledge capacity of using installed waste system	- Physical & knowledge capacity of installed WM system - Necessary capacity of the resident for separating waste	(Design Innovation Group, 2015) (Gemeente Delft, n.d.) (Gemeente Delft, 28, November 2013) (Interviews experts & residents)
	Personal capabilities and motivations	Personal capability and motivation in engaging with WM system	- What is the capability to engage in the WM process - Motivating factors in be more involved with WM system - Capability to engage in the WM process - Driving factors for improvement in decision-making process	(Design Innovation Group, 2015) (Gemeente Delft, June 2021) (Interviews experts & residents) (Shah, 2019) (VANG, 2020)
	Level of autonomy	The right of condition to self-govern the WM system	-Level of autonomy with waste systems in living area -What is the necessary level of autonomy for citizens	(Design Innovation Group, 2015) (Interview residents)

Continuation Table 5: Operationalization of conceptual model - theoretical trajectory

Dimension	*Variable*	*Indicator*	*Questions*	*Sources*
Discourses	Diagnostic frames	Perceptions of the definition of the problem and on the causal factors of the problem.	- Issues with separating waste or certain waste streams - Perspective question: on the implemented waste system - Perspective question: on the decision-making process of waste system - Certain factors to this perspective - Perspective question: on current WM system - Certain factors to this perspective	(Design Innovation Group, 2015) (Interviews experts & residents) (Midden, 2015)
	Prognostic frames	Preferred solutions that solve the problem.	- Possible changes in type of waste system and the linked decision-making process? - Important requirements of the waste system - Ideal situation regarding the waste system in living environment - Possible improvements in decision-making process	(Interviews experts & residents) (VANG, 2020)

Table 6: Operationalization of conceptual model – practical trajectory

Dimension	*Variable*	*Indicator*	*Type of questions*	*Sources*
Actors	Citizens	Type of resident	- Contextual questions of personal living conditions	(Interviews residents)
Competences	Waste separation knowledge & system understanding	Knowledge in several types of waste streams and understanding the implemented WM system	- Knowledge and capability to separate waste streams properly - WM system understanding - Frequency in doing the practice (cleaning, transporting)	(Design Innovation Group, 2015) (Interviews experts & residents)
Materials	WM system & available infrastructure	Personal living conditions and the implemented WM systems in the urban district.	- Waste system in house and living environment (place, size, type, tools, storage)	(Interviews experts & residents)
Meanings	Mental activities, emotions & motivational knowledge	Symbolic meaning, ideas, and aspirations on WM	-What is the meaning of WM -What is the meaning of citizen engagement with WM processes - Awareness of waste separation behaviour and interest in practice - Motivating factors to increase interest in practice	(Interviews residents) (VANG, 2020)

Appendix II: Interview manual English format

Expert interview

Reason for research
This research focuses on newly developed metropolitan communities in the Netherlands with an indication of 100 buildings built on one hectare. Various Dutch citizens, civil servants, waste collectors, spatial planning consultants and project managers are interviewed. The focus of this research is to understand residents living in highly urbanized areas what their obstacles, interaction and perception are of waste and what the type of waste system is in their living environment. However, it is also important to hear to process that is guided by the municipality in collaboration with spatial planning consultants. This research is a comparative case study with the purpose of retrieving expertise from international cities that realized inclusive, circular and zero-waste urban districts. This expertise will be presented to Dutch residents living in a metropolitan area, to see if these alternative waste systems are interesting. As a result, the research question has been formulated as: *How can citizen engagement be achieved in waste processing processes of Dutch households with lessons from (inter)national cases?*

Background of this study and of the researcher
The background of this research is that with current Dutch spatial planning projects including waste management systems, policy makers depend on urban planners and consultancy organizations to guide the implementation of this system in societies. The wishes and perspectives of residents who will live in similar areas are being left out. The question is how advisory organizations such as Stantec, municipalities and urban planners can create an inclusive and adaptive community in consultation with citizens and local businesses.

Introduction researcher
- Anne Pennings, 25 jaar, from 's-Hertogenbosch / Sint-Michielsgestel.
- MSc Environment & Society at Radboud University in Nijmegen.
- Specialization in European Spatial & Environmental Planning.
- In 2018 graduated as environmental engineer.
- Hereafter became a junior project manager at Philips in the Netherlands from 2018 till 2020.
- Wanted to travel but with the covid-19 Pandemic, I started earlier with my master in Nijmegen.

Research approach
Conduct a semi-structured interview with you about your experience and knowledge of how the policy and decision-making process of spatial planning projects of high urban buildings is handled in consultation and engagement from residents. I would like to gain insight in your decision-making process in these areas. It also explains how your system is developed that leaded to and inclusive and adaptive waste management system.

General rules
- Time indication of interview is ± 45 minutes.
- The respondent is not obliged to answer a question. The respondent may stop the interview at any time.
- If a question is unclear, the respondent may indicate this and ask for clarification.
- The interviews are used as input for a study by Radboud University, by the management faculty in collaboration with Stantec B.V.. The result is an internal report for Stantec and Radboud University, which will not be published.
- If the respondent wants to receive a copy of the transcript, this is allowed.
- The respondent remains anonymous (no name) and is given the opportunity to comment on the transcript and may indicate that parts of the shared information is omitted so that it is no longer used in the research.
- I would like to ask permission to record the interview so that I can create a transcript for the data analysis.

Interview set-up

Contextual questions

- Do you have a suitable case for this study? If yes, what is the name of the urban district:
- Position/job title:
- Role within the case:

Start question

- Was there a citizen engagement process in the urban planning development (Volt)?
- What is your decision-making process of implementing a waste system in a new residential area?
    - What are the successful elements with this process?
    - Are there still improvements possible in this process?

In-depth questions

- How was the (citizen engagement) process completed in the design of the waste system in residential tower(s) (Volt)?
- What is your role as (Role in development of case) with the realization of the waste management system and the associated citizen engagement process in case (Volt)?
- Which parties are consulted in the citizen engagement process and the design of the waste management system and what is the division of roles?
- What is the perception of the (e.g., municipality) on the current (citizen engagement) process
    - What are the factors that cause this?
    - What are points for improvement?
- What is the waste system in residential tower(s) on helicopter view and why was this system chosen?
- What do you ask of the residents in terms of personal capacity to separate waste with this system?
- What is the current management way regarding waste separation behaviour and citizen engagement?
- What are the (in)formal rules regarding the separation and discharge of waste for residents?
    - Have certain norms and standards been imposed on the residents regarding separation and how are they complied with?

Closing questions

- Are there elements that have not yet been requested, but that you would still like to share?
- Do you know any (civil servant/waste collector/spatial planning consultants/project managers) who have contributed to the realization of these residential tower(s), who may be interested in participating in this research?

Completion

Thank you very much for participating in this research. I would like to emphasize once again your anonymity and that you can indicate at any time whether the shared information should be omitted. Nevertheless, these answers mean a lot to my research. If you have any questions for now, I would love to hear them. If not, I will conclude the research with this, if you are interested in the transcript of the interview I would be happy to share it with you. I would like to thank you for the great cooperation and wish you a lovely day.

Colour coding of dimensions: Actor-Resource/materials-Rules of the game/competence-Discourse/meaning

Residents interview

Reason for study

This research focuses on the development of waste collection systems in new high-rise complexes in the Netherlands. Various citizens are interviewed about owner-occupied and (social) rental properties. The focus is on understanding residents with his or her obstacles, interaction, and perspective on waste (systems). The reason for this research is that policy makers in spatial planning projects, including waste management, rely on urban planners and consultancy organizations to design the implementation of waste systems in societies. There is no alignment with potential residents in newly developed residential tower(s) in the Netherlands. As a result, the question that has arisen is how advisory organizations such as Stantec, municipalities and urban planners can adapt to achieve citizen engagement with future residents. The associated research question is: "How can a more active citizen engagement process be achieved in waste management in new high-rise complexes in Delft?"

Research approach

I hereby share an open questionnaire with you with questions about your experience and interaction with waste and the accompanied waste system within the residential tower. If it is okay with you, after this questionnaire, I would like to share a second questionnaire with you about ±14 days later (April 20, 2022). The reason for two questionnaires is that you are in these two weeks ware on your waste separation behaviour and on the waste system. This provides a deeper insight into your obstacles and wishes regarding the system in your living situation.

Introduction researcher

- Anne Pennings, 25 jaar, from ’s-Hertogenbosch / Sint-Michielsgestel.
- MSc Environment & Society at Radboud University in Nijmegen.
- Specialization in European Spatial & Environmental Planning.
- In 2018 graduated as environmental engineer.
- Hereafter became a junior project manager at Philips in the Netherlands from 2018 till 2020.

Research approach

Conduct a semi-structured interview with you about your experience, interaction and perception with waste and the type of system that goes with it. If it is okay with you, I'd like to do two interviews with you. Today/any other day that suits you, the first interview will take place and the second interview ±14 days later. I would like to hold two interviews with you, because you will then be aware for two weeks between interviews 1 and 2 about your handling of waste and the associated hearing system. This provides in-depth insight into your obstacles and wishes regarding the system that suits you best life situation and the associated structures. - apply extra possibility with observation.

General rules

- Time indication of interview is ± 45 minutes.
- The respondent is not obliged to answer a question. The respondent may stop the interview at any time.
- If a question is unclear, the respondent may indicate this and ask for clarification.
- The interviews are used as input for a study by Radboud University, by the management faculty in collaboration with Stantec B.V.. The result is an internal report for Stantec and Radboud University, which will not be published.
- If the respondent wants to receive a copy of the transcript, this is allowed.
- The respondent remains anonymous (no name) and is given the opportunity to comment on the transcript and may indicate that parts of the shared information is omitted so that it is no longer used in the research.
- I would like to ask permission to record the interview so that I can create a transcript for the data analysis.

Interview day 1

Contextual questions

- What type of home do you live in (rent/purchase, size in m^2, storage options)?
- What is your age?
- In which sector/function do you work and/or what is your education?
- What is the size of your household (single/partner, etc.)?
- What is your physical condition (healthy or, for example, problems with legs or hands, etc.)?

Start questions

- What do you think of the subject of waste separation? Are you involved with the subject in everyday life?
- Are you aware of the waste you produce in a year and has this increased/decreased as you get older/changed life patterns?
- Did you have a say in the design process of the waste system in this residential tower?
    - If not, would you have liked to have this, so that you might have a better storage system in your home?

In-depth questions

- Can you explain the waste management system that is used in your home and residential tower (where do you separate and deposit your waste)?
    - What do you think of this process? Are there any obstacles you run into?
- Are you (in)directly influenced in your waste separation behaviour by the system used in your home and residential tower?
    - Do you have the right knowledge and physical capacity to properly separate waste with this system?
        - Why do you think this?
- What do you think is the solution for the future; source separation (citizens already separate waste before the recycling facilities), post-separation (citizens play no role in waste separation), or what is the correct ratio between the two and why do you think this?
- What are motivating factors to be more involved in the decision-making/design process for a waste system in your living environment and to improve your waste separation behaviour?

Closing questions

- Are you concerned about the decision-making process and waste separation behaviour that is currently used in your own living environment? Would you like to see a change in the waste system type decision-making process?
    - If so, what change? If not, why not?
- What are important aspects for you that a waste system must meet, and can you explain this further?
    - What is the ideal situation for you regarding waste separation in your living environment?
- Do you have any topics you would like to share?

Completion

Thank you very much for participating in this research. I would like to again approach your anonymity and that you may at all times let it be known that the information shared with this research may be omitted. Nevertheless, these answers mean a lot to my research. If you have any questions for now, I would love to hear them. If not, I would be happy to share our email addresses for in-depth research into your interaction with waste (system). The insights you will receive over the next two weeks can then be sent via email. share photos and memos with me. Additionally, the second conversation in 14 days will be about possible applicable waste systems. I would then like to hear your perspective again.

Colour coding of dimensions: Actor-Resource/materials-Rules of the game/competence-Discourse/meaning

Interview day 2

Brief introduction

Today we will take a closer look at the type of system that is suitable for you as a resident. Over the past two weeks you have looked at your waste separation situation and you may have discovered further aspects that are positive/negative. You may also have had the time to think about what a type of waste system needs for you as a resident in a highly urban area.

Start questions

- What points have you discovered in the past two weeks that we have not talked about yet?
- What would be the ideal waste system for you in your living environment?

Scenario sketching/ possible waste systems

I would now like to present the menu of waste systems that are used in the Netherlands and abroad in highly urbanized buildings. I would like to hear from you what you think about this and what your view is on the operation of these systems.

- Presentation of menu card with different systems divided into posters/flyers per type of system and the associated options: Current conventional system; OAT; Personal pick-up system; Return logistics; Wet/dry fraction; type of waste streams; smart meter system; Garage connection; Circular initiatives; Storage system in the house; difference in price in terms of use of raw materials/separation behaviour, etc. Displayed in Appendix IV.

In-depth questions

- What appeals to you most when you look at the menu?
- Which system, for you, will promote your engagement in dealing better with waste separation?

Closing questions

Do you have any points you would like to tell?

Completion

Thank you very much for participating in this research. I would like to again approach your anonymity and that you may at all times let it be known that the information shared with this research may be omitted. Nevertheless, these answers mean a lot to my research. If you have any questions for now, I would love to hear them. If not, this concludes the research, and if you are interested in the transcript of the interview, I am happy to share it with you. I would like to thank you for the great cooperation and wish you a lovely day.

Appendix III: Questionnaire English format

Reason for study

This research focuses on the development of waste collection systems in new high-rise complexes in the Netherlands. Various citizens are interviewed about owner-occupied and (social) rental properties. The focus is on understanding residents with his or her obstacles, interaction, and perspective on waste (systems). The reason for this research is that policy makers in spatial planning projects, including waste management, rely on urban planners and consultancy organizations to design the implementation of waste systems in societies. There is no alignment with potential residents in newly developed residential tower(s) in the Netherlands. As a result, the question that has arisen is how advisory organizations such as Stantec, municipalities and urban planners can adapt to achieve citizen engagement with future residents. The associated research question is: "How can a more active citizen engagement process be achieved in waste management in new high-rise complexes in Delft?"

Research approach

I hereby share an open questionnaire with you with questions about your experience and interaction with waste and the accompanied waste system within the residential tower. If it is okay with you, after this questionnaire, I would like to share a second questionnaire with you about ±14 days later (April 20, 2022). The reason for two questionnaires is that you are in these two weeks ware on your waste separation behaviour and on the waste system. This provides a deeper insight into your obstacles and wishes regarding the system in your living situation.

General rules

- Time indication of the questionnaire is 10 to 15 minutes.
- The respondent is not obliged to answer a question.
- When there is a question, the respondent may indicate and ask for clarification.
- The result is an internal report for Stantec and Radboud University which is not published.
- The respondent remains anonymous.

For the questionnaire it is important that you describe your story and opinion well. Please write your answers as completely as possible. This is a qualitative survey and unfortunately cannot use answers like yes or no. Please also send the questionnaire before Wednesday 13 April 2022 to anne.pennings@stantec.com.

Questionnaire day 1

Contextual questions

1. What type of home do you live in (rent/purchase, size in m^2, storage options)?

2. What is your age?

3. In which sector/function do you work and/or what is your education?

4. What is the size of your household (single/partner, etc.)?

5. What is your physical condition (healthy or, for example, problems with legs or hands, etc.)?

Start questions

1. What do you think of the subject of waste separation? Are you involved with the subject in everyday life?

2. Are you aware of the waste you produce in a year and has this increased/decreased as you get older/changed life patterns?

3. Did you have a say in the design process of the waste system in this residential tower?
    - If not, would you have liked to have this, so that you might have a better storage system in your home?

In-depth questions

1. Can you explain the waste management system that is used in your home and residential tower (where do you separate and deposit your waste, see note for elements)?
    - What do you think of this process? Are there any obstacles you run into?
2. Are you (in)directly influenced in your waste separation behaviour by the system used in your home and residential tower?
    - Do you have the right knowledge and physical capacity to properly separate waste with this system?
        - Why do you think this?
3. What do you think is the solution for the future; source separation (citizens already separate waste before the recycling facilities), post-separation (citizens play no role in waste separation), or what is the correct ratio between the two and why do you think this?
4. What are motivating factors to be more involved in the decision-making/design process for a waste system in your living environment and to improve your waste separation behaviour?

Closing questions

1. Are you concerned about the decision-making process and waste separation behaviour that is currently used in your own living environment? Would you like to see a change in the waste system type decision-making process?
    - If so, what change? If not, why not?
2. What are important aspects for you that a waste system must meet, and can you explain this further?
    - What is the ideal situation for you regarding waste separation in your living environment?

Do you have any topics you would like to share?

Completion

Thank you very much for participating in this survey! If you have any questions for now, please let me know at anne.pennings@stantec.com. Additionally, I will send a second shorter questionnaire in 14 days that is about possible applicable waste systems in high-rise complexes, where I would again like to hear your perspective if you want to help me further with this.

Questionnaire day 2

Today we will take a closer look at the type of waste system that can improve your separation behaviour. In the past two weeks you have had the time to observe your waste separation behaviour and the current system. You may have discovered new aspects that you have experienced positively and/or negatively.

Research approach

Share an open questionnaire with you with questions about your experience, interaction and perception with waste and the type of system that goes with it. If it is okay with you, I'd like to share two questionnaires with you. Two weeks ago on April 6, 2022, I shared the first questionnaire with you. Following this, I will send you the second questionnaire ±14 days later. The two questionnaires provide in-depth insight into your obstacles and wishes regarding the system that suits you in your life situation.

General rules

- Time indication of the examination is +/- 30 minutes.
- The respondent is not obliged to answer a question.
- If a question is unclear, the respondent may indicate this and ask for clarification.
- The respondent remains anonymous.
- The questionnaires are input for a study by Radboud University, the management faculty in collaboration with Stantec B.V. The result is an internal report which is not published.

For the questionnaire it is important that you clearly describe your perspective and opinion. Please write your answer as completely as possible. This is a qualitative survey and unfortunately cannot use answers like yes or no. Please also send the questionnaire before Friday 29 April 2022 to anne.pennings@stantec.com.

Questions

1. In the past two weeks, have you acquired any new obstacles/wishes/insights that you had not shared before, if so which ones?

Now open the attached document in the email. This is the waste systems menu. I would like to hear from you what your opinion and view is on the different elements of various waste systems that are possible in high-rise apartment complexes. You can add comments in the PDF document indicating which elements you find interesting and which elements would not work for you. Another option is to fill in the table below. If you have no idea or view for certain elements, you can indicate this.

2. Please indicate for the various elements whether this has a positive or negative influence on your waste separation behaviour, and the reason why?

Element	Positive	Negative
A. Household Storage		
1. Storage like a 'meter box'		
2. Pass hatch at front door		
3. Custom bins		
4. Innovative waste bag with four compartments		
5. Coloured Bags		
6. Green, fruit, food tray		
7. Food Grinder in sink		
B. Interim storage floor		
1. Interim storage with appropriate opening		
2. Residual waste shuttle to basement with separate storage for recycle streams		
C. Transport through building		

1. Current scenario – bring your own waste to the basement		
2. Current scenario but with possibility of storage on hallway		
3. Possibility to deposit waste in shuttle on ground floor at exit		
4. Possibility to deposit residual waste on every floor with shuttle, but manually take other flows to the basement		
5. Deposit every stream in shuttle in an opening, system has smart meter that organizes it itself downstairs (No green, fruit, food / Glass / large waste)		
6. A separate opening per stream to deposit residual waste and recycle waste (No GFT/Glass/large waste)		
7. Paternoster cabinet system through corridors		
8. Paternoster lift system		
D. Storage in building and block		
1. Smart sorting bins		
2. Press containers		
3. Smart meter containers		
4. Underground Waste Conveying System		
5. Local recycle repository		
6. Glass processor		
7. Above ground and/or underground containers		
E. Additional initiatives		
1. Recycling apps		
2. Electronics recycle places		
3. Wet vs. dry separation		
4. Compost containers		
5. Community gardens		
6. Clothing containers		
7. Bread containers		
8. Share material spots		
9. Repair spots		

3. Which elements will influence your waste separation behaviour the best (positively)? You can indicate it as A1, B3 and give a brief explanation.

4. What would be the ideal waste system for you in your living environment?

5. Do you have any points you would like to tell?

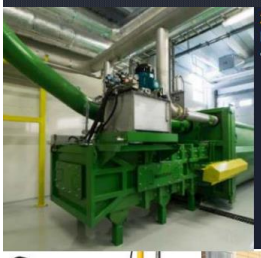
Completion

Thank you very much for participating in this survey! I would like to again approach your anonymity and that you may at all times let it be known that the information shared with this research may be omitted. Nevertheless, these answers mean a lot to my research. If you have any questions for now, I would love to hear them. If not, I will conclude the study with this, and if you are interested in the results of the study, I can share them with you after June 23, 2022. I would like to thank you for the great cooperation and wish you a lovely day.

Appendix IV: Waste management system menu card

Waste management systems

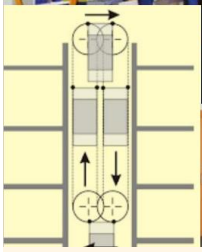
D. Storage in building and building block



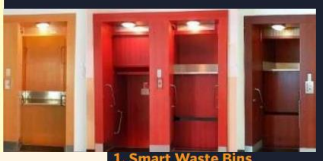
2. Trash Compactors container
Different options:
- Inside in garage connected with chutes. Outside below underground container, or small size only for paper.

4. Pneumatic Waste Pipes
Different stationing options:
- At mailbox, elevators or next to exit (ground floor) or other level/corridor of buildings
- In various aesthetic forms
- For all flows except for residual, chemical, food and glass waste streams.

7. Paternoster cabinet system
Transport from household to building storage space. Can also be a storage system, for example a cabinet.



8. Paternoster elevator system
A transport system between floors. A different system for each group.



1. Smart Waste Bins
Swap out traditional recycling bins for smart waste bins that automatically sort and track recyclables. Also 'Pay as you throw' system.

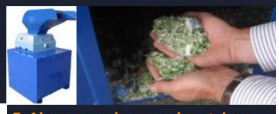
2. (Solar)-powered Trash Compactors
Place (solar)-powered trash compactors in out and/or indoor spaces to maximize the amount of waste each bin can hold. Also possible in garage. Also possible for only paper stream.
See next slide for more Examples →

3. Waste Level Sensors
Add waste level sensors to bins and dumpsters to track fill levels and optimize communities waste collection schedule.
Relevant collectors are informed when bins are full, and they can collect it in time.
The users can interact with the authorities regarding their waste disposal through the application provided by them. Bringing waste disposal on an exclusive digital platform, making waste disposal convenient and efficient.

4. Pneumatic Waste Pipes
An underground/invisible infrastructure for the removal of multiple (separate) waste streams from a building and/or area, which is fully automatic. This leads to a reduction of garbage trucks on the roads.
More information on next slide →

5. Local recycle facility
Local recycling centers in neighborhood. Modular, collection in containers. Includes administrators and involves residents.

6. Local glass processing machine
In-house machine for reducing glass waste.



7. Above or underground container
Regular above/ underground container. With or without separate roll container.

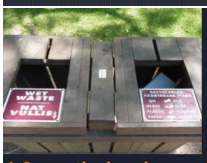
Waste management systems

E. Extra initiatives

1. Recycling App
Encourage residents to download a recycling app for:
- Up-to-date information on what can and can't be recycled for every waste stream.
- Locate nearest recycle center with contact information
- Teaching Do It Yourself ways to recycle waste
- Providing environmental trends and news
- User contribution tracking of the recycling movement
- Hub of local information and policies on waste management and/or sharing leftovers or other streams
- Monitor and track waste pickups with recycling dates reminder

Leading apps: **Irecycle, RecycleNation, Gimme 5, Waste Management App, My Waste, OLIO**

2. E-waste kiosks
Local e-waste kiosk to increase the electronic recycling rates by making it easier and more accessible. Eco-ATM Devices is going to pay in cash every time you deposit your E-waste.



3. System redesign: Dry and wet waste stream
A wet/dry system provides simplicity for residents and the municipality. Separate streams are 1) dry streams, 2) Green, fruit and food leftover and 3) wet streams. Focus is on post-separation at recycle facilities.

4. Composting in underground container
Underground neighborhood compost for green, fruit and food waste.

5. Neighborhood garden for compost
Possibilities are on rooftop or in the plinth of the building complex.

6. Clothing container close to shared washing area

7. Bread container in neighborhood

8. Shared equipment area

9. Repairing cafes