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Developing Dynamic Capabilities for Smart Waste Technology Adoption: A Case Study of Stormossen

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ABSTRACT

In the Nordic countries, municipal waste management institutions are increasingly forced to adopt digitalization. Smart waste management solutions such as radio frequency identification systems (RFID), on-board scales for weighing vehicles, and information analysis systems offer significant potential in terms of improving efficiency, sustainability, and compliance. However, the competencies necessary for adopting such technology are poorly theorized, especially within multi-municipal publicly owned utility organizations. This study examines how municipal waste management organisations develop and exercise dynamic capabilities in response to technological change. Drawing on Teece's (2007) sensing–seizing–reconfiguring framework, the study investigates how these dimensions manifest during the pre-adoption phase of smart waste technology planning, through an abductive, qualitative single case study design.

The case is Stormossen, a regional waste utility jointly owned by six municipalities in Western Finland. The organisation is currently planning the adoption of an integrated RFID and on-board weighing system ahead of a spring 2027 operational transition. Data were collected through five semi-structured interviews with organisational informants and analysed through thematic analysis structured around a Gioia-style data structure that links first-order concepts and second-order themes to the three aggregate dynamic capability dimensions. Findings reveal substantial sensing capabilities through environmental scanning, Nordic peer benchmarking, and EU regulatory monitoring; however, sensing remains concentrated at senior management level, creating information asymmetry with frontline staff. Seizing capabilities are constrained by the multi-municipal governance architecture, although a tiered decision-making structure preserves operational agility. Reconfiguring capabilities are primarily anticipatory: technical integration planning is well advanced, while frontline change management and rural connectivity planning require further development. The research extends dynamic capabilities theory to smart waste technology adoption in multi-municipal public utilities, providing a temporal model of capability development in the pre-adoption phase: sensing most advanced, seizing governance-constrained, reconfiguring anticipatory. Practically, it offers recommendations for governance-aware seizing, frontline engagement, phased piloting, and citizen-inclusive communication.

Keywords: dynamic capabilities, smart waste management, digital transformation, RFID technology, municipal organisations, public sector, multi-municipal governance, pay-as-you-throw, Nordic waste management, pre-adoption phase, qualitative case study

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List of Abbreviations

4G/5G	Fourth and Fifth Generation Mobile Network Standards
CRM	Customer Relationship Management System
DC	Dynamic Capabilities
ERP	Enterprise Resource Planning
EU	European Union
GDPR	General Data Protection Regulation
GPS	Global Positioning System
HR	Human Resources
ICT	Information and Communications Technology
IoT	Internet of Things
IT	Information Technology
PAYT	Pay-As-You-Throw
RBV	Resource-Based View
RFID	Radio Frequency Identification
ROI	Return on Investment
TAM	Technology Acceptance Model
TCS	Transport Control System
VINGO	Waste Collection Route Management Software (VTEC)

1. Introduction

1.1 Background and Context

Digitalization and environmental sustainability have become important strategic issues in modern public administration. Municipal waste management organizations find themselves at this strategic juncture, where they are faced with growing pressures on one hand due to stricter European Union policies on environmental management and the expectations of citizens pertaining to the level of services provided by these organizations, while technological advancements continue rapidly (Kaza et al., 2018; Pires et al., 2019).The waste management system in Finland is based on companies working in regions where they manage waste from different municipalities at the same time. The companies have the task of managing waste from households and commercial premises within a specified service area. In their operations, the firms face dual pressures that are characteristic of any company in the public sector. First, there is pressure to be efficient in order to promote modernization, and secondly, they must maintain accountability. This is a challenging situation in which it is difficult to incorporate technological innovations.Innovations in terms of technologies that have been adopted for waste management, such as RFID container tracking technology, on-board weighing technologies on waste collection trucks, IoTs, GPS route planning technologies, and analytical platforms, have become strategically important spheres of digital transformation among municipalities (Kaza et al., 2018; Pires et al., 2019; Anagnostopoulos et al., 2017). All of these innovations make it possible to switch from a classic time-based and volume-based approach to the implementation of a significantly more modern data-based approach to providing services to citizens. The importance of this innovation becomes even more pronounced due to the circular economy policy proposed by the European Commission and reflected in Finnish waste laws.

However, despite the evident advantages of the use of such technologies, there still exists a considerable difference between their availability and actual application. Thus, it can be concluded that organizational rather than purely technical aspects predominate at this stage. In this respect, the key organizational aspect is the possibility to understand, evaluate, and implement such advanced technologies in practice. Stormossen is a regional waste utility located in Vaasa, Western Finland, which was established in 1985 by six municipalities (Vaasa, Mustasaari, Isokyrö, Korsnäs, Malax, and Vörå) and serves approximately 107,000-108,000 people. The company has approximately fifty staff members and three biogas reactors as well as eleven waste reception stations but does not have its own fleet of vehicles. Currently, Stormossen undergoes significant growth since starting in spring 2027, the organization will provide waste collection services for about 60,000 homes and 12,000 leisure homes. Such growth requires implementation of integrated RFID and on-board weighing technologies for obtaining accurate household-level waste data and charging for the collected weight of waste. In this regard, Stormossen represents a highly relevant organization to research the development of dynamic capabilities before implementing smart waste technologies.

1.2 Research Problem and Theoretical Gap

The existing research on smart waste management technologies has, for the most part, concentrated upon the technological properties and environmental implications associated with particular technologies such as IoT sensing architecture, RFID system design, route optimization algorithms, and applications of analytics (Gutierrez et al., 2015; Anagnostopoulos et al., 2017; Folianto et al., 2015; Longhi et al., 2012). Technologically oriented approaches have also provided some significant insights into the effectiveness of smart waste management systems. Yet, surprisingly, this body of literature has neglected to analyze organizational processes and capabilities involved in successful implementations of these technologies. There still is a theoretical assumption that organisational variables will adapt to the technology automatically.

The issue of institutionalized adoption of such technology by the organization becomes very challenging when it comes to waste management utilities that serve several municipalities. Organizations working across several municipalities will have to deal with institutional complexities and build consensus across political institutions having different priorities. They must also implement the technology across organizational chains of service delivery, and introduce changes in technology through diverse staff and contractual relationships. In many ways, the process of adopting new technologies becomes even more complicated than in private firms.

Dynamic capabilities theory developed by Teece, Pisano, and Shuen (1997) and further refined by Teece (2007), Eisenhardt and Martin (2000), Winter (2003), and Helfat et al. (2007)

provide a theoretical framework to examine the process of innovation implementation within organizations. Dynamic capabilities refer to higher-order capabilities through which companies sense changes in their environment, seize new opportunities, and configure their resources to ensure sustainable competitive advantages (Teece, 2007). While in the resource-based view of the firm, which was introduced by Barney (1991), organizations are considered in terms of resource endowment, dynamic capabilities view firms as entities with the ability to generate and renew their resources. In recent years, dynamic capabilities theory has been extensively used as a framework for studying digitalization processes in private businesses (Warner & Wäger, 2019; Vial, 2019). However, there is still limited research on applying dynamic capabilities to digital technologies adoption in public sector waste management services (Piening, 2013; Pablo et al., 2007). Specifically, multi-firm dynamics that involve political governance, organizational accountability, multi-party authorization, and inter-firm reconfiguration need are yet to be studied in light of dynamic capabilities theory.

1.3 Research Question

Based on the theoretical and empirical gaps identified above, the main research question of this thesis is formulated as follows:

> ***How do municipal waste management organizations develop and exercise dynamic capabilities in response to technological change in the waste management sector?***

To operationalize this central research question and provide empirical focus, three sub-questions guide the investigation:

(1) In what ways does the sensing capability manifest in the identification of opportunities arising through the use of smart waste technologies in the special institutional context of the multi-municipal waste utility?

(2) How does the multi-municipal institutional framework facilitate or hinder the exploitation of opportunities through investments in smart waste technologies, and what processes are involved in this process?

(3) What reconfiguration capabilities are used in anticipation of the organizational changes brought about by smart waste technology?

1.4 Objectives of the Study

The study aims to achieve four related research objectives. Firstly, to investigate how the sensing capabilities, i.e., abilities to perceive, monitor, and understand environmental changes associated with technology innovation and regulation, emerge during the pre-adoption planning stage of the introduction of smart waste technologies within a multi-municipal setting. Secondly, to examine the effects of the multi-muncipal governance structure on the seizing capability of dynamic capabilities. This will include analyzing the factors limiting as well as facilitating investment in technology within complex governance structure. The study also seeks to determine the current state of reconfiguration capabilities, particularly the organizational activities that prepare the firm for necessary technical, staffing, and organizational changes associated with the introduction of RFID and weighing technologies. Finally, the study aims to enrich theory by contributing to the understanding of how dynamic capabilities operate in a public sector, multi-municipal context at the pre-adoption stage.

1.5 Intended Contribution of the Study

This study contributes both theoretically and practically. On a theoretical level, this research makes contributions to the dynamic capabilities field by applying it within the context of pre-adoption of smart waste technologies in multi-municipal public sector organizations. Additionally, it makes contributions to the field by analyzing the role of multi-municipal governance on the development and speed of dynamic capabilities as opposed to what is mostly analyzed within the private sector. This makes a contribution to the developing field of dynamic capabilities within the public sector, as proposed by Piening (2013) and Pablo et al. (2007).

Further contributions are made to the temporal understanding of dynamic capabilities by offering an empirical foundation for a development model of dynamic capabilities before the adoption stage, which has been somewhat neglected by scholars but strategically important for successful adoption. The findings reveal that the capabilities of sensing, seizing, and reconfiguration develop during different stages of the pre-adoption phase of smart waste technology adoption. The implications for the study of dynamic capabilities have been enhanced by the findings on the timeline-driven development of capabilities. From a practical perspective, the findings could prove useful for managers and other decision-makers dealing with similar problems in their municipalities, such as governance-oriented investment evaluation, interdisciplinary cooperation, employee involvement, contractor coordination, and citizen communication.

1.6 Structure of the Study

The remainder of the thesis is organized as follows. In Chapter 2, the theoretical background will be presented through a systematic review of the related bodies of literature, namely digital transformation in the public sector and municipalities, smart waste management technologies and their challenges in adoption, and dynamic capabilities and their role in digital transformation in the public sector setting. Chapter 2 concludes with the integration of these literature streams into the theoretical framework used for the empirical study. The research methodology will be explained in Chapter 3, which covers the philosophy of research, the research design, data collection and analysis methods, and data structures. Chapter 4 covers the empirical results arranged by the three elements of dynamic capability – sensing, seizing, and reconfiguration. The discussion of empirical findings based on the theoretical background and previous studies will be covered in Chapter 5, along with the theoretical and practical implications of this research. Chapter 6 includes the conclusions of the thesis, covering main findings, contributions, limitations, and suggestions for further research.

2. Theoretical Background

This chapter will provide the theoretical underpinnings for this research by conducting a systematic review of the interrelated streams of literatures on the following subjects. These literatures are arranged in an increasingly specific way in the conceptual funnel. The first focus on digital transformation as a broader organizational phenomenon; the second one on digital transformation as applied specifically to municipal public sector organizations; the third one on smart waste management technologies as a recent form of digital transformation in municipal organizations; and, finally, the fourth one on dynamic capabilities theory as a framework for analyzing technology adoption.

2.1 Digital Transformation in Public Sector Organisations

2.1.1 Concept and Importance of Digital Transformation

Digital transformation has been recognised as one of the most significant strategic forces shaping the modern corporation across industries. According to Vial (2019), Bharadwaj et al. (2013) define digital transformation as the process of integrating digital technology into corporate strategy with the aim of creating value. This involve major transformations in the way in which the organisation operates in order to achieve its core objectives. However, although this definition focuses on technology, digital transformation is not solely represent a technology-driven initiative. According to Mergel et al. (2019), as established in their influential review of literature, digital transformation entails organisational transformation. This includes cultural transformation, business process reorganisation, stakeholder relationship management, and organisational restructuring. Similarly, Matt et al. (2015) describe digital transformation as a multi-faceted phenomenon incorporating four inter-related facets: the technology facet, which encompasses the technology itself; the value creation facet, which encompasses the role of digital technologies in value creation processes; the structure facet, which entails the structural changes necessary for leveraging digital technologies; and the financial facet, which encompasses the investment costs and economics of digital transformation.

Indeed, the significance of digital transformation as a strategy is evident in many works in the management discipline (Vial, 2019; Tidd & Bessant, 2018). Those companies that manage to transform themselves digitally are bound to benefit through increased efficiency, better decision-making, enhanced service provision, and organizational agility. Those organizations that will not manage to build the necessary capabilities that would enable them to capitalize on opportunities brought about by digital transformation may face strategic decline due to the advancement that other technologically capable firms make. One such sector, which is increasingly moving from competition towards regulation, is municipal solid waste management.

2.1.2 Digital Transformation in the Public Sector: Features and Challenges

Although digital transformation has been widely studied in the private sector, little attention has been paid to the public sector. There are various reasons why such differences exist because the nature of organizations in both sectors is entirely different. The private sector focuses on maximizing its profits whereas the public sector is expected to maximize its societal benefits through public value creation.

The first difference relates to the governance aspect. Private bodies are able to respond quickly to any changes in the market since they have a lot of freedom and independence. In turn, public organizations have to consider many aspects relating to governance, which include democracy, election periods, legality, collaboration among different organizations, and engagement of citizens (Gil-Garcia et al., 2018; Pollitt & Bouckaert, 2011). As Cordella and Tempini (2015) explain, such factors result in a conflict between the logic of digital transformation, which is associated with quickness and innovations, and the logic of democratic public administration, which involves legitimacy and caution.

Secondly, digitalisation faces unique challenges in the public sector due to resource constraints. Discretionary resources coupled with fixed salary structures in the public sector often pose continuous challenges in the recruitment and retention of digital skills needed to facilitate digitalisation (Kattel & Takala, 2021; Hood, 1991). The overreliance on legacy information systems in many public sectors further poses additional challenges since it creates technical debt which makes digitalisation a difficult process (Weill & Ross, 2004; Vial, 2019). For instance, Stormossen's overreliance on old billing software systems and CRM solution that were not designed to be compatible with RFID and IoT systems is an example of technical debt.

Thirdly, there is multi-stakeholder complexity in the governance of the public sector. The requirement for coordination between multiple agencies, service providers, regulatory authorities, and individuals with different capabilities and levels of readiness for digital transformation has been identified as one of the key features of the networked governance of the public sector (Mergel et al., 2019; Agranoff & McGuire, 2003; Klijn & Koppenjan, 2000). Multi-municipality utility companies like Stormossen are even more affected by this complexity, because large amounts of funding have to be committed and political consensus reached between several municipalities with different timelines.

Fourthly, there are distinct issues pertaining to data governance and privacy. Public organizations have very strict limitations on how personal information can be handled and processed in accordance with the law (Dunleavy et al., 2006). The application of RFID and weigh systems for waste management implies handling and processing of information regarding waste produced by each household in order to bill the customers, thus adhering to GDPR requirements.

2.1.3 Digital Transformation in Municipal Contexts

One of the important levels to analyze digital transformation in public administration is that of the municipality. This is because municipalities exist at the intersection of higher-level government directives and delivery of services to citizens. They have many service responsibilities, including garbage collection and transportation, cultural services, and social services among others. There is constant pressure on municipalities to enhance efficiency without affecting service delivery and accountability (Osborne, 2010; Dunleavy et al., 2006).

The process of digital transformation in municipal administrations is additionally hindered by multilevel governance. Municipal administrations have to coordinate their digital transformation initiatives in accordance with national digital governance strategies, EU regulations, and supranational environmental policy targets. At the same time they must consider political motivations behind locally made decisions and citizen preferences (Gil-Garcia et al., 2018; Anttiroiko et al., 2014). Social heterogeneity is yet another essential aspect: municipal services have to be available to all socio-economic classes irrespective of age, linguistic proficiency, or socio-economic status, making digital service development more challenging (Linders, 2012; Bekkers & Homburg, 2007). Another particular field in which municipalities actively engage in digital transformation initiatives is waste management. Indeed, according to Anagnostopoulos et al. (2017), the growth of cities, environmental legislation, and citizens' demands compel municipal administrations to undertake a digital transformation of waste management services through the adoption of smart technologies. The case described above sets the empirical context for the current study.

2.2 Smart Waste Management Technologies

2.2.1 Waste Management: Definition and Significance

Waste management refers to all processes involving the production, collection, transportation, processing, and final disposal of waste materials generated by human activity (Kaza et al., 2018; Hoornweg & Bhada-Tata, 2012). Municipal waste management implies the provision of a multi-stakeholder service. This framework includes municipal authorities, people, waste management operators, treatment centers, and controlling bodies (Guerrero et al., 2013). Municipal waste management is essential to sustainable urban development and environmental protection.

The problem of global waste management is great indeed. As stated by Kaza et al. (2018), 2.01 billion tonnes of solid waste were generated worldwide in 2016; however, most of the waste per capita was generated in the countries with the highest level of economic development. In Europe, the circular economy approach described in the EU Circular Economy Action Plan (European Commission, 2020) makes a lot of pressure on waste management organizations to increase sorting efficiency and recycle more waste. Finnish national goals based on EU requirements mean increased recycling and better control of materials flows. Considering these obligations, traditional models of waste management using scheduled waste picking and aggregated statistics became insufficient. According to Anagnostopoulos et al. (2017), the use of the fixed schedule leads to inefficient practices such as partially filled waste containers and overflow situations. These creates additional costs and adverse impacts on the environment.

Circular economy theory is another theoretical foundation of this research. In circular economy theory, waste is considered a resource that needs to be recovered, reused, and recycled (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Ellen MacArthur Foundation, 2013).

The circular economy model inspires Stormossen to study RFID and weighing technology. The material flow information collected by RFID and weighing systems can be used to measure and report the efficiency of the circular economy (Ghisellini et al., 2016).

2.2.2 Smart Waste Management: Concept and Strategic Significance

Smart waste management refers to the use of technology to plan, monitor, and optimize the waste collection and treatment process, thereby enhancing efficiency and sustainability (Kaza et al., 2018; Pires et al., 2019). The notion of smart waste management is strongly associated with that of the smart city. This involves the use of information and communication technology (ICT) for effective delivery of urban services (Longhi et al., 2012; Albino et al., 2015). Smart waste management involves the shift from the traditional model of relying on schedules and manual inspections. Instead, decisions will be increasingly based on real-time household and container-level waste data

However, the importance of smart waste management is not only limited to the operation side. In line with the growing recognition of environmental sustainability in the policies of the EU, national, and local governments, it is necessary for the organizations in the waste management sector to provide information about their performance. This requires reliable data and performance indicators. Smart waste management acts as one of the most important sources for such performance data and regulatory reports (Pires et al., 2019; European Commission, 2020).Moreover, effective waste management systems provide opportunities for implementing the principles of circular economies through finer tracking of waste streams. Therefore, smart waste management systems offer the necessary information platforms for the design of waste minimization programs, circular economy business models, and evidence-based policies (Geissdoerfer et al., 2017; Kirchherr et al., 2017).

2.2.3 Key Technologies in Smart Waste Management

A well-designed smart waste management system combines several digital technologies, each offering specific functions, to form an integrated smart waste management system (Longhi et al., 2012; Gutierrez et al., 2015; Atzori et al., 2010). This is illustrated in Table 1.

Table 1.Key Technologies in Smart Waste Management System

Technology	Primary Function	Key Benefit	Key Limitation
IoT Sensors	Real-time monitoring of fill levels in waste bins; wireless transmission of data to management centres	Demand-driven routing; reduces overflows and wasted trips by 20–40%	High installation and operational costs; reliance on stable internet connectivity; battery management
RFID Technology	Individual tracking and identification of waste containers via embedded chips and truck-mounted readers	Unique digital identity per container; automated pick-up documentation and billing integration	Chip damage or sensor failure; limited Finnish provider market; chip placement cost
GPS Tracking	Real-time location tracking of collection vehicles; route planning and optimisation	Verification of pick-ups; route efficiency; reduced fuel consumption	Requires reliable mobile/satellite coverage; weak in built-up environments
On-board Weighing Systems	Precise measurement of waste collected from each bin during lift events	Foundation for PAYT billing; per-household waste profiles	Vehicle motion and terrain affect accuracy; calibration needed; winter weather impact in Nordic settings
Data Analytics Platforms	Processing of data from IoT, RFID, GPS, and weighing systems	Operational, billing, compliance, and circular economy insights	Requires high-quality input data, analytical skills, and computing resources
CRM/ERP Integration	Integrating field technology data streams with customer management and billing systems	Automated weight-based billing; single integrated operational data system	System integration complexity; data model inconsistencies; cost and time of interface development

Source: Compiled by the author based on Longhi et al. (2012); Gutierrez et al. (2015); Folianto et al. (2015); Pires et al. (2019); Kaza et al. (2018); Anagnostopoulos et al. (2017).

The integration of such technologies into one cohesive smart waste management system results in an artificial ecosystem wherein waste collection is a data-driven process . The RFID technology and weight management system that Stormossen intends to install is equivalent to a certain arrangement of these technologies, which include bin recognition, vehicle tracking, and weighing.

2.2.4 Benefits of Smart Waste Management and Links to Competitive Advantage

The use of smart technologies for waste management results in multiple advantages in terms of operations, finance, environment, and strategy. One important benefit is smart waste bins fitted with fill level sensors and dynamic route optimization allow for substantial savings due to a decrease in unnecessary waste collection trips. As research findings have shown repeatedly, demand driven waste collection routes can result in a 20-40 per cent reduction in waste collection trips when compared to fixed collection schedules (Pires et al., 2019; Gutierrez et al., 2015).

Environmental sustainability represents another important benefit of smart waste management technologies. Less frequent collection trips result in reduced CO_2 emissions, which is increasingly important as EU member countries have to show improvement in terms of climate goals (European Commission, 2020). Additionally, more detailed waste generation data provided through RFID technology helps achieve better recycling, thus contributing to circular economy targets (European Parliament, 2018; Kirchherr et al., 2017). For Stormossen, measuring the rate of recycling would become especially valuable in terms of strategic priorities of senior management.

The importance of smart waste management is not only about efficiency, but also about the creation of competitive advantage and institutional advantage. According to Kaza et al. (2018) and Porter (1985), organisations that have unique competencies in terms of data analytics will become unique and difficult to copy by their counterparts. In public institutions, where competition will come mainly from other organisations, in which case it will be about benchmarking against other similar institutions, the concept of institutional advantage becomes relevant, referring to better relations with their owner municipalities, more political power for investment strategies, and higher trust among citizens. However, it will be necessary for them to have organisational capabilities for choosing suitable technology, making investment decisions amid uncertainties, and adopting technologies.

2.2.5 Challenges and Barriers to Smart Waste Technology Adoption

Despite their advantages, smart waste management systems face several changes during adoption, especially in local authorities. These challenges emerge at multiple organisational and institutional levels.

Financial constraints represent one of the most significant barriers. A full-scale deployment of a smart waste management system that would include RFID technology, GPS, weighing, and data analysis entails significant capital investments in all related processes, including purchasing equipment, development of software, installation of the system, its training, and maintenance (Kaza et al., 2018). It is challenging to prove the need for such expenditures, as there are no guarantees about their successful functioning in Nordic conditions.

Interoperability is yet another challenge. Local waste management companies employ legacy information technology (IT), including CRM, billing systems, and route management systems that often lack the capability to integrate effectively. Introducing RFID, weighing, and GPS data into a legacy system requires complex processes such as integration and ensuring data quality (Anagnostopoulos et al., 2017; Gubbi et al., 2013). The empirical findings gathered for the purpose of this study support expectations of unexpected difficulties in integrating software: "There is always some glitch. We will have some glitches here too, but we'll fix them."

Workforce capability gaps represent another important challenge. These are skills that may not be possessed by the existing employees and which are hard to achieve within public service wage systems (Vial, 2019; Kattel & Takala, 2021).

In addition to the above, the multi-stakeholder nature of public waste management creates a specific barrier. Implementing technology in waste utilities owned by multiple cities necessitates cooperation between owners, transportation companies, suppliers of technological innovation, regulatory agencies, and citizens, each with different interests and priorities (Guerrero et al., 2013; Agranoff & McGuire, 2003). Consensus among stakeholders significantly slows the decision-making process.

2.2.6 Pay-As-You-Throw (PAYT) Billing Systems and Technology Adoption Frameworks

The Pay-As-You-Throw approach is a method of charging for waste collection whereby the payment made by an individual depends on how much or how heavy waste produced is compared to fixed fee systems (Dijkgraaf & Gradus, 2004). In most cases, the success of PAYT adoption can be traced back to weighing and RFID technology because they enable accurate measurement for usage-based billing. From a theory perspective, user fees in waste collection are just like any other user fees in electricity services as both aim to reduce waste generation (Fullerton & Kinnaman, 1996). The empirical evidence supports the practice and it has been established by Dijkgraaf & Gradus (2004) that there is cost reduction and waste saving as a result of PAYT application in the Netherlands. Perceived fairness of paying lower charges for households that produce less trash is an important factor that facilitates acceptance by the public of PAYT (Jenkins et al., 2003).

Stormossen's technology adoption decision processes are also influenced by other complementary frameworks besides those of dynamic capabilities. According to Diffusion of Innovations framework developed by Rogers (2003), five characteristics – relative advantage, compatibility, complexity, trialability, and observability – affect rates of adoption processes. All five characteristics apply to Stormossen's Malax pilot project. Technology Acceptance Model by Davis (1989) and Venkatesh et al. (2003) stresses perceived usefulness and ease of use as determinants of adoption. This is relevant to the change management discussed by Interviewee 3. Finally, institutional theory by DiMaggio and Powell (1983) and Scott (2014) includes coercive, mimetic, and normative isomorphism. These concepts help explain peer benchmarking processes among Nordic countries evident at Stormossen. These theories are used as supplementary frameworks for better understanding of dynamic capabilities.

2.3 Dynamic Capabilities Theory

2.3.1 Concept and Theoretical Origins

The development of dynamic capability theory as an approach to strategy formation is directly related to efforts to improve on the limitations inherent in the resource-based view (RBV) of the firm. According to RBV, sustainable competitive advantage derives from valuable, rare, inimitable and non-substitutable firm resources and capabilities (VRIN), a perspective developed by scholars such as Barney (1991) and Peteraf (1993). Despite its contribution to understanding competitive advantage, RBV was found to be limited in the sense that it could not handle rapid changes in organizational contexts. This limitation contributed to the emergence of dynamic capability theory (Eisenhardt & Martin, 2000; Wang & Ahmed, 2007). The latter can be defined as "the ability of the firm to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516). Teece et al.'s (1997) definition marked a departure from the focus on resources towards the process of their modification. Subsequent contributions by scholars including Eisenhardt & Martin (2000); Zollo & Winter (2002); Winter (2003); Teece (2007) among others, further expanded the dynamic capabilities literature.

Dynamic capabilities, according to Eisenhardt and Martin (2000), may be associated with certain organisational practices, namely product development, alliances, and strategy making, which can be empirically observed by means of qualitative research methods. The importance of organisational learning and knowledge codification in creating and maintaining dynamic capabilities is pointed out by Zollo and Winter (2002).

2.3.2 Dynamic Capabilities and Sustained Competitive Advantage

Dynamic capability theory suggests that firms with srong dynamic capabilities will be able to maintain a competitive advantage by continuously adapting the configuration of its resources due to environmental changes. As per Teece et al. (1997) and Helfat et al. (2007), there is an indirect relationship between dynamic capabilities and competitive advantage as dynamic capabilities enable firms to reconfigure resources in order to attain competitive advantage rather than providing direct competitive advantage.

Winter (2003) clarifies this linkage through a hierarchical perspective in which operational capabilities are the activities or routines that allow an organization to perform current organisational functions, whereas dynamic capabilities are the next level of routines that enable the modification of operational capabilities over time. This hierarchy is highly relevant to the Stormossen scenario where operational capabilities are the present routines used in waste collection and billing, and the dynamic capabilities being researched are the next level of routines needed to improve such operational capabilities.

According to Teece (2007), dynamic capabilities that have path-dependent, tacit, and embedded routines in organizational structures are those that hold the most strategic value, as they cannot be easily replicated by rivals or peers even if they understand the logic behind them. For the public sector, where competition mainly relies on benchmarking, the inability to replicate such capabilities translates to an institutional advantage, which manifests in terms of innovation, efficiency, and regulatory compliance compared to competing organizations.

2.3.3 The Sensing–Seizing–Reconfiguring Framework

Teece's (2007) decomposition of dynamic capabilities into three interrelated dimensions, namely sensing, seizing, and reconfiguration, is the most operationalizable approach for research on dynamic capabilities. The following section discusses these approach in detail using Teece's framework, which is summarized in Table 2 below.

Table 2.Dynamic Capabilities in the Municipal Smart Waste Management Context

DC Dimension	**Theoretical Definition (Teece, 2007)**	**Manifestation in Municipal Waste Management**	**Empirical Indicators in Stormossen Case**
Sensing	Scanning for opportunities and threats across technologies, markets, and the external environment	Identifying RFID/weighing technology as a strategic priority; monitoring EU regulations; benchmarking against Nordic peers	Benchmarking Nordic peers (Sweden, Norway, Denmark); engaging the Finnish Waste Management Association; monitoring the EU Waste Framework Directive; identifying internal operational constraints
Seizing	Capturing opportunities through technology investments and resource mobilisation	Translating sensed information into investment decisions through navigation of multi-municipal governance; obtaining	Applying a three-criteria evaluation (recycling rate + carbon footprint + economics); operating a tiered approval system;

DC Dimension	Theoretical Definition (Teece, 2007)	Manifestation in Municipal Waste Management	Empirical Indicators in Stormossen Case
		municipal approval for technology investment	building business cases; planning the Malax pilot
Reconfiguring	Reconfiguring the resource base through consolidation, protection, and restructuring of resources and organisation	Modifying operating systems, billing systems, staff skills, and contractor relationships to fit the new technology	Retrofitting fleets via tendering; integrating IT systems (RFID↔CRM/billing); training and change management; redesigning contractor tendering

Source: Adapted from Teece (2007). Empirical indicators derived from interview data collected May 2026.

Sensing refers to the ways through which firms sense and interpret the technological, competitive, and regulatory environments to identify opportunities and threats. According to Teece (2007), there are some micro-mechanisms that help in developing the sensing capability within a firm. The micro-mechanisms include an analysis system to understand the competitive and technological environments, investing in exploratory research and development activities, participating in industry networks and partnerships, and making sense of the strategic significance of the gathered information. Important sensing channels in municipal solid waste management can include benchmarking Nordic counterparts, regulatory intelligence, suppliers, and operational diagnosis.

Seizing is the process of making decisions and allocating resources based on what has been sensed. According to Teece (2007), while good decision-making is crucial, seizing also involves having the right organizational structures in terms of authority, investment management, and stakeholder coordination. In the case of multi-muncipal public utilities, resource seizing is more complex than in private organizations, as investment decisions need to be made at different governance and stakeholder levels.

Capability reconfiguration is the process whereby a firm realigns its capabilities based on decisions made about investment. Teece (2007) highlights that effective reconfiguration involves more than operational and information system restructuring; it requires organisational learning, employee training, organizational culture changes and redesigning inter-organizational coordination. The case of Stormossen provides an illustration of capability reconfiguration, which entails all the organisational changes necessary for shifting from a volume-based service to a weight-based one with enhanced data collection.

2.3.4 Dynamic Capabilities in Digital Transformation

The relationship between dynamic capabilities and digital transformation has been widely studied in recent years due to the understanding that digital technologies constitute one of the most transformative and disruptive types of environmental changes for modern organizations (Warner & Wäger, 2019; Vial, 2019). Indeed, according to Vial (2019), disruption of value chain configurations, the necessity for business model innovation, and strong organizational resistance are distinctive elements of digital transformation scenarios, and dynamic capabilities help organisations respond to these challenges.

Warner and Wäger (2019) provide empirical insights into the emergence of dynamic capabilities in the context of firms engaged in digital transformation, whereby three types of capabilities, including digital sensing, digital seizing, and digital reconfiguring, support successful digital transformation compared to organisations that struggle with digital transformation. Digital sensing involves scanning the technological environment for opportunities; understanding the strategic implications of technologies; and integrating the insights gained into organizational actions. Firms with effective digital seizing capabilities have the ability to invest in technologies, under conditions of uncertainty explains Stormossen's deliberate move not to be one of the first Finnish companies to adopt RFID weighing technologies.

Further, Teece (2018) contends that within the digital economy the sensing dimension should include not only market and technological sensing but also sensing platforms' ecosystems, the trajectories of data assets, and regulation concerning digital technologies. In fact, the importance of platform ecosystems and regulation concerning digital technologies is reflected in the Stormossen findings, which reveal that regulatory intelligence, involving monitoring changes in European Union waste regulations and recycling targets, is considered another sensing channel, besides Nordic country benchmarking and suppliers.

Fichman (2004) introduced the "technology assimilation gap" model of digital technology adoption, where organizations adopt digital technologies without building the necessary organizational capabilities for their exploitation. According to Fichman, this gap is a result of the lack of attention to the seizing and reconfiguring elements of dynamic capabilities. The recognition of the possibility of such a gap in the case of Stormossen by the interviewee in the first interview reveals the organizational learning approach, which can be considered a key element of reconfiguration capabilities.

2.3.5 Dynamic Capabilities in Public Sector Organisations

Use of dynamic capabilities theory for understanding the challenges faced by public organizations is rather a relatively new yet growing field of study, considering the realization that public organizations are faced with the same sorts of environmental challenges that have been considered in the dynamic capabilities literature regarding private firms (Piening, 2013; Pablo et al., 2007). According to Piening (2013), who reviews comprehensively the issue of dynamic capabilities in public organizations, such organizations possess the capability to create dynamic capabilities, yet in a different way from that of the private organizations owing to specific characteristics of the public sector like democratic accountability, authorization procedures, multilateralism, and value creation within the context of public value creation.

Collaborative capability, which refers to the development and use of inter-organisationalacross organisations, has been highlighted by Pablo et al. (2007) in their study of dynamic capabilities within a Canadian healthcare organisation as particularly important in the public sector setting. Their findings also indicate that environmental scanning is an essential skill in facilitating innovation in public organizations. Kattel and Takala (2021) have identified three other capability requirements in public sector digital transformation from their analysis of the UK Government Digital Service: the recruitment of digitally competent people within the remit of the public sector salaries; the capability to test the digital technology on significant scale without interfering with the delivery of the services; and capability to deal with public sector complexity involved in the decision-making regarding technological investments. All these capability requirements can be seen in the Stormossen case with regards to recruitment of digitally competent personnel, creation of the Malax pilot and decision-making concerning technology investments.

One most important issue in this theory is the concept of competitive advantage in public sector dynamic capabilities theory. According to Piening (2013), public sector competitive advantage is achieved through sustainable value generation, where an organisation is able to offer effective services to the citizens. Public sector dynamic capabilities will create public value competitive advantage rather than competitive advantage based on the market economy environment.

2.3.6 Dynamic Capabilities in Waste Management: A Research Gap

While dynamic capabilities have received significant attention in relation to digital transformation and the public sector, there is very limited research on the application of dynamic capabilities concepts. The literature on waste management has paid considerable attention to operational capabilities such as logistics efficiency, process optimization, and equipment maintenance higher-order dynamic capabilities that are necessary for the adaptation of operational capabilities due to changes in technological and regulatory change (Bouzon & de Roodenbeke, 2007; Bouloutas & Stournaras, 2014).

In the area of environmental management, there is an extensive body of knowledge on the sustainability-oriented dynamic capabilities approach (Dangelico et al., 2017; Aragón-Correa & Sharma, 2003). Three capability areas are particularly relevant in related to the smart waste management context within a municipality environmenal sensing, green innovation capability, and sustainability-oriented reconfiguration. None of these capabilities has been studied empirically in the context of the adoption of smart technology in within waste management utilities.

2.4 Theoretical Framework

2.4.1 Framework Development and Rationale

The theoretical framework developed in this chapter integrates the three streams of literature discussed above into a single conceptual structure that serves as the foundation for empirical analysis. The theoretical framework builts on the dynamic capabilities of sensing, seizing, and reconfiguring as organisational capabilities that allow waste management firms to harness the opportunities offered by digitalisation through smart waste management implementation. There are three theoretical foundations that support this theoretical framework: firstly, the dynamic capabilities theory advanced by Teece (2007); secondly, the connection between dynamic capabilities and digital transformation described by Vial (2019) and Warner & Wäger (2019); and thirdly, the body of knowledge related to smart waste management generated by Kaza et al. (2018), Pires et al. (2019), and Anagnostopoulos et al. (2017).

In addition, the model takes into account three contextual factors associated with multi-municipal utilities: the multi-stakeholder governance structure that influences the constraints of the process of seizing (Pablo et al., 2007; Piening, 2013); and the concept of public value that reshapes the notion of competitive advantage (Moore, 1995; Twizeyimana & Andersson, 2019). The framework also considers the multi-organizational setting of service provision that extends the concept of reconfiguration beyond organizational boundaries (Agranoff & McGuire, 2003; Klijn & Koppenjan, 2000).

2.4.2 Framework Structure and Components

The theoretical framework consists of three interconnected levels . The first level represents the external environment from which there emerges a demand for capability development. The key environmental aspects that affect this level include growing EU pressure via the Circular Economy Action Plan and the Waste Framework Directive, national recycling targets, innovation in waste management technology, operaqtional growth pressures, and efficiency and sustainability demands.

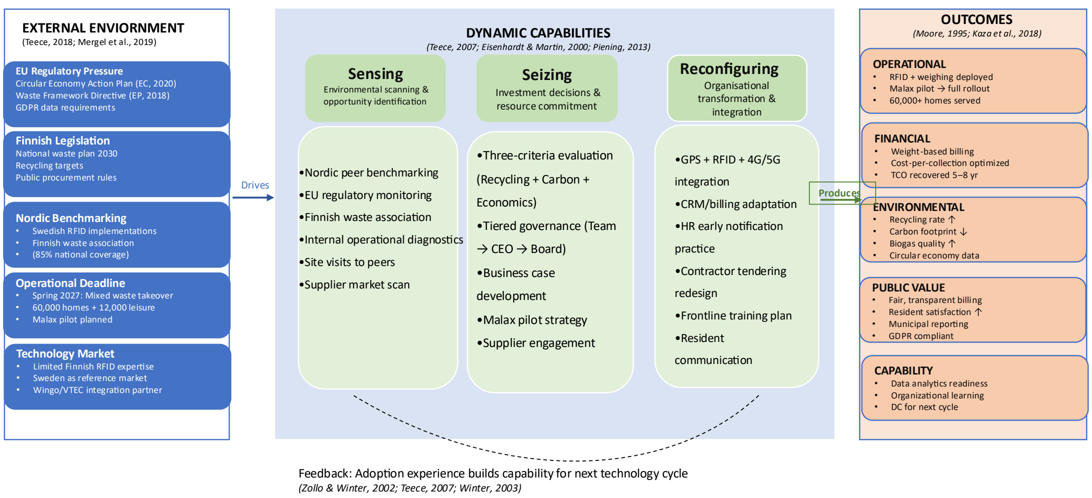
Level two consists of dynamic capabilities possessed by firms and their adaptation to the changing environment. The concept of dynamic capabilities can be broken down into three components namely sensing, seizing, and reconfiguration according to Teece (2007). In order to follow the suggestion by the supervisor to present the framework in a verb-driven format, the three dynamic capabilities shall be represented using organisational actions, starting with verbs.

Sensing: Monitoring EU regulation changes; Benchmarking Nordic counterparts; Partnering with Finnish Waste Management Association; Conducting market scan for suppliers; Analysing internal operational shortcomings. Seizing: Evaluating investment opportunities based on the three - criteria approach (recycling rate, carbon footprint, and economic impact);Securing top-down muncipal approvals; Building the business case; Launching the Malax pilot project; Determining supplier specifications. Reconfiguring: Implementing RFID, weighing systems, GPS, and 4G/5G technology integarted with VINGO, CRM, and billing systems; Training employees; Developing new contractor specification requirements; Mapping network coverage; Developing PAYT a communication strategy.

Level three reflects the expected outcomes of organisational and public value: increased effectiveness, data on waste production per household, weight-based billing, better measurement of recycling performance, and circular economy practices. The model also takes into account the fact that the multi-municipal governance setting affects capability building at each level and is distinct from the private sector's dynamic capabilities path.

Figure 1.Theoretical Framework: Dynamic Capabilities and Smart Waste Technology Adoption

Figure 1. Theoretical Framework: Dynamic Capabilities and Smart Waste Technology Adoption



Source: Adapted from Teece (2007); Vial (2019); Warner & Wäger (2019); Piening (2013); Moore (1995).

Source: Adapted from Teece (2007); Vial (2019); Warner & Wäger (2019); Piening (2013); Moore (1995).

Figure 1 presents the analytical scaffolding for Chapter 4. Each verb-led activity corresponds directly to a second-order theme in the data structure. This alignment ensures that the empirical analysis can be traced consistently from interview evidence to first-order concepts, second-order themes, and aggregate dynamic capability.

3. Research Methodology

The methodological decisions that form the foundation of the empirical study are described in this chapter. First, the research philosophy is discussed in the chapter, and then comes the research approach, research design, and finally, data collection and analysis methodologies. In addition, this chapter outlines how the data structure connects to both the interviews and the theories. This chapter concludes with an explanation of the quality criteria and ethical considerations.

3.1 Research Philosophy and Paradigm

Every research study is based on underlying philosophical principles pertaining to ontology and epistemology, which in turn influence methodology and therefore requires explicit clarification rather than being taken for granted (Saunders et al., 2019; Creswell & Poth, 2018). This particular study is based on the epistemological principles of interpretivism. According to interpretivism, one must start by acknowledging the fact that the social world including organisational capabilities cannot be discussed and analysed without making reference to the meanings and interpretations attached to them by human beings who live within them (Creswell & Poth, 2018; Lincoln & Guba, 1985). The role of the interpretivist researcher is to understand how people interpret things and act upon them accordingly. The main difference between interpretivism and positivism lies in their different assumptions towards social realities and knowledge generation.

Organisational dynamic capabilities can be understood as social constructed phenomena that emerge through human interaction and interpretation processes. Such organisational dynamic capabilities are not something that can be easily operationalized into variables or measured using standardized measurement instruments. Instead, they are something that can be studied through careful engagement with the interpretations of the people within the organisation who engage in such dynamic capabilities (Teece, 2007; Eisenhardt & Martin, 2000). The ontological position of this interpretive research paradigm is that of constructivism, where organisational constructs such as capabilities, structure, and process are socially constructed through humans and do not exist independently (Saunders et al., 2019; Berger & Luckmann, 1966). The dynamic capabilities of Stormossen can thus be perceived as constantly evolving organisational processes and not static or physical assets. Interviews would be appropriate for such inquiry due to their suitability for dealing with social constructs.

3.2 Research Approach

Consistent with the interpretivist paradigm, this research follows a qualitative approach to research. Qualitative approaches are ideal for exploring organisational process dynamics, uncovering meanings from organisational actors' experiences. They also generate theoretically enriching yet cannot be measured numerically or quantitatively (Creswell & Poth, 2018; Denzin & Lincoln, 2018). The research questions guiding this study are inherently interpretive, as they focus on how dynamic capabilities emerge and are exercised within an organisation.

A quantitative approach was considered unsuitable to conduct this study because it does not align the characteristics of dynamic capabilities research. First, quantitative research involves the operationalisation of variables before prior to data collection, but the concept of dynamic capability involves complex and multidimensional characteristics. Second, the relatively small number of organizational actors that could be involved reduces the applicability of statistics.

An abductive approach has been adopted, involving continuous movement between theory and empirical data, such that the final conclusions would be empirically and theoretically grounded (Saunders et al., 2019; Dubois & Gadde, 2002). The process of abduction, as introduced by Peirce (1878) and developed by Dubois & Gadde (2002), starts from a surprising observation and ends with an interpretation that explains the surprising element. The procedure contrasts deduction (testing existing theory) and induction (building a theory based on data only). In the current research, the sensing-seizing-reconfiguring model (Teece, 2007) forms the backbone of the empirical analysis. However, the analysis remains open to evidence refuting, modifying, or even enriching the model.

3.3 Research Design: Single Case Study

A case study approach is used in thisresearch because the study will focus on a single case organisation,Stormossen. This research design is the most appropriate way of studying a current phenomenon in a real-world setting. It is particularly suitable in a situation where the phenomenon under consideration cannot be experimented and there are no distinct boundaries between the phenomenon and the context (Yin, 2018). The dynamic capabilities of municipal waste companies are largely defined by the organizational and institutional context.

The selection of Stormossen as the case organisation is justified for several reasons. Firstly, Stormossen represents a revelant case which exemplifies the characteristics of the institution as indicated by multi-municipality ownership, public utility service provision, operating in the Nordic context and involvement in smart waste technologies which are central to the research problem. Secondly, the organization is information-rich (Patton, 2015; Stake, 1995); the organisation is currently in the pre-adoption stage of its technology journey making it theoretically suitable for examining dynamic capability development. Thirdly, there is also an existing history of research collaboration between the researcher and the case organization.

However, the limitations of case study research regarding statistical generalizability are discussed further in Chapter 6. Within the interpretivist paradigm adopted in this research, the focus is not statistical generalizability but analytical generalizability in the development of theoretical propositions which can then be empirically tested (Yin, 2018; Lincoln & Guba, 1985). In turn, analytical generalizations developed in this study represent theoretical propositions about the impact of institutions in the public sector on dynamic capabilities rather than statistical representativeness. Other qualitative approaches were also considered during the process of research design. However, grounded theory is not applicable since this research is based on the existing theoretical framework (Teece, 2007). Moreover, ethnography was also deemed inappropriate due to the limited time frame of a master's thesis.

3.4 Data Collection: Semi-Structured Interviews

3.4.1 Interview Design and Protocol

The majority of the empirical information was gathered using semi-structured interviews of organisational informants from Stormossen who came from different departments associated with the RFID and Weighing Technology Innovation Project. Semi-structured interviews are considered to be the most frequently used technique for collecting qualitative data in organisations (Bryman & Bell, 2015). In particular, the use of semi-structured interviews is already mentioned for studying dynamic capabilities since allows the researcher to explore pre-determined theoretical domains (sensing, seizing, reconfiguring) as well as unexpected insights related to each individual informant's organisational role and specialisation (Patton, 2015; Rubin & Rubin, 2011).

The interview protocol was developed through a three-step process. First, the conceptual model was translated into theme-based blocks that related to each dynamic capability, creating the basis for general questions suitable for all organisation members. Second, specific questions were created according to the role each informant fulfilled within the technological adoption project, through a review of the literature. Third, the protocol was reviewed in light of the research questions to ensure comprehensiveness. The final protocol included four theme-based blocks: role and experience; awareness of technology and information sources (sensing); decision-making and investment (seizing); and reconfiguration of processes and employees (reconfiguring).

All interviews were conducted in May 2026 through Microsoft Teams, the mode of communication preferred by all interview participants. The interviews were conducted in English. Before conducting an interview, the participants were briefed on the purpose of the research and were informed that all information provided would be kept confidential. They were also provide their verbal consent before the interviews were recorded and transcribed.

3.4.2 Participant Selection and Profiles

The organisational informants were chosen using a purposive sampling technique (Patton, 2015), whereby the aim was to ensure that all organisational functions that would be involved in adopting RFID and weighing technologies well-represented. The following two criteria were used for participant selection. First, the participants should be substantially involved in sensing, seizing, or reconfiguration practices regarding technology adoption. Second, the participants should occupy organisational roles that allow them to offer insights on capability building processes. Consistent with the unit of analysis being the organisation, the research solely focuses on organisational informants. The resident perspective information that had been initially incorporated in other drafts was not included, because it introduced a parallel story.

Table 3. Interview Participants - Organisational Roles and Profiles

Identifier	Role	DC Dimensions Primarily Addressed	Format
Interviewee 1	Circular Economy Manager	Sensing, seizing, reconfiguring (strategic integration)	Microsoft Teams (May 2026)
Interviewee 2	Chief Service Officer (Operations & Logistics)	Sensing, seizing, reconfiguring (operational)	Microsoft Teams (May 2026)
Interviewee 3	HR Manager	Reconfiguring (workforce development & change management)	Microsoft Teams (May 2026)
Interviewee 4	Supervisor, Waste Reception Stations	Reconfiguring (field operations)	Microsoft Teams (May 2026)
Interviewee 5	Environmental Educator	Sensing (communication & external awareness)	Microsoft Teams (May 2026)

Source: Own interviews, May 2026. Identities have been anonymised throughout the thesis to protect informant confidentiality, in line with supervisor guidance.

3.5 Data Analysis and Data Structure

3.5.1 Thematic Analysis

The findings gathered through semi-structured interviews were analyzed using thematic analysis, following the methodological framework outlined by Braun and Clarke (2006).

Thematic analysis was chosen due to its flexibility in identifying and interpreting themes emerging from qualitative data and its suitability for theory-informed qualitative case studies. The use of thematic analysis supported the examination of how dynamic capabilities emerged within the context of planning smart waste technology planning at Stormossen.

The data analysis process was conducted through several interrelated steps. First, the interviews were transcribed and then repeatedly reviewed many times to ensure that a deeper understanding of the data was gained. Initial notes were recorded and the themes related to technology change, governance, organisational coordination, and operational change identified. The second stage involved creating the initial codes based on the interview text. These codes were further categorized based on the three aspects of dynamic capabilities – sensing, seizing, and reconfiguration. Other themes that emerged from the empirical analysis were also taken into account during the process of analysis. This process reflected the abductive logic was ensured in the data analysis process through continuous movement between the empirical data and theoretical interpretation.

3.5.2 Data Structure: First-Order Concepts, Second-Order Themes, and Aggregate Dimensions

To strengthen analytical rigour and ensure alignment between empirical findings and theoretical abstractions, coding was done using the data structure approach of the Gioia method (Gioia, Corley, & Hamilton, 2013). First-level concepts refer to the language and perspective of informants; second-level themes refer to organisational dynamics and activities related to capabilities; and third-level aggregates represent the three dynamic capabilities identified by Teece. The data structure was created in an iterative process, where themes were systematically tested against the theoretical propositions shown in Figure 1, thereby ensuring perfect alignment between Figure 1 and the data structure. Figure 2 shows the full data structure. All second order themes presented in Figure 1 as verb phrases describing organisational activities. Moreover, each first-level concept can be traced back to its corresponding interview evidence in Chapter 4 and Appendix E.

Examples of the coding structure used in the analysis are presented below.

First-Order Concepts (Informant Voice)	Second-Order Themes (Verb-Led Activities)	Aggregate Dimension
Drawing on prior circular-economy roadmap work; recognising digital material-flow gaps; identifying RFID as relevant from prior experience	Activating individual absorptive capacity	Sensing
Watching Sweden, Norway, the Netherlands and Germany; comparing peer waste utilities; planning a site visit to a Finnish RFID adopter	Benchmarking Nordic peers	Sensing
Engaging the Finnish Waste Management Association (Jätehuoltoyhdistys); using association networks for peer practice	Engaging the Finnish Waste Management Association	Sensing
Reading EU directives; tracking national targets; translating EU → national → municipal cascade	Monitoring EU regulatory developments	Sensing
Talking to Nordic and European RFID/weighing suppliers; tracking VTEC/Wingo; assessing Finnish provider market	Scanning supplier markets	Sensing
Recognising aggregate-only weighing; spotting bin-level data gaps; learning from billing complaints	Diagnosing internal operational limitations	Sensing
Frontline supervisors and educators unaware of RFID project; senior management	Identifying frontline information asymmetry (sensing capability gap)	Sensing

First-Order Concepts (Informant Voice)	Second-Order Themes (Verb-Led Activities)	Aggregate Dimension
retains technology knowledge		
Team-leader → CEO → board hierarchy; differentiated authority by investment size; municipal representation on board	Operating the tiered governance hierarchy	Seizing
Recycling impact + carbon impact + economic impact for every project; reliability as field-deployment criterion	Applying the three-criteria evaluation framework	Seizing
Choosing not to be among the first adopters; waiting for proven Nordic operation; piloting before committing	Adopting a deliberately late, risk-averse posture	Seizing
Limited Finnish providers; Swedish maturity but higher cost; trade-off in tender criteria	Navigating the constrained Finnish supplier market	Seizing
Information not flowing through six municipal organisations; uneven awareness across owner municipalities	Coordinating municipal communication	Seizing
Malax pilot as learning laboratory; phased risk reduction; pre-board test of operational integration	Piloting RFID and weighing in Malax	Seizing
Integrating RFID, weighing, GPS, 4G/5G with VINGO and CRM/billing; container registration and digitisation	Integrating field, connectivity, and application layers	Reconfiguring

First-Order Concepts (Informant Voice)	Second-Order Themes (Verb-Led Activities)	Aggregate Dimension
Informing employees before purchase; training after purchase; lessons from biowaste expansion 2023	Informing and training the workforce	Reconfiguring
Specifying technology requirements in tenders; using tendering as adoption lever for contractors	Redesigning contractor tendering specifications	Reconfiguring
Connectivity gaps in forests/rural areas; winter weather effects on weighing accuracy	Mapping rural connectivity and Nordic operating conditions	Reconfiguring
Economics + happier customers + digital automation rate as success indicators	Defining a three-dimensional success measurement framework	Reconfiguring

Source: Developed by the author from thematic analysis of interview data (May 2026). Each second-order theme corresponds to a verb-led activity in the theoretical framework (Figure 1), ensuring full harmonisation between framework and data structure.

This data structure provides a transparent and systematic foundation for interpreting how dynamic capabilities develop during the pre-adoption phase of smart waste technology implementation in a multi-municipal public utility context.

3.6 Quality Criteria and Ethical Considerations

Credibility, transferability, dependability, and confirmability were used as criteria used in evaluating quality in qualitative research, equivalent to validity and reliability in quantitative research respectively (Lincoln & Guba, 1985). Credibility, which is similar to internal validity, was established by several methods, including triangulation of data from five organisational sources whose positions differed functionally; triangulation using the dynamic capabilities framework; and provision of both disconfirming and confirming evidence (such as the information asymmetry at the frontline reported in section 4.2.4). Even though member checking did not take place due to time limitations , the fact that the researcher was familiar with the organisation minimised chances of contextual errors.

Transferability was supported through thick description (Geertz, 1973) of the organisational context, governance structures, and the institutional setting in which Stormossen operates; allowing readers to evaluate whether the conclusions drawn apply elsewhere. Dependability was strengthened by documenting data gathering and data analysis procedures in systematically . Regarding confirmability, the researcher remind reflexively aware of my prior interaction with the organization. This facilitated access and understanding may also increase the risk of favorable organisational interpretations . This risk was mitigated by analyzing shortcomings and weaknesses in organizational dynamic capabilities.

Before conducting interviews, each participant was made aware of the aims, procedures, and methods employed for securing confidentiality in the research. Verbal consent was obtained for recording the interviews as well as their use of academic purpose. All collected data were kept confidential and were accessible only to the researcher and the supervisor. All informants remained anonymous during the entire research process. Thus, the interviewees are referred to by nameless titles such as Interviewee One and Interviewee Two, as well as the position held within the organisation.

3.7 Reflexivity and Positionality

The concept of positionality in organisational qualitative research calls for reflexivity in terms of the way that the researcher's previous experience, theoretical perspective, organisational connections and personal background influence both the research process and interpretation of the results (Creswell & Poth, 2018; Denzin & Lincoln, 2018). The most significant positionality issue in the current study concerns the fact that the researcher had previously collaborated with Stormossen, which facilated access to senior-level organisational informants but potentially increased the risk of interpreting data in an overly positive light from an organisational perspective. These risks were addressed in practice in the several ways. First, by presenting disconfirming data in addition to confirmatory data (e.g., frontline information asymmetry, reconfiguration planning challenges, and limited Finnish RFID solutions providers' market); secondly, by employing more than one theoretical approach (both dynamic capabilities theory as well as TAM and innovation diffusion theory); and thirdly, by conducting an analysis according to the academic rather than organisational criteria.

3.8 Interview Conduct: Transcript Quality and Limitations

The interviews were conducted using the software Microsoft Teams, with automatic transcription function. While automatic transcription has become very reliable, there were still some problems that needed to be highlighted with respect to its accuracy. Finnish proper nouns like Stormossen, Vörå, and Jätehuoltoyhdistys and technical terms like RFID, VINGO, 4G/5G, and CRM were not always transcribed accurately. In addition overlapping speech occasionally created transcription difficulties.

Interview duration ranged from approximately six minutes (Interviewee 5 - Environmental Educator) to about twenty-six minutes (Interviewee 1 - Circular Economy Manager). These difference reflected varying levels of involvementn the RFID project, as well as different accessibility of organizational participants. Interviews that took less time, specifically, interviews with Interviewee 4 and 5, offered smaller amounts of information regarding specific themes; hence, the lack of certain topics within these answers is informative in itself. All interviews were conducted in English, which represented a second or third language of all Finnish informants. Despite high fluency in English, sometimes informants had trouble expressing their ideas clearly, particularly related to the use of technical vocabulary and regulations; however, the researcher used probing questions to overcome this difficulty. In terms of time, all interviews were held on the same day (4 May 2026); however, the afternoon interview with Interviewee 1 provided the most comprehensive account of the strategic and integrative process.

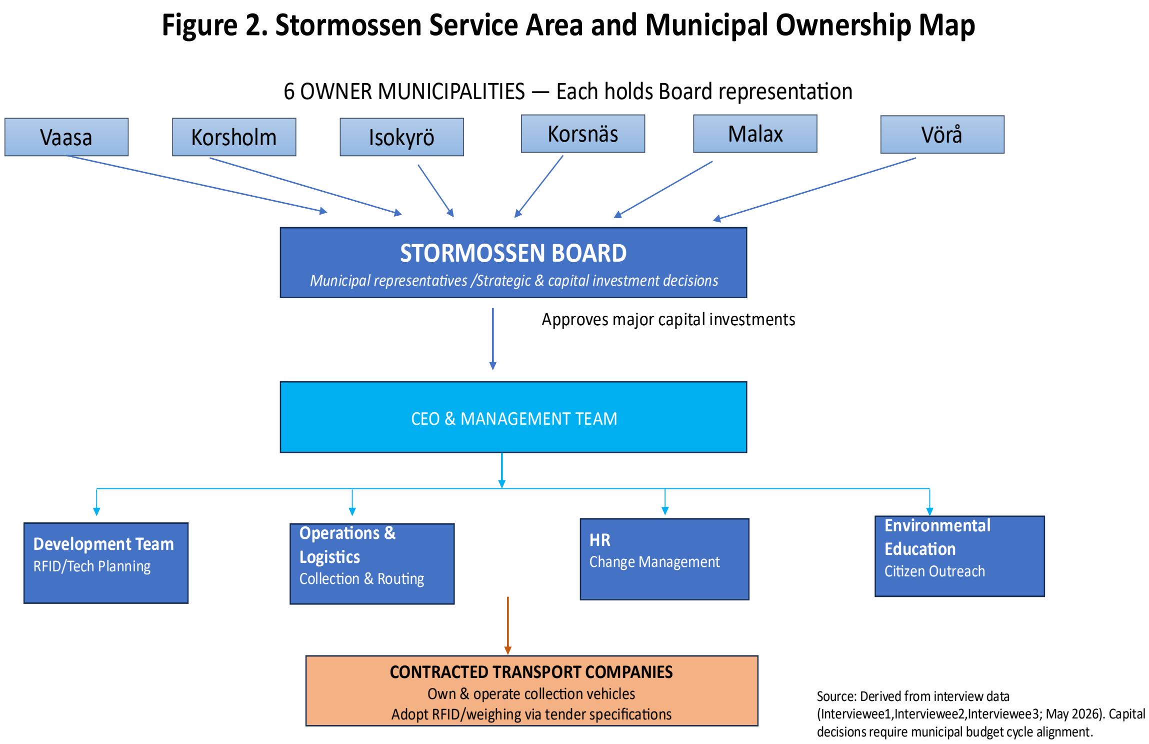
4. Empirical Findings

The findings presented in this chapter are derived from semi-structured interviews with organisational informants at Stormossen, conducted in May 2026. The results have been organised around the lines of the three dimensions of dynamic capabilities: sensing, seizing, and reconfiguring. Chapter 4 begins with discussing the background of the case organisation, Stormossen, and its operational situation with regard to the RFID and weighing technologies project. Findings related to opportunity identification, evaluation, and commitment are covered in sections 4.2, 4.3, and 4.4, respectively. The analysis of the Malax pilot is provided within Section 4.3 (seizing), since the pilot was an organizational device used to evaluate and commit to investment decisions amid uncertainties. Interview evidence is presented through anonymous quotes referred to as Interviewee 1 to Interviewee 5, respectively.

4.1 Stormossen as a Case Organisation: Operational Context

Stormossen is a regional waste management organisation operating in the Vaasa region located in Western Finland. This company has been in operation since 1985 and is owned by six municipal governments, including Vaasa, Mustasaari, Isokyrö, Korsnäs, Malax, and Vörå. The organization is governed through a board that represents the six owner municipalities, which make decisions about strategy and investments. Stormossen serves approximately 107,000 residents and employs around 50 people. The organisation runs three biogas plants that treat separated biowaste and eleven waste reception sites with its operational area. Its services include biowaste collection (introduced in 2023), packaging waste collection (introduced in 2023), and mixed waste collection scheduled to begin in spring 2027.

Figure 2.Stormossen Service Area and Municipal Ownership Map

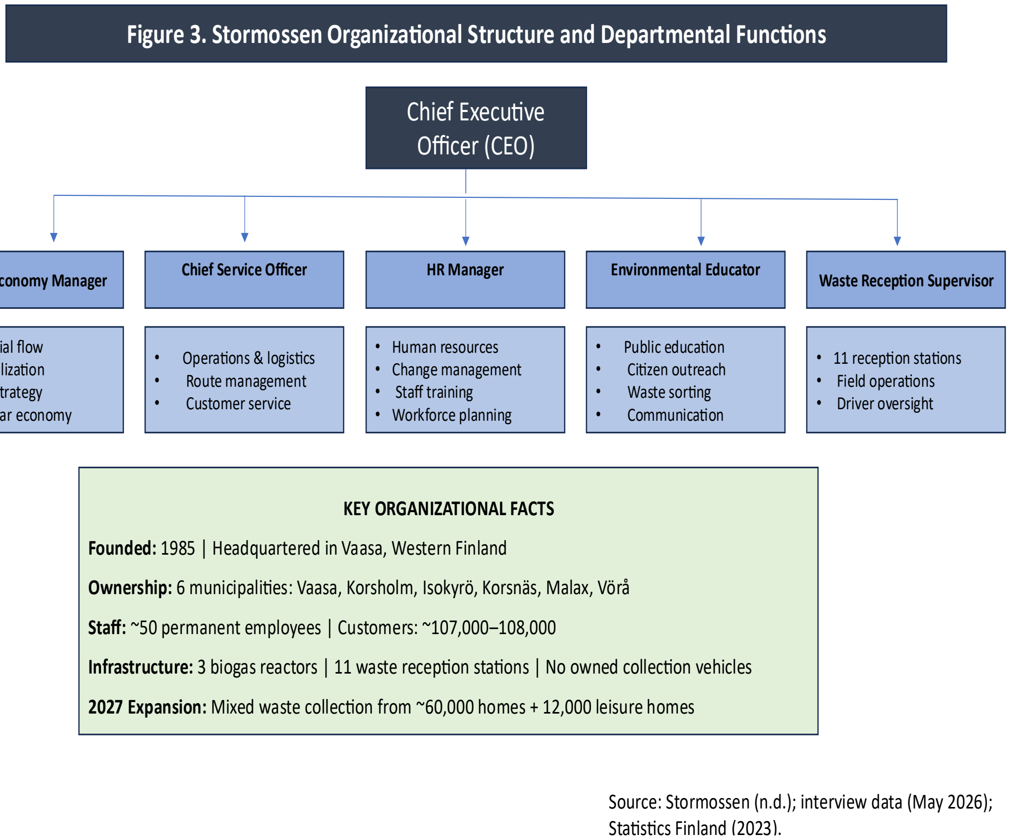


Source: Stormossen organisational records and interview data (Interviewees 1–3, May 2026).

Figure 2 illustrates the geographical reach and municipal ownership structure of Stormossen. The organisation operates across several municipalities within the Vaasa region. This multi-municipal ownership structure is important for understanding Stormossen's governance and decision-making processes.

One aspect that makes Stormossen unique in its operations is the fact that it lacks its fleet of vehicles to collect wastes from customers. Waste collection services is sub-contracted to transporters through competitive tendering.. The involvement of transport companies makes the use of technology an important step, because it is up to the contractor to purchase and operate the technology.

Figure 3.Stormossen Organisational Structure and Departmental Functions



Source: Stormossen (n.d.); interview data (May 2026); Statistics Finland (2023).

Stormossen currently uses the VINGO route management system and the Transport Control System (TCS). The two systems generate live data for positions of vehicles and generate data for each route and each vehicle but do not provide data at the individual bin level. This is the core issue which the new RFID system aims to solve.

Table 4. Stormossen Technology Adoption Timeline and Milestones

Period	Development	Significance for RFID/Weighing Adoption
1985	Stormossen founded	Establishes multi-municipal governance structure with six owner municipalities
Pre-2023	Volume-based collection; manual data systems	Establishes legacy IT infrastructure; creates the digital transformation pressure

Period	Development	Significance for RFID/Weighing Adoption
2023	Biowaste and packaging waste collection introduced	Major operational change; lessons learned for change management and stakeholder communication
2024–2025	RFID and weighing technology sensing phase begins	Nordic peer benchmarking; EU regulatory monitoring; internal operational diagnostics
May 2026 (study)	Pre-adoption phase; technology evaluation; business case development	Point at which dynamic capabilities are examined in this research
Spring 2027	Mixed waste collection takeover; planned Malax RFID pilot	Operational deadline driving technology adoption urgency; ~60,000 homes + 12,000 leisure homes
2027–2032	Phased RFID and weighing rollout; weight-based billing implementation	Target outcome of the capability development process examined in this study

Source: Derived from interview data (Interviewees 1–3, May 2026).

The technology implementation in the empirical setting of this case involves the implementation of RFID tags to identify the waste bins and the implementation of onboard weighing sensors to measure the weight. The implementation process will entail the use of RFID tags embedded in all the waste bins in the region, RFID readers embedded in collection vehicles, onboard weighing sensors that weigh the waste bin at the time of collection, live data transfer through the mobile network (4G/5G), and integration into the CRM system, routing system, and invoicing system of Stormossen. By May 2026, Stormossen was in informal talks with suppliers, strategic discussions about the technology, and preparing for the Malax pilot project scheduled to begin in spring 2027.

4.2 Sensing Capabilities :Identifying and Interpreting Technological Opportunities

4.2.1 Origins of Technological Awareness

These interviews indicate that Stormossen’s recognition of RFID and weighing technologies as strategically relevant emerged through a combination of internal knowledge and external enviornmental signals rather than through a formalised sensing process. It is especially interesting to note the source of strategic awareness in relation to Interviewee 1 because this clearly illustrates that previous experience in a related field creates mental models for recognizing new opportunities in technology:

> *"Before I joined the waste handling, I was the coordinator of the joint municipalities organisation. I was the coordinator of writing a circular economy roadmap for the businesses in Ostrobothnia. We realised that an important thing about this is knowing what kind of materials are moving, because if you know what materials are flowing, you can start thinking about where they could be used as recycled materials or maybe reused. When I moved into the waste handling business, I noticed that there were vast amounts of information in different databases, but they are not being mined and used properly. So we started to develop tools for that digital tools."*
>
> **-** Interviewee 1, Circular Economy Manager

This example demonstrates how existing knowledge about a related area of expertise, regional circular economy strategy development, contributed to the development of cognitive frameworks within which the importance of digital material flow data from a strategic perspective was recognised by the organisation. This is a specific kind of individual absorptive capacity (Cohen & Levinthal, 1990). In this case, the capability emerged not through to organizational scanning, but through prior professional experience. It serves as a unique sensor for Stormossen, but at the same time it also creates organisational vulnerability the organization due to its concentration on a single individual.

Interviewee 2 provided a complementary operational account of how sensing awareness emerged from the practical limitations of the current collection system:

> *"At the moment, it serves us quite well because we are not billing customers about how much the waste is weighed we're not billing by weight. But in future, we are planning to use the RFID technology for that too, so we can get every household, every waste bin, how much waste there is inside that. We get that information too. Now we don't. We only get the info from our scale in our own area, when the trucks drive here to get rid of the waste."*
>
> -Interviewee 2, Chief Service Officer

These two parallel perspectives, one strategic and other operational perspective, demonstrate a dual input-sensing model where operational intelligence and opportunity discovery act as two complementary inputs to each other. This approach aligns with the definition provided by Warner and Wäger (2019).

4.2.2 Environmental Scanning Channels and Processes

Environmental scanning through various channels was found in the interviews; the channels involved networking within the industry, peer organizations, regulation information, dealings with suppliers, and professional journals. The most comprehensive description of the scanning channels was provided by Interviewee 1, as follows:

> *"Inspiration or solutions come from several sources. We have this organisation where all the Finnish municipal waste handling companies are together—the Finnish Waste Association covering the waste of 5.6 million people, 85% of Finnish municipal waste. So of course there is a lot of information sharing there. We are also looking at solutions from Sweden a lot. In some areas we are looking at what Norway is doing. For some digestate and nutrient recovery questions we look at Dutch and German ways of treating. So it's very much the Nordic countries and Northern Europe."*
>
> -Interviewee 1, Circular Economy Manager

Table 5. Sensing Channels and Their Institutional Sources at Stormossen

Sensing Channel	Institutional Source	Type of Intelligence	Relevance to RFID/Weighing Adoption
Finnish Waste Management Association (Jätehuoltoyhdistys)	National industry body covering 85% of Finnish municipal waste	Peer practice sharing; technical benchmarking; regulatory intelligence	Primary peer network for Finnish-context RFID experience
Nordic peer organisation benchmarking	Swedish, Norwegian, and Danish peer waste utilities	Operational performance data; technology demonstration; lessons learned	Sweden as primary RFID reference market
EU regulatory monitoring	European Commission; EU Waste Framework Directive; Circular Economy Action Plan	Regulatory requirements; policy signals; compliance deadlines	EU traceability requirements driving urgency for RFID adoption
National legislation monitoring	Finnish waste legislation; national recycling targets	Compliance requirements; national policy signals	Finnish recycling targets driving collection data quality requirements
Supplier/technology market scanning	Nordic and European RFID/weighing providers; VTEC/Wingo (route management)	Technology capability; pricing; integration possibilities	Identifying available solutions; building toward procurement specification
Site visits to peer organisations	Waste company in southern Finland; planned visits	Operational demonstration; implementation lessons; performance verification	Confirming technology maturity before commitment

Sensing Channel	Institutional Source	Type of Intelligence	Relevance to RFID/Weighing Adoption
Internal operational diagnostics	VINGO and TCS data; billing disputes; customer service records	Internal performance gaps; operational limitation identification	Aggregate-only data limitation driving need for bin-level RFID data
Circular economy roadmap experience	Ostrobothnia circular economy roadmap (Interviewee 1's prior role)	Strategic framework; material flow logic; regional context	Foundational cognitive framework for sensing digital material flow

Source: Derived from interview data (Interviewees 1 and 2, May 2026).

Interviewee 2 provided a complementary operational perspective emphasising peer-organisation site visits as a form of experiential intelligence that supplements the more formal information gathered through industry networks:

> *"We are gathering information from those companies who already have this technology in use, first from them, and then the companies that manufacture these RFID technologies. The next company from Vaasa to south—they are using it already, and we are going to visit them and get all the information they have. It's a much smaller company, but they have the technology already."*
>
> **-** Interviewee 2, Chief Service Officer

This planned site visit reflects the organization’s tendency to rely on information that is operational or practice- based rather than just technical or commercial information provided by the suppliers. This behavior can be associated with their Nordic peer benchmarking tendencies as a way of sensing processes.

4.2.3 Regulatory Intelligence and EU Legislative Signals

Regulatory intelligence emerged as a recurring theme across several interviews, as an important organisational sense-making process that became highly relevant for Stormossen. Increased requirements regarding traceability associated with the EU Waste Framework Directive, national recycling objectives in Finland, and growing digital demands were considered to be significant environmental signals that impacted the analysis of RFID and weighing systems by Stormossen.:

> *"A very strong push comes from the European Union legislation and the European Union incentives, which is then translated into national laws and national incentives, which is then again translated into wishes, laws and statutes on a municipal level, which kind of puts us—it sets the goals for us, and it also sets the challenges for us. And then when we go looking for tools to solve this problem, we look at what is our own experience, what do others do."*
>
> -Interviewee 1, Circular Economy Manager

This multi-level regulatory hierarchy (EU → national → municipal) is very pertinent to understanding the external pressure being exerted on Stormossen for its technology sensing. Stormossen is not conducting technology sensing in isolation; it is under a growing pressure to regulate its activities in accordance with increasingly stringent rules, which have turned waste data management from a mere convenience to a matter of compliance. Together with external pressure, these developments also influenced the preparation of Stormossen's business case for RFID and weighing technologies.

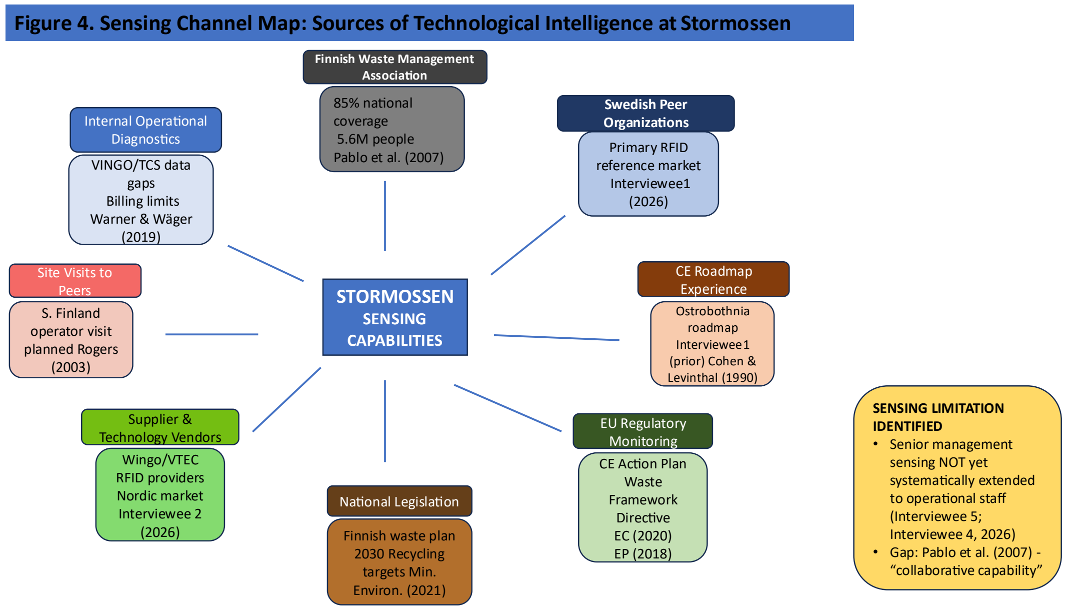
4.2.4 Limitations of Current Sensing: Information Asymmetry Across Organisational Levels

Although the strong point of Stormossen's sensing process through its senior management is apparent, one major weakness identified from the interview is that the sensing process has only been limited to the senior management team and has not been institutionalized into an organization-wide practice that integrates frontline operation knowledge. The information disparity can be seen in the cases of Interviewees 4 and 5.

According to Interviewee 4 (Waste Reception Station Supervisor), there was no specific information concerning the RFID system, and the concept first had to be explained before answering more elaborate questions. She was aware of some adjustments being made within the system but did not know what RFID would entail for her workplace. Interviewee 5 (Environmental Educator) stated that there is always an update about technological advancements in internal meetings ("someone tells you when there is any new technology happening"), however she had no information regarding RFID.

This pattern reveals a distinctive feature of Stormossen's sensing capability. Although the management of the company has been successful in developing a number of highly effective sensing routines, these have not yet been used together with operational sensing in a way that would enable the knowledge gained at the operational level influence the process of requirement definition. Collaborative ability, as highlighted by Pablo et al. (2007), is particularly important for any public organization, and especially when implementing RFID technology. The knowledge that enables us to utilize such technology comes from the operational level, hence there is certainly room for improvement.

Figure 4.Sensing Channel Map: Sources of Technological Intelligence at Stormossen



Source: Interview data. Framework: Teece (2007); Cohen & Levinthal (1990); Pablo et al. (2007).

Source: Interview data; Teece (2007); Cohen & Levinthal (1990); Pablo et al. (2007).

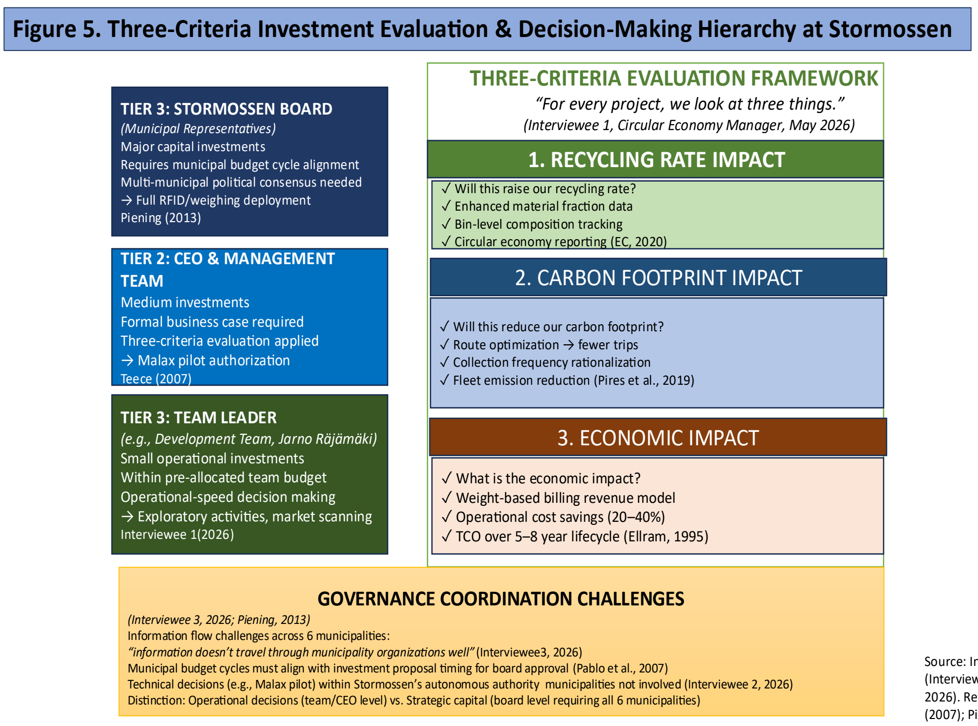
4.3 Seizing Capabilities: Strategic Decision-Making and Resource Commitment

4.3.1 Governance Architecture and Decision-Making Processes

The capturing dimension of the dynamic capabilities at Stormossen is influenced by the governance system of the multi-municipality structure. It was noted that for the coordination of interests among the six municipalities, which each have their own politics and budget cycles, was an important part of the technology investment environment. As mentioned by Interviewee 1:

> *"We are a typical hierarchical organisation. If we're looking at new technology, that would be very much the development team or the logistics team. We will look at technologies, make an evaluation, and maybe go and see and visit someone who has this technology. These decisions we do ourselves. Then when we have looked at a technology, we will basically write a report trying to see the technological aspects of it, what possible benefits it would have, what impact will it have on the carbon footprint, and what is the possible economic impact. This will be presented to the management board within Stormossen and they will then either decide: we are not interested, or we are interested, or interesting but we're going to leave it for the time being. If it is a yes, depending on the size of the investment, it can either be decided by our CEO directly, or if it's a larger investment, then it goes to the Stormossen board."*
>
> **-** Interviewee 1, Circular Economy Manager

Figure 5.Decision-Making Hierarchy for Technology Investment at Stormossen



Source: Interview data (Interviewee1,Interviewee2,Interviewee3; May 2026). Referenced: Teece (2007); Pablo et al. (2007); Piening (2013); Ellram (1995).

Level	Decision-Maker	Scope of Authority	Criteria Applied
1. Operational	Team leader (e.g., development team lead)	Small investments within team budget allocation	Technical feasibility; operational fit; budget availability
2. Management	CEO / Management team	Medium investments exceeding team-leader budget but within management authority	Three-criteria evaluation: recycling rate impact + carbon footprint impact + economic impact
3. Board governance	Stormossen Board (representatives of all 6 owner municipalities)	Large capital investments; strategic initiatives with multi-municipal implications	Full formal business case; ROI analysis; regulatory alignment; municipal budget compatibility

Source: Derived from interview data (May 2026). Specific budget thresholds were not disclosed in the interviews.

This hierarchical framework for governance is particularly relevant when considering the issue of multi-part ownership as it ensures a set monetary limit for decision making power. The frameworks allows that smaller projects and explorations are made by the team leaders and senior management, while large investment decisions are reviewed by the entire board. Considering the scope of the RFID and weighing systems for around 60,000 homes, the board’s approval would definitely be necessary.

Interviewee 2 introduced an important qualification to the governance constraint narrative:

> *"I don't think [the municipalities] will delay [the timeline]. The municipalities don't have anything to do with this. We can, we decide what techniques we use. And as I said, this is not for the pricing or it's just for us to learn that this technology and*

how to use it. And maybe in next five years, all the mixed waste collections would have this RFID technology and scales at the waste trucks."

-Interviewee 2, Chief Service Officer

Interviewee 2 differentiates between tactical decisions (decision on technology under the control of Stormossen) and decisions that require the approval of the board and may be the approval of the municipality as well. Within the framework of the Malax case being an instance of learning, the involvement of the municipality in deciding upon the technology is not mandatory.

4.3.2 Investment Evaluation Criteria

A structured, multi-criteria approach to technology investment evaluation was observed in the interviews and is formally embedded in Stormossen's processes. Interviewee 1 described the criteria applied to all technology investment decisions:

"For every project that we are looking at, we are looking at three things. What is the impact on our recycling rate? So will this raise our recycling rate in somehow? What is the impact on our carbon footprint? And what is the economic impact of this possible project."

-Interviewee 1, Circular Economy Manager

The three criteria model is comprised of three factors: recycling effect, carbon effect, and economic effect. In other words, this framework integrates environmental, operational, and financial considerations, taking into account the fact that there are two sides of responsibility of Stormossen – environmental and financial sustainability. Secondly, the framework aligns with the requirements of EU regulation directly, which means that projects being considered will automatically be in line with all the necessary criteria from the very beginning. Thirdly, the framework represents a decision-making basis for the multi-municipal board.

Interviewee 2 added reliability as a non-negotiable first-order criterion for field-deployed technology:

"Reliability is the first thing because it's a technology that gives information and knowledge to do the right pricing for waste management. Reliability is the first,

and then when we take it in use, so it should be quite easy not take too long that we can take it to our normal practice quite fast, in quite fast rhythm. I'd say one or two months."

-Interviewee 2, Chief Service Officer

Interviewee 2's emphasis on reliability reflects with the unique risks associated with waste management technologies, because if technological equipment fails either due to cold weather in Finland, poor cellular signal in remote areas, or due to constant pressure from daily operations, then it may compromise the reliability and legitimacy of the weighing system.

4.3.3 Current Stage of Seizing Activity and Supplier Engagement

At the time of interviewing, Stormossen's seizing activities were still at an early stage of market exploration. The organisation had initiated discussions with suppliers but had not entered procurement negotiations or committed financial resources. Interviewee 1's description of the two main expected technical challenges illustrates the technical complexity of the seizing process:

"From my experience, there is going to be two main challenges: one is the mechanical working and reporting—that it physically actually works and reports and has the connection to the internet through the mobile nets. This is one of the reasons why Stormossen didn't want to be among the first to try this technology. We want to see it working somewhere. The second thought all I know where there's going to be challenges is to get the right linkage between the reporting system of the weighing software into the CRM and the billing software that we're using."

- Interviewee 1, Circular Economy Manager

This represents an example of a deliberate seizing strategy based on control and risk reduction: The technological expertise necessary to ensure safe adoption is being developed by Stormossen slowly but surely. On the other hand, Stormossen is developing a strategy for integrating the software solutions that will pose difficulties in terms of implementation.In this regard, the VINGO/VTEC integration plan is considered one of the essential components of Stormossen's seizing strategy.

Interviewee 2 identified the limited Finnish RFID provider market as a significant seizing constraint:

> *"It needs scales to these waste trucks. And there is not so many companies, at least in Finland, that has the knowledge of that technology. In Finland, we have almost no company that has had it for long enough that we could consider it reliable. I know that in Sweden they have companies that have this technology, and more knowledge of that thing, but it's not where we can get the best pricing."*
>
> - Interviewee 2, Chief Service Officer

This market limitation—technical maturity in Sweden but limited Finnish provision—creates a seizing paradox. Swedish suppliers have more mature solutions but may impose higher costs and offer less accessible maintenance support, while the Finnish market lacks providers with an established track record. This trade-off is likely to influence vendor selection criteria in the formal tendering process.

4.3.4 Municipality Coordination Challenges

Interviewee 3 (HR Manager) provided a candid view of communication challenges across the six-municipality governance structure revealing a seizing constraint that extends beyond formal governance into information dynamics:

> *"It is more difficult because there's a lot more people involved. And the information also doesn't go forward as fluently as you would imagine in a municipality. So even when we try to inform them and send messages and try to tell what is going on or what kind of technology we are going to start to use, the information doesn't travel through the municipalities' organisations that well. So it can happen that the people who need to know the information don't get it every time."*
>
> — Interviewee 3, HR Manager

For Interviewee 3, the constraining factor in terms of multi-municipality governance is not just the requirement of board authorization for decisions from six different municipalities but also the practical problem of ensuring that relevant decision-making information reaches the appropriate actors in each municipality. This process therefore requires effective stakeholder communication and coordination. Without adequate contextual knowledge of the intended investments, decision-making will be limited.

4.3.5 Piloting RFID and Weighing Technologies in Malax

An important example of a seizing activity within the Stormossen organization is the proposed pilot for Malax. The organization plans to conduct this pilot as a controlled pilot project of RFID and weighing technologies before making a final deployment decision. The pilot project is seen as a seizing activity since it is an investment process where the company tests technological uncertainty before going into full implementation.

Rather than making an immediate commitment towards implementation, Stormossen has adopted an iterative approach that involves the evidence generation and organisational learning. As such, the pilot being implemented in Malax serves as both an experiment and a source of organizational learning, whereby the organization is able to explore issues related to compatibility, reliability, accuracy, and implications for administration. At the same time, the pilot serves to generate the necessary evidence needed to make the final seizure decision. The pilot also possesses diffusion characteristics as specified by Rogers (2003), particularly trialability and observability.

The planning for the pilot project is closely connected to inter-municipal cooperation. Because Stormossen is jointly owned by six municipalities, even a consciously restricted pilot project will involve cooperation between operations management, the municipality hosting the project (Malax), contractors, and technology suppliers. The pilot project of Malax demonstrates that the capability building in public utilities is not only dependent upon technology acquisition but also on coordination among several different organizational and municipal agencies.

> *"Before making large investments, we first need to understand how the system works in practice, what problems may appear, and how municipalities respond to it."*
>
> -Interviewee 1, Circular Economy Manager

This statement crystallises Stormossen's strategic preference for incremental capability development and evidence-based decision-making prior to full-scale technological implementation. From a dynamic capabilities perspective, the Malax pilot is not separate from seizing but central to it: it is the organisational mechanism through which sensing-stage information is converted into a board-ready investment justification.

4.4 Reconfiguring Capabilities: Planning for Organisational Transformation

4.4.1 Technical Reconfiguration Requirements

The interviews surfaced a comprehensive understanding of the technical reconfigurations required for RFID and weighing technology adoption. Interviewee 1 articulated the full technical architecture:

> *"After this [RFID system], we will know how much waste was picked up from each house. This also gives us a possibility to reconsider our costs—so how often shall we pick up at this house? Do we need to pick it up every week, every second week, or every fourth week? This will also of course be affecting how we are going to bill these houses for the service. The way of doing it is the same—we still pick up waste from these houses and we treat it—but the reporting, the follow-up, and the billing will be more detailed."*
>
> -Interviewee 1, Circular Economy Manager

> *"It will set a large demand on the online digital follow-up, since this is going to be followed up immediately. So we will have to go through the 4G or 5G network to get this data coming in all the time. The container registration across all the municipalities must be completed and digitised first. The digital weighing mechanism must be compatible and must have ways of communicating with our reporting and billing system."*

-Interviewee 1, Circular Economy Manager

Interviewee 2 explained the operational architecture from a logistics perspective, focusing on the planned automatic data flow that minimises driver-behaviour change:

> *"The route planning is the same, and the driver—we try to get all these data systems and programs to work so that it will be automatic. The scale would work automatically when the truck driver takes the bin to the scale in the back of his car so it would be automatic that information moves to us also. The truck driver doesn't need to do anything differently than today. He just gathers at the same time more information than before."*

-Interviewee 2, Chief Service Officer

Interviewee 2’s emphasis on automated data exchange reflects the highly technical nature of the reconfiguration process. Instead of requiring users to adapt themselves to the new digital interface, the technology itself is set up to ensure that the RFID data and weight measurement data are gathered automatically. The underlying assumption here is that RFID data and weighing system have been successfully integrated with the VINGO route planning system, which Interviewee 2 indicated was happening together with VTEC.

Figure 6. RFID and Weighing Technology Integration Architecture at Stormossen

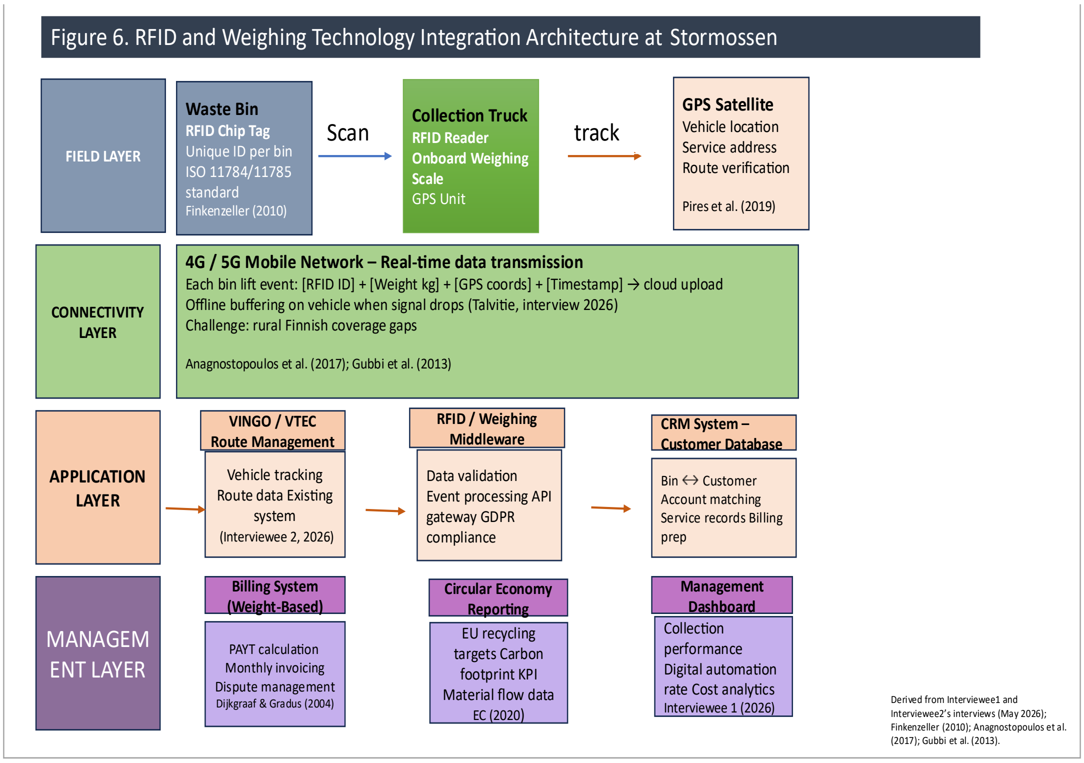


Figure6. RFID and Weighing Technology Integration Architecture at Stormossen Source: Derived from Interviewee1 & Interviewee2 's interviews (May 2026); Finkenzeller (2010); Anagnostopoulos et al. (2017); Gubbi et al. (2013).

Layer	Component	Function	Key Challenge Identified
Field Layer	RFID chip (embedded in bin)	Unique bin identification	Container registration and digitisation across all six municipalities
Field Layer	RFID reader (truck-mounted)	Reads bin chip at moment of lift	Limited Finnish provider expertise; hardware procurement
Field Layer	On-board weighing scale	Measures bin weight at the moment of collection	Winter weather and terrain effects on accuracy

Layer	Component	Function	Key Challenge Identified
Connectivity Layer	4G/5G mobile network	Real-time data transmission from truck to management systems	Coverage gaps in rural and forested areas
Application Layer	VINGO/VTEC route management	Receives and processes field data; route tracking	API integration with RFID/weighing data feeds
Application Layer	CRM/Billing system	Generates individual weight-based bills from collection event data	Data model incompatibility; billing logic redesign from volume to weight

Source: Derived from interview data (Interviewees 1 and 2, May 2026); Finkenzeller (2010); Anagnostopoulos et al. (2017); Gubbi et al. (2013).

4.4.2 Workforce Development and HR Change Management

Interviewee 3 (HR Manager) explained Stormossen's approach to workforce change management:

> *"First we tell them, even before we start to purchase anything, we tell the employees that we are planning on starting to use this kind of technology or whatever device it is. And then we keep them informed during the process. When we have purchased the device, we will have schooling for the ones who need to be able to use that technology, and then we just start using the thing."*
>
> \- Interviewee 3, HR Manager

This sequence consisting of pre-purchase notification, ongoing communication during evaluation, and post-purchase training reflects a structured change management practice aligned with Kotter's (1996) model, which emphasises urgency creation and continuous communication. Interviewee 3 also acknowledged initial resistance:

> *"Sometimes people can think that they don't need any new devices or technology, that they are used to working the way they do now and think that it doesn't help them or it's not beneficial. But many times when even when people are against*

some new things or new technologies, they soon realise that this actually makes their job easier."

- Interviewee 3, HR Manager

Interviewee 3’s belief in eventual acceptance by employees is aligns with the Technology Acceptance Model (TAM), which states that the factors contributing to individual acceptance of technology include ease of use and perceived usefulness (Davis, 1989). Any technology that is seen to make work easier, such as the automated data-capture system described by Interviewee 2 are more likely to gain employee acceptance over time, even among initially sceptical staff.

Interviewee 4 (Supervisor at Waste Reception Stations) emphasised that connectivity reliability is a precondition for driver trust and pointed to operating conditions specific to Stormossen's service area:

"Of course I need learning, practising, and one important thing is that connections are good or excellent. Some stations are in the middle of the forest that connections, Wi-Fi or 5G at those connections, are workable. In winter, it may affect maybe the weighing accuracy level also."

-Interviewee 4, Waste Reception Stations Supervisor

"Usually, when changes are made, there are always some resistance. But I believe after we changed our stations to autonomous, automatic stations, those are more open-minded to coming systems when we talk about smart or some kind of electrical choices."

-Interviewee 4, Waste Reception Stations Supervisor

Interviewee 4's observation that the prior shift to autonomous reception stations has made staff more receptive to subsequent technological change provides an important theoretical insight. Past technological adoption not only generates change-management learning but also reshapes the organisational culture of operational staff, increasing receptivity. This is consistent with Teece's (2007) emphasis on the path-dependence of reconfiguring capabilities, which incorporate cumulative organisational learning through adaptation.

4.4.3 Contractor Reconfiguration Through Tendering

A distinctive reconfiguration mechanism that emerged in the interviews is the use of public procurement tendering to extend technology requirements to contracted transport companies. Because Stormossen owns no vehicles, the RFID readers and on-board weighing scales must be installed on contractor vehicles.

> *"We are doing [contractor engagement] by public tendering. When we do the tendering, we are telling them upfront that these are the expectations we will have regarding what kind of cars you can use, what kind of area you will be working in, and what kind of digital reporting we will be expecting from you. That's the way you're basically telling them upfront that this is what we will be expecting. And then if they don't like it, they will not participate in the tender."*
>
> **-** Interviewee 1, Circular Economy Manager

> *"Yes, they [contract partners] do have to adopt this technology because the cars they are using are theirs. They are entrepreneurs for us and we pay for their services. So in good cooperation we can handle it."*
>
> **-**Interviewee 2, Chief Service Officer

Tendering as reconfiguration represents an advanced organizational mechanism whose purpose is to extend technological requirements beyond the organisation itself and into outsourced service delivery arrangements. By including technology requirements such as hardware configuration, connection requirements, and data reporting, Stormossen uses the tendering process as a mechanism for technology control. Bidders who are not willing or capable of meeting the conditions would be unable to qualify for the contract.

4.4.4 Success Measurement Framework

Interviewee 1 articulated a multi-dimensional success measurement framework consistent with the three-criteria evaluation logic:

> *"We will of course look at the economics of itthat's one measure. We are looking for better customer service, so hopefully happier customers. The thinking is that if your waste is being weighed, then you're actually only paying for the waste you*

have created so it's more fair. We will also measure the digital performance—we will keep track on what percentage of the pickups have gone as they should go without any glitches. The bin was lifted, weighed, reported, billed automatically as it should. And then we will get a percentage value on how many glitches, how many repairs do we need to do, how much manual work do we need to do."

-Interviewee 1, Circular Economy Manager

This framework consists of economic efficiency, customer satisfaction, and digital automation rate, which are closely related to the criteria for evaluating investments. Digital automation rate is the number of deliveries that can be done digitally without manual labour expressed as a percentage. It is an important element of analysis as it reflects the level of efficiency of the system and reconfiguration.

5. Discussion

The findings presented in Chapter 4 are dicussed in relation to the theoretical framework discussed in Chapter 2 and broader literature. The review is based on three dimensions of dynamic capabilities, namely sensing, seizing, and reconfiguring, followed by the synthesis of the theoretical contributions, implications of the findings for digital transformation in the public sector, revision of the model based on empirical findings, and limitations of the study.

5.1 Sensing Capabilities: Between Awareness and Institutionalisation

The findings reveal that there has been considerable development of sensing capabilities within Stormossen with regard to identifying, monitoring, and interpreting the changes within the technological and regulatory environment. Nevertheless, these capabilities remain concentrated at the senior management level, and they have not yet been embedded into an organisational sensing system. These findings align with Teece's (2007) perspective, where sensing comprises both recognising the technological opportunities and communicating them throughout the organization.

One aspect that makes Stormossen's sensing process theoretically unique is that of the significant involvement of Interviewee 1 in the development of the roadmap for the circular economy in Ostrobothnia. Interviewee 1's prior professional experience contributed to the development of a cognitive framework of the benefits of digitalising material flows constitutes a form of individual absorptive capacity (Cohen & Levinthal, 1990). This example validates Teece's (2007) microfoundations perspective that highlights the role of key individuals as primary sensing actors within the organisations. However, the findings also suggest an additional dimension to this theory, that receives limited attention in Teece's framework. In this specific case, organizational sensing relied on individual experience in an related institutional setting.

These findings also have important practical implications. A sensing capacity highly dependent on the prior knowledge of a single individual is becomes vulnerable in the event of that individual's absence. The implications drawn using a dynamic capability perspective state that the public- sector organisations should move from relying on absorptive capacity at the individual level to institutionalised scanning procedures within organisations (Zollo &

Winter, 2002). Stormossen has not reached this stage because its sensing ability is still highly dependent on managerial absorptive capacity. The heavy dependency on the knowledge derived from the experience of the peer organisation, especially those in Sweden and other Finnish companies, arises because of the market immaturity of smart waste technologies and a rational choice to believe more in performance results rather than supplier performance claims. This finding resonates with the findings by Folianto et al. (2015), showing the heavy influence of peers on decisions made by public utilities, and institutional theory where organisations within a field tend to emulate their successful peers' actions (DiMaggio & Powell, 1983).

The information asymmetry problem that exists between top management sense-making and operational level awareness is a structural problem associated with sense-making within hierarchical organisations in the public sector. According to Pablo et al. (2007), this problem is related to limited collaborative ability, which is particularly critical in public organizations because service delivery involves knowledge of the process that is found at the operational level. Operational knowledge that comes from field supervisors and drivers, concerning rural roads, weather conditions, accessibility of containers, etc., is exactly the type of knowledge that the top management lacks, and hence fails to acquire during the sense making process.

5.2 Seizing Capabilities: Governance as Both Enabler and Constraint

The empirical findings provide a clear illustration of how multi-municipal governance impacts the seizing dimention of dynamic capabilities, which is theoretically different from the seizing process in private sector organisations. The necessity for coordination among six municipalities, each functioning within its unique political, financial, and strategic timeline, constitutes a governance challenge that is far less pronounced in most private-sector contexts and significantly influences the rate of decision-making on technology investments (Piening, 2013; Pablo et al., 2007).

"The three-criteria evaluation approach - recycling effects, carbon effects, and economic effects - represents an important innovation in the organisation's approach to the seizing dimension of dynamic capabilities. Importantly, what makes the approach innovative is the fact that environmental considerations have been integrated into the investment evaluation alongside economic criteria through a structured decision-making framework. Such an approach provides a practical mechanism for generating public value in Moore's (1995) terms. The framework enables managers to assess projects based on the environmental, operational, and financial obligations that the organisation must meet.

Interestingly, while multi-municipal governance may hinder seizing activities, it may also enhance investment stability and sustainability.The requirement for reaching agreement among several municipalities prior to making investment decisions adds an element of political legitimacy, thereby making the investment decision more difficult to reverse under changing political conditions. As Moore (1995) explains, public value generation requires not only efficiency but also political authorization, even if such authorisation develops more slowly but produces more resilient decisions. This findings offers an important theoretical implication although seizing is hindered by complex governance structures, such structures may enhance the legitimacy and longevity of seizing decisions and longevity- an aspect that has received limited attention in the public-sector dynamic capabilities literature.

The classification of operational and investment decision-making, offered by Interviewee 2, also clearly shows that the governance model maintains operational agility within a broader multi-municipal governance structure. Malax pilot was designed as a learning-oriented process, not a board-approved seizing process, we find an example of a form of governance-enabled seizing: the organization can conduct a trial in order to gain data about its performance and strengthen the investment case for future seizing decisions..

However, the limitation related to the Finnish RFID supplier market revealed by Interviewee 2 represents a fundamentally different type of seizing limitation market based, rather than governance-based. The limited number of Finnish suppliers experienced in implementing RFID solutions and the relatively higher prices and reduced operational convenience of Swedish suppliers need to be addressed within the business case and tender documentation. Teece (2018) argues that seizing technology-related opportunities implies careful analysis of the supplier market as part of investment decision-making, which becomes even harder in particularly in concentrated supplier market that exist outside of the adopting organisation’s direct control.

5.3 Reconfiguring Capabilities: The Human Dimension of Digital Transformation

The empirical findings on reconfiguring capabilities reflect a pattern widely observed in the digital transformation literature: technical reconfiguration is more developed than organisational and human reconfiguration (Vial, 2019; Warner & Wäger, 2019). The technical architecture for integrating RFID, weighing, GPS, 4G/5G, VINGO, and CRM/billing is well defined at Stormossen.

Stormossen's approach to change management in HR involves pre-purchase notification, continuous communication during the evaluation process, and post-purchase training, as noted by Interviewee 3. This indicates that Stormossen has developed a relatively advanced evidence-based change-management capability. This capability appears to have developed through experience gained in earlier adoption initiatives, such as the biowaste and packaging waste collection program initiated in 2023. As shown by Teece (2007) and Zollo & Winter (2002), this accumulation of learning from previous implementation experiences reflects the core principle of reflexive organisational learning that underpins dynamic capability development.

Incorporating technology adoption criteria into into contractor tender specifications represents an important example of reconfiguration that extends the analysis of dynamic capabilities to the inter-organisational level. Inter-organisational coordination was identified as a critical capability for public organisations delivering services using networks of multiple organizations, according to Pablo et al. (2007) and Agranoff & McGuire (2003). Stormossen's use of tender specifications to support technology adoption shows how public procurement can be used as a means of supply chain management and capability extension without the need for direct employer–employee control over contracted employees.

The connectivity challenge identified by Interviewee 4, namely the limited availability of 4G/5G services in rural and forested regions within the service area, represents a unique problem of reconfiguration faced in the rural Nordic environment. Potential solutions might involve negotiations for expanding the coverage area with mobile network providers, utilising offline caching technology, or a combination of both strategies. This instance demonstrates that the problem of reconfiguration associated with dynamic capabilities depends on more than just organizational and governance factors, but also the geographical nature of the service area itself.

The final theoretical insight concerns the scale and timing of reconfiguration. Interviewee 1 noted that gathering and measuring waste from “60,000 homes and 12,000 leisure homes starting from spring 2027 will surpass any previous efforts made by the organisation.This demonstrates the scale of reconfiguration that the organisation has to engage in. Previously, technology changes have been on a much smaller scale. Spring 2027 therefore represents the point at which sensing and seizing operations should shift into reconfiguration.

5.4 Dynamic Capabilities in a Pre-Adoption Context: A Theoretical Contribution

One important theoretical contribution from the study is related to the temporality of developing dynamic capabilities in relation to the process of technology transition prior to adoption. Prior research on dynamic capabilities in digital-transformation contexts has typically focused on organisations undergoing or having completed technological transition to new technologies (Warner & Wäger, 2019; Vial, 2019). The case of Stormossen helps explain how dynamic capabilities function before the adoption of a new technology.

The findings suggest a temporal sequence in the development of dynamic capabilities during the pre-adoption stage. Capability for sensing is well-developed; capability for seizing is being developed and is limited by public sector governance issues; and capability for reconfiguration is largely future-oriented. The above order of development (sensing > seizing > reconfiguration) has important theoretical implications in two ways. First, it demonstrates that the three dynamic capabilities do not necessarily develop simultaneously or in a mutually reinforcing manner, as per the static capability approach, but rather there is a logical order of development moderated by governance. Second, the above order holds practical value in terms of managerial capability investment. Firms in the pre-adoption stage should prioritise capability building in the area of sensing, especially the systematic involvement of frontline operational knowledge, while also investing in the strengthening seizing capabilities once a robust business case has been established. Investments in reconfiguration prior to seizing may lead to inefficient resource allocation if the seizing decision is reversed at a later stage; nevertheless, some types of pre-seizing reconfiguration, such as connectivity mapping, preparation of pilot sites, and HR communication, are critical for enabling rapid scaling following the seizing decision.

Table 6. Phased Capability Development at Stormossen (May 2026)

Phase	Dominant Dynamic Capability	Stage at Stormossen (May 2026)	Key Organisational Activity
Early Sensing	Sensing – individual absorptive capacity	Completed (senior management level)	Benchmarking Nordic peers; Monitoring EU regulations; Diagnosing internal operations
Advanced Sensing	Sensing - institutionalised organisational scanning	Partial formal channels established but not system-wide	Engaging the Finnish Waste Management Association; Scanning supplier markets; Planning peer site visits
Early Seizing	Seizing – governance navigation & business case	Current phase	Applying three-criteria evaluation; Exploring market; Planning Malax pilot; Developing Wingo integration
Committed Seizing	Seizing - formal procurement & capital commitment	Not yet reached	Specifying formal tenders; Securing board approval; Committing capital
Early Reconfiguring	Reconfiguring - anticipatory planning	Partial -technical plan advanced, HR plan less developed	Registering containers; Developing fleet specifications; Notifying HR; Beginning frontline engagement
Operational Reconfiguring	Reconfiguring - active implementation	Future (Spring 2027+)	Installing systems; Training staff; Operating pilot; Transitioning billing

Source: Developed by the author from empirical analysis.

5.5 Implications for Public Sector Digital Transformation

Several broader implications for research and practice related to digital transformation in public sector organisations follow from the study's findings. While these implications relate directly to waste management, they speak to the more general problem of dynamic capability development in public sector organisations.

First, the governance system of public utilities imposes seizing constraints that need to be incorporated into models of dynamic capabilities developed specifically for the public sector. The need to gain multi-stakeholder political authorisation—reaching consensus with several governmental bodies, each with its own mandate and accountability mechanism—introduces a distinctive form of seizing dynamics that is qualitatively different from those described in the private sector literature.

Second, the findings reveal the importance of cross-functional knowledge integration for public-sector dynamic capability building. Gaps in strategic and operational sensing, knowledge sharing between management and field levels during technology design, and mismatches between technical and human reconfiguration plans all point to a single underlying problem: integrating different types of knowledge from different organisational levels and functions. In hierarchical public sector institutions, the cross-functional integration of knowledge needed to build dynamic capabilities can be hindered by governance and division-of-labour structures (Pablo et al., 2007; Kattel & Takala, 2021).

Third, the findings emphasise the importance of deliberate organisational learning from prior technology adoption experiences. The lessons consciously derived by Stormossen from its 2023 biowaste and packaging waste expansion and applied to RFID planning illustrate how prior, less complex technology transitions can build adaptability for more complex transitions (Zollo & Winter, 2002). For organisations lacking such experience, peer-learning networks within the industry become particularly important.

5.6 Theoretical Synthesis: Dynamic Capabilities in Multi-Municipal Public Utilities

5.6.1 The Temporal Dimension of Dynamic Capability Development

The first and most critical theoretical contribution that can be made through this research is in the area of the pre-adoption phase, the stage during which organisations recognise emerging technologies, start sensing, begin seizing activities and make plans to reconfigure themselves in anticipation of the change. While there have been much of the dynamic capabilities literature focusing on organizations that are undergoing or having completed technological transformation, the pre-adoption phase of organizations has received much less attention.

The Stormossen example illustrates that pre-adoption stage is not merely a preparatory phase but also a significant capability-building stage in itself. The sensing capabilities developed in the pre-adoption stage such as peer-intelligence networks, regulatory surveillance, vendor relationships, and operational diagnoses will directly impact the decision-making regarding the seizing stage and reconfiguration capabilities. Bad sensing in pre-adoption results in bad decisions regarding seizing, leading to bad IT investments and underestimation of integration costs and operational emphasis.

The fact that sensing is highly developed among senior management members in the pre-adoption stage, yet operational sensing capacity is not institutionalized. This reflects a typical temporal pattern in capability acquisition in which individual absorptive capacity (individuals in senior management who have previous experience) comes before organizational sensing capacity (institutionalized sensing), in which there is a systematic dissemination of organizational knowledge at different organizational levels. The findings also suggest that organisations must be prepared to build their sensing capacity, including frontline knowledge acquisition, before the implementation stage starts.

5.6.2 The Paradox of Governance in Public Sector Seizing

Perhaps the most theoretically distinctive finding of this study concerns the paradoxical role of multi-municipal governance within dynamic capability development. As discussed in Section 5.2, Stormossen's multi-municipal governance both constrains and supports seizing: it constrains seizing speed by requiring alignment across six politically autonomous municipalities, and it supports seizing legitimacy by providing the political authorisation that makes investment decisions resilient to future political change. This paradox is not adequately captured in prior public sector dynamic capabilities research, which has tended to treat multi-party governance primarily as a hindrance (Piening, 2013; Pablo et al., 2007).

In theory, the paradox influences the way dynamic capability strategy for the public sector needs to be approached. If the complexity of the governance process is viewed merely as an obstacle to overcome by either governance avoidance or below threshold piloting, the organisation risks losing the legitimacy benefits that comes from engaging the entire governance process. The Stormossen scenario demonstrates that avoidance can be acceptable in certain instances, such as the Malax pilot, but cannot substitute for full engagement when there is a major long-term investments are involved.

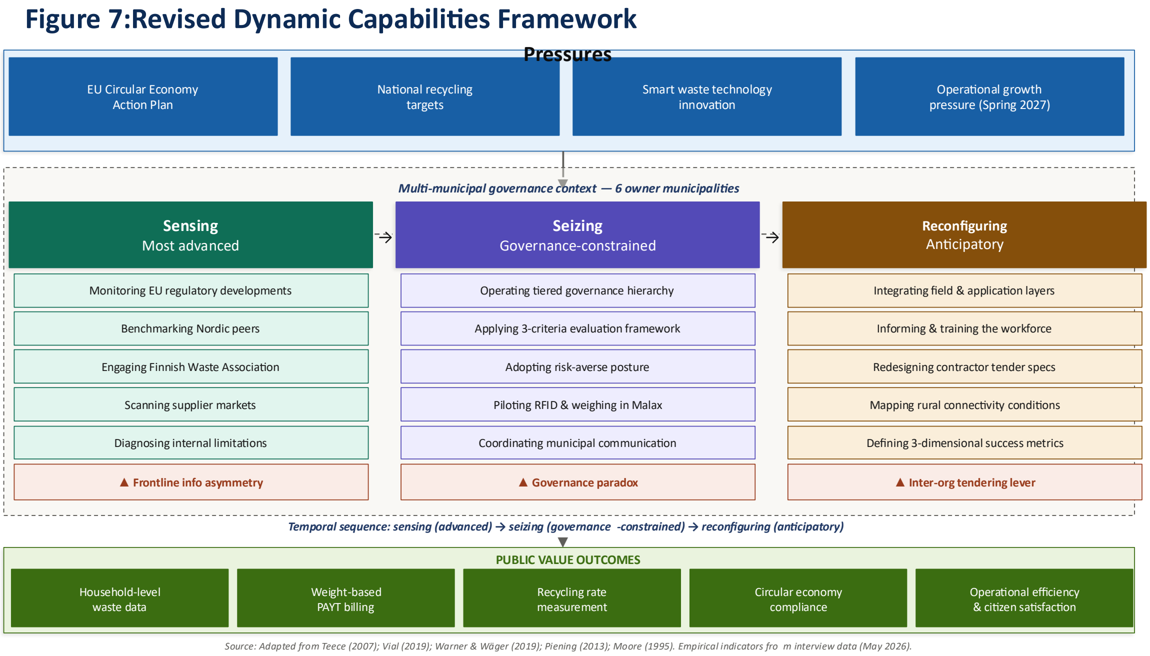
Moreover, the function of governance as a legitimation process suggests that investment in the governance process itself needs to be considered a strategic resource that establishes political legitimacy for technology investments. Technology investment approved through full multi-municipal governance procedures involving stakeholder engagement, analysis, and democratic decision-making will prove much more stable in the face of political turnover compared to an investment secured through governance bypass. For the governance process of multi-municipal public utilities, where leadership changes frequently because of municipal elections, political legitimacy is a strategic resource.

5.7 Revisiting the Sensing–Seizing–Reconfiguring Framework

5.7.1 The Revised Framework

This section presents a refined version of the dynamic capabilities framework introduced in Chapter 2 (Figure 1). This refined framework adopts the tripartite model suggested by Teece (2007); however, it extends the three dimensions in two important ways: by representing each dimension as a set of verb-based organisational activities (Figure 2), and by emphasizing the multi-muncipal governance environment, service delivery environment, and timeline of capability development prior to adoption discovered during the empirical analysis.

Figure 7. Revised Dynamic Capabilities Framework



The revised framework differs from the framework introduced in Chapter 2 in three substantive ways. First, every activity is expressed in verb-led form (for example, "Monitoring EU regulatory developments" rather than "EU regulatory monitoring"), making the framework directly readable as a description of organisational action. Second, the framework now incorporates the temporal sequencing observed in the case (sensing largely advanced; seizing constrained by governance; reconfiguring anticipatory). Third, the framework explicitly recognises the inter-organisational extension of reconfiguring through tendering, which is essential for utilities operating without internally owned vehicle fleets, such as Stormossen.

5.7.2 Theoretical Implications of the Revised Framework

The revised theoretical framework generates three important implications. First, in the context of multi-municipal public sector settings, the seizing dimensions should be defined to encompass the political-authorisation-processes dealing with democratic accountability, elections, and budget processes that do not have counterparts in private sector seizing as per Teece (2007). Secondly, reconfiguration of capabilities in logistics-outsourced public utilities goes beyond organisational boundaries and requires a different approach based on the use of public procurement and tendering as a means of inter-organisational reconfiguration through market-like inclusion and exclusion mechanisms rather than managerial control. Thirdly, itizen expectations and public communication challenges and public communication issues indirectly influence technology adoption planning. These are not considered a distinct capability element because the unit of analysis is still the firm. Instead, they are viewed as environmental factors influencing the sensing, seizing, and reconfiguring elements, especially in terms of weight-based billing communication and accessibility

5.8 Limitations of the Analytical Framework and Directions for Theoretical Development

While the sensing-seizing-reconfiguring model proved to be analytically useful in the Stormossen case, the model revealed several limitations that indicated paths for future theory development. The first shortcoming is that the model places emphasis on the importance of purposive organizational behavior: sensing as purposive scanning, seizing as purposive decision-making, and reconfiguring as purposive transformation. However, the sensing behaviour demonstrated by interviewee 1 was not the result of a purposive organizational scanning process but rather a dynamic capability developed through a combination of experience and role, a phenomenon more accurately characterised as emergent dynamic capability than purposeful routine behaviour.

A second limitation concerns the framework's representation of the three dimensions as a sequence (sensing → seizing → reconfiguring). The empirical evidence shows substantial feedback loops and concurrent development across the three dimensions. At Stormossen, reconfiguration activities (technical integration planning, internal HR communication, contractor tendering preparation) are progressing concurrently with sensing (Nordic peer benchmarking, regulatory monitoring, supplier engagement) and seizing (market exploration and business case development). The temporal sequence is best understood as a sequence of dominant dimensions rather than a strict linear progression.

A third limitation concerns the framework's predominantly intra-organisational focus, which may underemphasise the role of the institutional environment in shaping capability development. The Finnish waste management network, EU regulation, peer benchmarking pressure, and the changing technology supplier market are not just external influences on sensing; they actively co-construct the trajectory of capability development. An institutional perspective on capabilities (Scott, 2014; Seo & Creed, 2002) would offer a more comprehensive account of the Stormossen story than the intra-organisational dynamic capabilities perspective alone. Future research should integrate institutional theory more deeply with dynamic capabilities theory in public sector contexts.

6. Conclusions

This chapter presents the main conclusions of the study and is structured as follows. Section 6.1 summarises the key empirical findings regarding the development of sensing, seizing, and reconfiguring capabilities at Stormossen during the pre-adoption phase of smart waste technology adoption. Section 6.2 outlines the theoretical contributions of the study to the dynamic capabilities and public-sector digital-transformation literature. Section 6.3 presents the practical implications and recommendations for Stormossen and similar municipal waste management organisations. Section 6.4 discusses the limitations of the study and suggests directions for future research. Section 6.5 reflects on the research quality and methodological contribution of the qualitative case study approach, while Section 6.6 presents a practical management roadmap for Stormossen's future technology implementation process.

6.1 Summary of Key Findings

The objective of the current study was to examine the process through which municipal waste management organizations generate and utilise dynamic capabilities in response to technological change. In the present study, qualitative research methodology based on single case analysis with an emphasis on Stormossen, a regional waste management firm owned by six different municipalities located in Western Finland, was chosen. The three components of dynamic capabilities, namely sensing, seizing, and reconfiguring, were analyzed using Teece's (2007) model, within the context of Stormossen’s pre-adoption technology-planning process.

Concerning sensing, the results show that Stormossen has developed a strong capability to perceive and understand technological opportunities. Interviewee 1’s individual absorptive capacity developed through prior experience leading the circular economy roadmap of the region has played a central role in organisational sensing through Nordic benchmarking practices, interacting with Finnish Waste Management Association, following European Union regulations, market analysis of suppliers, and internal operational diagnostics. The two-pronged approach of internal operational analysis and external environment monitoring aligns well with the maturity stage of digital sensing described by Warner and Wäger (2019). However, an important weakness in sensing capability remains. Most sensing activities occur at the senior management level, whereas the knowledge of the RFID project among operational personnel, including the Waste Reception Supervisor and Environmental Educator, is rather weak.

With regard to seizing, the results reveal that the multi-municipality governance structure affects technology investment decisions in a fundamentally different way compared with seizing activities performed within the private sector. The hierarchical arrangement, from team leader to CEO/management team to board (with municipality members), presents a governance navigation problem for the organization in terms of keeping operational decisions and strategic investment decisions distinct. The three-criteria approach (impact on recycling rate, impact on carbon footprint, and economic impact) represents a sophisticated seizing tool, taking into account the organisation’s environmental and financial accountability responsibilities. At the time of the study, seizing activities had progressed only to the stage of market investigation and evaluation at the time of the study, and the Malax pilot functioned as a learning mechanism supporting future seizing decisions.

For reconfiguring, the results demonstrate a strong awareness of the technical, operational, HR, and inter-organisational reconfiguration which will be needed as part of the RFID implementation process. There is a high level of preparedness for technical reconfiguration which includes RFID technology, onboard weighing, GPS, 4G/5G connectivity, together with VINGO and CRM/billing systems. The HR side of reconfiguration involves the firm’s established practice of informing employees about technology purchases before providing training. Procurement tendering using contract specifications as part of inter-organisation reconfiguring capabilities emerged as a particularly significant finding.

Table 7. Comparison of Dynamic Capability Maturity Across Dimensions

DC Dimension	**Capability Maturity**	**Strengths Identified**	**Development Gaps**
Sensing	Developed at senior management level; not yet institutionalised	Benchmarking Nordic peers; Engaging the Finnish Waste Management Association; Monitoring EU regulations;	Frontline operational knowledge not systematically engaged; frontline staff had limited

DC Dimension	Capability Maturity	Strengths Identified	Development Gaps
	organisation-wide	Diagnosing internal operations; Activating Interviewee 1's individual absorptive capacity	specific awareness of the project
Seizing	Emerging but governance-constrained; early market-exploration phase	Three-criteria evaluation framework; Tiered authority structure preserving operational agility; Malax pilot as governance-agile seizing strategy	Formal procurement not yet initiated; Finnish RFID provider market constraint; municipal communication challenges; IT integration complexity underestimated initially
Reconfiguring (Technical)	Advanced planning; architecture defined; integration partners identified	Integrating GPS+RFID+4G/5G; Wingo/VTEC integration roadmap; three-criteria success measurement framework; Tendering as contractor reconfiguration lever	Winter/rural connectivity gaps unresolved; CRM/billing integration complexity; container registration scope unclear
Reconfiguring (Human/Organisational)	Early-stage planning; established HR practice but limited frontline engagement	Early notification HR practice; lessons from 2023 biowaste expansion; greater openness from prior reception-station automation	Frontline staff consultation not yet structured; operational change communication processes still developing; multi-municipal

DC Dimension	Capability Maturity	Strengths Identified	Development Gaps
			implementation coordination remains complex

Source: Synthesised from empirical findings and theoretical analysis.

6.2 Theoretical Contributions

This study makes two major theoretical contributions to the dynamic capabilities and digital transformation literatures. The first contribution concerns the application of dynamic capabilities theory in an unexplored organisational domain, namely, the pre-adoption stage of smart waste technologies in multi-municipal public-sector organisations. Applying the sensing-seizing-reconfiguring model to this case contributes to the literature by explaining the impact of public -sector institutions such as multi-actor political governance, political authorization, and democratic accountability on the process and pattern of capability development and which differ significantly from the capability-development processes commonly described in private-sector literature. The findings of the research demonstrate that the multi-municipality structure functions both as a constraint on seizing speed and an enabler of seizing durability. The study extends the work of Piening (2013) and Pablo et al. (2007), suggesting that public sector institutions are not just modifiers but independent drivers of capability development.

The second contribution is an understanding of the timing of the development of dynamic capabilities in the pre-adoption stage. The finding that sensing, seizing, and reconfiguring capabilities are developed at different stages in the pre-adoption period (with sensing being the most advanced; seizing being constrained by governance considerations; and reconfiguration being anticipatory) represents an expansion of dynamic capabilities theory to encompass the entire technology adoption process. While existing research is has primarily focused on the implementation and post-implementation stages (Warner & Wäger, 2019; Vial, 2019), the pre-implementation stage has been relatively underexplored. The proposed temporal framework not only expands dynamic capabilities theory but also provides insights into how companies can prioritise their investments in capability development.

6.3 Practical Recommendations

Based on the empirical findings and theoretical analysis, the following practical recommendations are offered for Stormossen and comparable municipal waste management organisations planning smart waste technology adoption.

Recommendation 1: Institutionalise sensing capability through frontline engagement.

Stormossen should formalise a consultation process where the company engages with its frontline staff especially waste truck drivers and reception station supervisors—to define the requirements of the RFID and weighing system. This could be achieved through structured consultations with representatives of the frontline staff before the finalisation of procurement tenders. The frontline staff have information that is highly relevant to the requirements of the system because of their experience with the challenges of operating in rural areas.

Recommendation 2: Develop a governance-aware, phased investment proposal.

The development of the RFID technology and weighing equipment should follow a phased approach that starts from the Malax pilot stage, with clear decision-making criteria regarding for determining progression to subsequent stages. Such an approach, risks will be minimised at the early stages, organisational learning can be strengthened, and approval by the multi-municipal board will be easier due to the modular nature of the project. The business case should additionally the business case should consider impact on recycling, carbon emissions, and economics within the three-criteria evaluation system.

Recommendation 3: Connectivity Mapping.

Prior to establishing specifications, Stormossen should commission a connectivity assessment of areas that will be covered by waste-collection routes. This mapping needs to reveal locations where there is inadequate mobile connection to facilitate data transmission, and recommend solutions such as data buffering, installing antennas, and making arrangements with cellular service providers.

Recommendation 4: Strengthen public communication during implementation.

Any operational changes that result from the introduction of RFID technology and the weight-based billing system ought to be backed up by clear communication within the process. Communication efforts should clearly explain the functionality of the new system, how billing will operate, and how one can access service information. In view of the multi-lingual nature of Stormossen's service region, this should be incorporated into the design of the communication strategy.

Recommendation 5: Establish a dedicated technology adoption steering group.

The coordination needed by all parties involved for the execution of the RFID and weighing project in six muncipalities, various transportation service providers, the software company VTEC, and the technology vendor requires a project steering group composed of members from all key stakeholder organisations. Such meetings could be held quarterly during procurement and monthly during implementation.

6.4 Limitations and Directions for Future Research

However, there are several limitations associated with this research that should be acknowledged. First, the choice of the case study method has its drawbacks. Although the method is appropriate for theoretical analysis, it does not allow statistical generalisation of the findings due to the specificity of the case (multi-municipal governance, Nordic operation, company size, contemporary period, and adoption phase).

Second, it should be noted that the research takes place within a certain timeframe, which creates another limitation. Specifically, the dynamic capability formation occurs prior to technology adoption. Thus, the activities related to sensing, seizing, and reconfiguring activities identified in the study cannot yet be fully evaluated in relation to actual implementation outcomes

Another limitation of the empirical evidence used here is that it is limited to perspectives within the organisation, without adequately considering possible shifts in the regulatory context or ownership structure of the municipal owners involved in the case organisation. The continued participation of the municipal owners and the stable regulatory context in which Stormossen operates, are important assumptions underlying Stormossen's strategic positioning.

The fourth limitation of the study relates to the lack of inclusion of municipal governance stakeholders in the interview data. The interview schedule did not allow the inclusion of these stakeholders. This means that the political and governance aspect of seizing is interpreted primarily through the perspectivesof Stormossen's managers.

Future avenues for research would be:

- longitudinal case study of dynamic capability development through implementation at Stormossen and other similar organisations;
- comparative multiple case study among Nordic municipal waste utilities to examine the transferability of the findings;
- a design integrating qualitative assessment of capabilities with the adoption performance measures;
- Further studies examining the influence of citizen communication on the digital transformation of public organisations; and
- studies on the relationship between dynamic capability configurations and citizen acceptance of PAYT billing.

6.5 Reflections on Research Quality and the Contribution of Qualitative Case Study Methodology

This section reflects on the research quality of the study and on the methodological contribution of the qualitative case study approach to the study of dynamic capabilities in public sector organisations. Qualitative case study research occupies a distinctive position in organisational research methodology: it is neither the most resource-efficient approach (quantitative surveys covering large populations can be conducted more efficiently) nor the most empirically parsimonious (experimental designs offer stronger causal attribution), but it offers a depth of organisational insight that neither alternative can match (Yin, 2018; Patton, 2015). This depth is the methodological foundation of the present study's theoretical contributions.

The approach used to analyse data using deductive theoretical coding (based on the sensing–seizing–reconfiguring model), along with inductive coding based on empirical observations, demonstrates the process of abduction characteristic of qualitative case study research (Dubois & Gadde, 2002). While the theoretical model provided a basis for the analysis of organisational capability development, the revealed additional factors related to governance complexity, organisational communication and delivery of public services which served as a basis for developing a modified theoretical framework in Section 5.7.1. The design to collect data from five informants representing various positions within an organisation represents an ideal basis for triangulation that cannot be achieved through one-informant designs. The converging evidence regarding the necessity of the proposed technologies, the issues related to data quality and system integration complexity is supported by the diverging opinions of the respondents concerning the importance of municipal governance and awareness on the part of frontline personnel. Future research needs to involve additional stakeholders, including municipal organisations, transport companies and technology suppliers.

6.6 Practical Implications for Stormossen: A Management Roadmap

6.6.1 Near-Term Priorities (Now to Spring 2027)

In the near term, Stormossen should prioritise four parallel work streams. First, a structured frontline engagement programme should be designed and launched, drawing on the operational knowledge of waste truck drivers and reception station supervisors to inform RFID and weighing system requirements. Second, the Malax pilot design should be finalised with explicit decision criteria tied to the three-criteria evaluation framework, so that pilot results can directly support board-level seizing decisions. Third, a comprehensive 4G/5G connectivity mapping exercise should be completed across the operational area, with mitigation options identified and costed. Fourth, container registration and digitisation across the six municipalities should commence, since this is a prerequisite for any RFID deployment.

6.6.2 Medium-Term Priorities (Spring 2027 to 2029)

In the medium term, the focus should shift to formal procurement, supplier selection, and the operational launch of the Malax pilot. Tender specifications should embed both technology requirements and the explicit reconfiguring expected from contractors. Workforce training should be initiated alongside hardware deployment, drawing on the organisation's established pre-purchase notification and post-purchase training practice. The CRM/billing system integration with VINGO/VTEC should be scoped, contracted, and tested under pilot conditions. A dedicated technology adoption steering group should be established to coordinate the multi-party implementation effort.

6.6.3 Long-Term Capability Building (2029 and Beyond)

Long-term strategy involves institutionalising the capabilities created during the pre-adoption and implementation phases as permanent organizational routines. Sensing must be enhanced through formal frontline knowledge-capture procedures and improved communication between strategic and operational management levels. Seizing capabilities should be strengthened through continuous business-case evaluation and sustained governance participation. Reconfiguring capabilities should be supported through change management competence and coordination via tendering. The three-dimensional success measurement model (economics, customer satisfaction, automation ratio) needs to be embedded as a continuing performance management tool. The lessons learnt during the RFID deployment process need to be deliberately captured for use in future technological innovations based on the theory of deliberate learning by Zollo & Winter (2002).

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Appendices

Appendix A: Privacy Notice

Privacy Notice for Master's Thesis Research

Title of the Study: Developing Dynamic Capabilities for Smart Waste Technology Adoption: A Case Study of Stormossen

Data Controller: University of Vaasa, Wolffintie 34, 65200 Vaasa, Finland

Researcher: Monisha Mohan Nair (2403943), Master's Student, Strategic Business Development, University of Vaasa, X9912261@student.uwasa.fi

Purpose of the Study: This research examines the possibilities and processes through which technology can be used to manage waste effectively. Key areas include the organisational processes, decision-making, and capabilities required for smart waste technology adoption.
Personal Data Collected: Name (anonymised in publication); Job title; Organisation; Contact information (email); Interview responses (audio recordings and transcripts).
Purpose and Legal Basis for Processing: Personal data are collected and processed solely for the purpose of conducting this academic research. Participation is voluntary, and the legal basis for processing is the participant's consent.
Data Recipients: The researcher; thesis supervisor at the University of Vaasa; university administrative staff involved in thesis evaluation.
Data Storage and Protection: All data are stored securely in university-approved secure storage. Audio recordings and transcripts are stored in encrypted form.
Data Retention: Personal data will be retained only for the duration necessary to complete the thesis and evaluation process. After completion, data will be deleted or anonymised in accordance with university guidelines.
Participant Rights: Participants have the right to access their personal data, request correction of inaccurate data, withdraw consent at any time, and request deletion of their data.
Voluntary Participation: Participation in this research is entirely voluntary. Participants are free to withdraw at any time.

Contact: For any questions, please contact the researcher at the University of Vaasa.

Appendix B: Consent Form

Consent to Participate in Research

Study Title: Developing Dynamic Capabilities for Smart Waste Technology Adoption: A Case Study of Stormossen

I confirm that I have been informed about the objectives and nature of this research study. I understand that participation is entirely voluntary and that I may withdraw at any time without consequence.

By signing this form, I confirm that:

- I have read and understood the Privacy Notice for this study
- I voluntarily agree to participate in this research
- I consent to the processing of my personal data for the purposes described in the Privacy Notice
- I understand that the interview will be audio-recorded
- I understand that my responses will be used solely for academic research purposes and that my identity will be anonymised in the thesis
- I am aware that my data may be accessed by the University of Vaasa for thesis supervision and evaluation purposes

Participant Information

Name: ____

Position / Organisation: ____

Signature: ____

Date: ____

Researcher: Monisha Mohan Nair | Master's Student | University of Vaasa

Appendix C: Interview Guide — Organisational Informants

Section 1: Introduction and Role

1. Can you describe your role at Stormossen and your main areas of responsibility?

2. How long have you worked at Stormossen, and what is your professional background?

3. Could you briefly describe your direct involvement with Stormossen's current technology development activities?

Section 2: Technology Awareness and Environmental Scanning (Sensing)

4. How did you first learn about RFID and weighing technology as potentially relevant for Stormossen's operations?

5. What sources of information do you rely on to stay informed about new technologies in waste management?

6. What external factors—EU regulations, national legislation, peer organisations adopting similar technology, pressure from owner municipalities—are influencing Stormossen's thinking about this technology?

7. How does Stormossen stay informed about developments in Nordic waste management practice? Are there specific organisations, networks, or peer companies that you follow particularly closely?

8. In your view, how clearly is the current technology project communicated across different levels of the organisation?

Section 3: Decision-Making and Investment Evaluation (Seizing)

9. Who is involved in decisions about adopting new technology at Stormossen? What is the approval process for a significant technology investment?

10. What criteria does Stormossen use to evaluate whether to invest in new technology? What would need to be demonstrated for this RFID and weighing project to receive approval?

11. What are the biggest challenges in reaching investment decisions—budget constraints, technical uncertainty, getting alignment across the six municipalities?

12. Has Stormossen had any contact with technology suppliers about this system, or visited other waste companies that are already using it?

13. What is the current stage of the investment decision process for this project?

Section 4: Operational Integration and Change Management (Reconfiguring)

14. What changes to current operations, logistics, and IT systems will be required when RFID and weighing technology is introduced?

15. What skills or training will your staff—and contracted transport companies—need to use this technology effectively?

16. How does Stormossen typically prepare employees when new systems or technologies are introduced?

17. How will the transition be coordinated across the six municipalities and contract partners?

18. What are the biggest implementation challenges you anticipate from your functional perspective?

19. How will Stormossen measure whether the technology adoption was successful?

20. What lessons from previous technology adoptions at Stormossen are shaping how you approach this project?

Appendix D: Interviewee Consent and Profiles (Anonymised)

All organisational informants were briefed about the purpose of the study, the method of data collection, confidentiality assurances, and their option to withdraw before the interview began. All gave explicit verbal consent for recording and academic use of their interview data. In line with supervisor guidance, all personal names have been replaced with anonymised identifiers in the body of the thesis, in all quotations, in tables, in figures, and in this appendix.

Identifier	Role	Consent	Date	Notes
Interviewee 1	Circular Economy Manager	Verbal consent given on recording	4 May 2026	Primary strategic informant
Interviewee 2	Chief Service Officer (Operations & Logistics)	Verbal consent given on recording	4 May 2026	Primary operational informant
Interviewee 3	HR Manager	Verbal consent given on recording	4 May 2026	Change management informant
Interviewee 4	Supervisor, Waste Reception Stations	Verbal consent given on recording	4 May 2026	Field operations informant
Interviewee 5	Environmental Educator	Verbal consent given on recording	4 May 2026	Communication/external education informant

Source: Own records, May 2026.

Appendix E: Thematic Coding Framework

This appendix presents the thematic coding framework used in the analysis of interview data, mapping first-order interview evidence onto second-order verb-led themes and the aggregate dynamic capabilities dimensions.

Aggregate Dimension	**Second-Order Theme**	**Representative First-Order Evidence (Speaker)**	**Theoretical Connection**
Sensing	Activating individual absorptive capacity	'We started to develop tools for that—digital tools' (Interviewee 1)	Cohen & Levinthal (1990); Teece (2007) microfoundations
Sensing	Diagnosing internal operational limitations	'We only get the info from our scale in our area, when trucks drive here' (Interviewee 2)	Internal+external dual-input sensing (Warner & Wäger, 2019)
Sensing	Engaging the Finnish Waste Management Association	'Finnish Waste Association covering 85% of Finnish municipal waste' (Interviewee 1)	Mimetic isomorphism (DiMaggio & Powell, 1983)
Sensing	Benchmarking Nordic peers	'Mainly we are looking at solutions from Sweden a lot' (Interviewee 1)	Peer benchmarking; Nordic operational reference market
Sensing	Monitoring EU regulatory developments	'A very strong push comes from EU legislation … translated into national laws … municipal level' (Interviewee 1)	Regulatory sensing (Teece, 2018); EU CEAP (EC, 2020)
Sensing	Identifying frontline information asymmetry	Interviewee 4 needed RFID explanation; Interviewee 5: 'I haven't recognised many situations where I learned about new technology'	Collaborative capability gap (Pablo et al., 2007; Piening, 2013)
Seizing	Operating the tiered governance hierarchy	'Team leader → management → board … depending on the size of the investment' (Interviewee 1)	Multi-stakeholder governance as constraint and enabler (Piening, 2013)
Seizing	Applying the three-criteria evaluation framework	'Recycling rate? Carbon footprint? Economic impact?' (Interviewee 1)	Public value creation (Moore, 1995); integrated performance criteria
Seizing	Adopting a deliberately late, risk-averse posture	'Stormossen didn't want to be among the first—we want to see it working somewhere' (Interviewee 1)	Technology assimilation gap (Fichman, 2004)

Aggregate Dimension	Second-Order Theme	Representative First-Order Evidence (Speaker)	Theoretical Connection
Seizing	Navigating the constrained Finnish supplier market	'In Finland, we have almost no company that has had it long enough to be reliable' (Interviewee 2)	Technology market maturity as seizing constraint
Seizing	Coordinating municipal communication	'The information doesn't travel through the municipalities' organisations that well' (Interviewee 3)	Multi-stakeholder governance complexity (Guerrero et al., 2013; Agranoff & McGuire, 2003)
Seizing	Piloting RFID and weighing in Malax	'Before making large investments, we first need to understand how the system works in practice' (Interviewee 1)	Trialability and observability (Rogers, 2003); deliberate learning (Zollo & Winter, 2002)
Reconfiguring	Integrating field, connectivity, and application layers	'The digital weighing mechanism must be compatible and communicate with our reporting and billing system' (Interviewee 1)	Technical reconfiguration (Vial, 2019; Warner & Wäger, 2019)
Reconfiguring	Informing and training the workforce	'Even before we start to purchase anything, we tell the employees that we are planning to use this kind of technology' (Interviewee 3)	Change management (Kotter, 1996); TAM (Davis, 1989)
Reconfiguring	Redesigning contractor tendering specifications	'We tell them upfront these are the expectations … if they don't like it, they will not participate' (Interviewee 1)	Inter-organisational reconfiguring (Pablo et al., 2007; Agranoff & McGuire, 2003)
Reconfiguring	Mapping rural connectivity and Nordic operating conditions	'Some stations are in the middle of the forest—connections must be workable' (Interviewee 4)	Contextual reconfiguring; Nordic rural digital infrastructure
Reconfiguring	Defining a three-dimensional success measurement framework	'Economics + happier customers + digital automation rate (% auto-completed pickups)' (Interviewee 1)	Performance evaluation aligned with three-criteria investment framework

Source: Developed by the author from thematic analysis of interview data (May 2026).