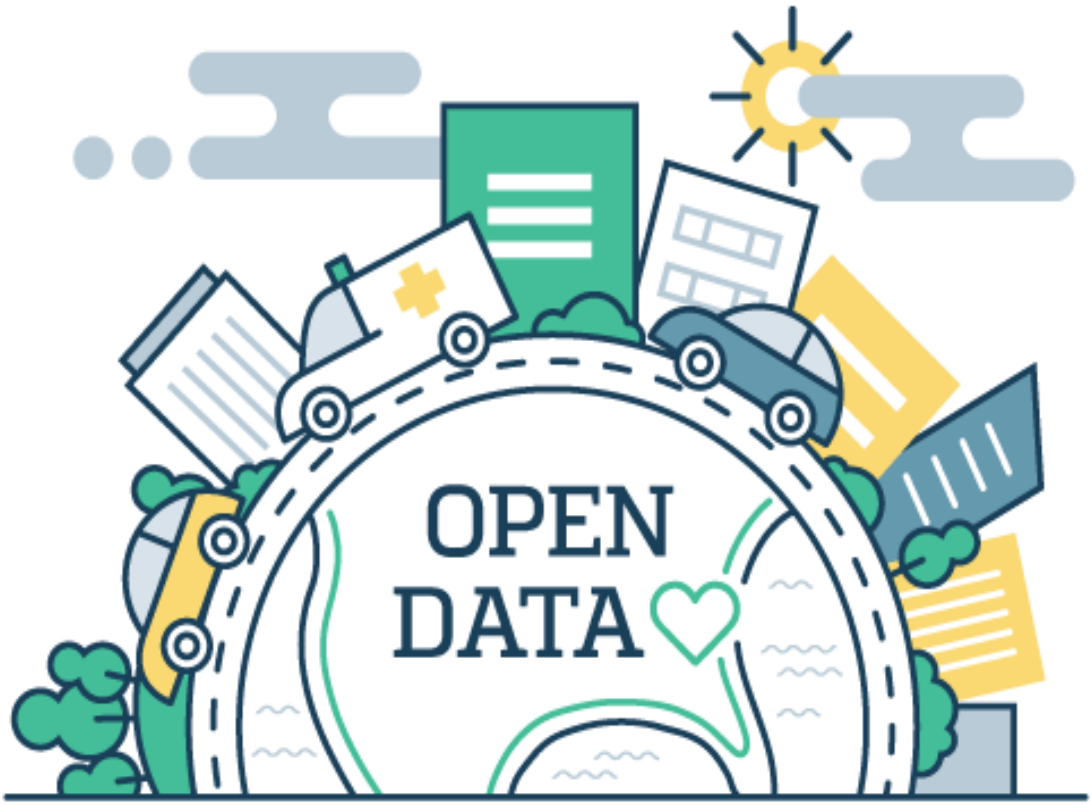
Rethinking the Business Model of Open Data Intermediaries: A Case Study of 9292 in the Dutch Public Transport Ecosystem



Name: Olivier Wijnmaalen
Responsible Professor: Peter van Oosterom
Supervisor: Bastiaan van Loenen
University: TU Delft
Program: Geographical Information Management and Applications (GIMA)
Date: 01/09/2025 – 19/02/2025

Abstract

Open data intermediaries (ODIs) play a key role in transforming openly available datasets into usable information products. While recent research has proposed business-model archetypes of ODIs, in-depth empirical studies of how these archetypes operate in practice remain limited. This study addresses this gap through a qualitative single-case study of 9292, the Dutch public-transport travel-information platform, representing the archetype interactive app without complementary products.

Using Shaharudin *et al.'s* (in press) business-model framework, the research combines archival analysis and semi-structured interviews to examine how 9292 creates, delivers, and captures value. The findings show that, despite relying on open datasets, the platform's sustainability depends on long-term relationships with transport operators, data-processing capabilities, institutional legitimacy, and strong brand recognition. Value creation is highly ecosystem-dependent, while value capture relies on hybrid funding through operator contributions, advertising, and ticketing.

The study further finds that 9292 operates as a multi-sided open-data platform, indicating that platform economics should be explicitly considered when analyzing ODI business models, a perspective not captured in existing frameworks.

Acknowledgments

I would like to express my sincere gratitude to my supervisor, **Dr. ir. Bastiaan van Loenen**, for his guidance, critical feedback, and continuous support throughout this research. I am also deeply grateful to **Asharaf Shaharudin** for his valuable insights and for inspiring this research topic through his work on open data intermediaries.

My special thanks go to the **staff of 9292**, for their openness, time, and willingness to share their knowledge and experiences during the interviews. Their contributions were essential to this study.

Contents

1 Introduction

Over the past two decades, the availability of open government data has increased significantly. Open data, defined as data that can be freely used, modified, and shared for any purpose (Shaharudin, Van Loenen, & Janssen, 2025, p. 2), has been actively promoted at both national and international levels. As a fundamental right starting as the right to information, the United States launched the *Open Government Initiative* in 2009. The European Union adopted the open data movement, and the Open Data Directive of 2019 aimed not only to open data but also to strengthen the capabilities for reusing open data (Directive (EU) 2019/1024). Currently, the European Commission (n.d.) shows that the benefits of open data are diverse and range from improved efficiency of public administrations, economic growth in the private sector, to wider social welfare, including creating jobs, better decision making, and overall economic growth. This shows that open data has the potential to increase overall wealth and societal benefits. While the open data movement has gained momentum, there are shortcomings in the reusability of open data, hindering its full potential.

There are various shortcomings in the current open data initiatives such as the mismatch between the supply and demand of open data, the lack of appropriate software to process data, and confusion regarding data licenses (Dove *et al 2023*; van Loenen *et al.*, 2021). Other studies highlight that user needs are often insufficiently considered, resulting in mismatches between what is published and what can be effectively applied (Van Loenen *et al*, 2018, p. 34). This suggests that publishing data alone is insufficient to fully realize the potential of open data (Temiz *et al.*, 2022). Open data must be transformed and delivered in a way that enables its effective use. For open data to make an impact, it must be delivered to its end user in a useful way. Recent research highlights the growing role of open data intermediaries (ODIs) in bridging the gap between providing the right information to the right user in a user-friendly manner (Shaharudin, Van Loenen, & Janssen, 2024). ODIs are defined as: Third-party actors who provide specialized resources and capabilities to (i) enhance the supply, flow, and/or use of open data and/or (ii) strengthen the relationships among various open data stakeholders (Shaharudin, 2024).

While raw data remains openly accessible, the central challenge lies in ensuring that it reaches appropriate users and is transformed into actionable resources; therefore, ODIs have become increasingly important (Verhulst *et al*, 2020). Recent studies confirm that intermediaries significantly influence whether open data can achieve transparency, participation, and innovation goals (Dove *et al* 2023, p. 2, & Micheli, 2023). They enhance the circulation and usability of data by improving supply, flow, and use, or by strengthening relationships between stakeholders (Shaharudin *et al.*, in press). Open data intermediaries play a crucial role not only in facilitating the use of open data but also in enhancing access, as data providers often encounter practical and technical challenges. By establishing crucial links between different segments of the open data community, they help bridge gaps between data provision and use (Shaharudin *et al*, 2024). For example, the organization *Our World in Data* functions as an intermediary that compiles, harmonizes, and visualizes extensive collections of global datasets on topics such as health, education, and the environment. Through curated indicators and intuitive visualizations, it translates complex statistical data into accessible knowledge for policymakers, journalists, educators, and the general public. This demonstrates how open data intermediaries transform raw, fragmented data into integrated and understandable information products, lowering the barrier for non-expert users and promoting evidence-

based public discourse. Beyond enabling access, ODIs also operate as organizations with distinct resources, strategies, and business models.

The importance of ODIs has gained increasing recognition in recent years (Verhulst *et al*, 2020, Micheli, 2023, Dove *et al*, 2023, Shaharudin 2025). These organizations can take diverse institutional forms: some operate as non-governmental or non-profit entities, others are affiliated with public sector bodies, and some function as commercial enterprises. Regardless of their organizational type, each possesses a distinctive logic for creating, delivering, and capturing value. Whether their activities are supported through public funding, volunteer engagement, or market-based mechanisms, their underlying business model can be systematically examined. Micheli (2023, p.33) emphasizes that value creation does not only mean monetary or economic but could also be improved societal values or transparency. In other words, business models describe an organization's internal logic. Shaharudin *et al.* (in press) stresses the need for research on the business models of ODIs, not only to gain insight into their own sustainability but also that of the entire open data ecosystem. In an effort to conceptualize these business models, Shaharudin *et al.* (in press) developed nine archetypes of business models for ODIs. Each proposes a distinct taxonomy on 3 dimensions of value proposition, value creation, and value capture. However, as the authors note, their analysis offers only a *bird's-eye view* of these archetypes and does not capture the contextual nuances of how such business models function in practice. They explicitly call for qualitative, in-depth case studies to investigate the organizational dynamics, resources, and strategic choices that underpin different intermediary models. This research directly responds to that call by conducting a detailed case study of the specific archetype: Interactive app without complementary products. By examining how a specific archetype creates, delivers, and captures value, this study provides the empirical depth needed to complement and refine the existing typologies, thereby advancing the theoretical understanding of open data intermediary business models. While simultaneously gaining deeper insight into ODI business models.

1.1 Research Motivation and Research Gap

From a theoretical perspective, the role of open data intermediaries (ODIs) is well recognized within the open data ecosystem, yet limited research has examined how these organizations' structure and sustain their business models. This gap is relevant because business model design and innovation are closely linked to organizational performance and long-term sustainability (DaSilva & Trkman, 2014 & Perić *et al.*, 2017). Business models also clarify how organizations position themselves and interact with other actors in their ecosystem (Lambert & Davidson, 2013). More precisely, Micheli (2023) states that long-term business models remain one of the key challenges for ODIs to reach the full potential of open data. Given these concerns, a clearer understanding of how ODIs configure their business models is essential for assessing their viability and their contribution to the open data ecosystem. Which can ultimately lead to reaching the full potential of open data.

Several studies have attempted to classify ODI business models. Janssen and Zuiderwijk (2014), for instance, identified six types of ODIs based solely on based their products and services. Extending this work, Shaharudin *et al.* (in press) developed a taxonomy of ODI archetypes structured around three dimensions: value proposition, value creation, and value capture. His study did result in a general framework of ODIs archetypes in terms of business model; however it was acknowledged that the nuances

for these archetypes remain underexplored. This research will therefore directly add to the validation Shaharudin's framework. Not only will it add to Shaharudin's framework, it will also contribute to a more diverse and cumulative body of literature on ODI business models. A single case study of Esri (Shaharudin *et al.*, 2025) advanced theorization on ODI business models and offered recommendations for sustainable open data ecosystem practices, yet the authors note that its findings are not generalizable to all archetypes. To conclude, this research contributes to these gaps in two ways. Theoretically, it responds to the call for more nuanced, qualitative descriptions to further validate the ODI archetypes. Secondly it contributes to a more diverse and cumulative body of literature on ODI business models. From a practical standpoint, ODIs play a crucial role in realizing the societal and economic potential of open data. However, reaching long-term sustainability remains a challenge (Micheli, 2023). Studying existing business models can therefore provide valuable insights into potential risks or opportunities for having a sustainable business model. By examining another archetype, this research not only describes its business model but also analytically identifies potential risks, opportunities, and enabling conditions for sustainable operation.

1.2 Research Questions

Building on the identified research gaps, this study examines the category of open data intermediaries commonly described as *interactive apps without complementary products*. The purpose is to develop an empirically grounded understanding of how this type of intermediary operates within the open data ecosystem and to provide a detailed account of its business model. This leads to the following central research question: *How does 9292, as an open data intermediary characterized as an interactive app without complementary products, fit within and extend the business-model framework of open data intermediaries?*

To answer this question, the analysis investigates how such intermediaries structure their core business model dimensions. First, the study examines (1) what characterizes their value proposition. It then considers (2) how these intermediaries create and deliver value through their operational, technical, and organizational processes, followed by (3) how they capture value through their revenue logic, cost structure, and wider resource and dependency conditions. Building on these descriptive insights, the study further explores (4) what strengths, weaknesses, risks, and enabling conditions shape the sustainability of this business model.

Taken together, these questions support an in-depth understanding of how ODI structures and maintains its business model. This contributes in two ways: first, by providing empirical insights that may inform and nuance the theoretical understanding of business models within open data intermediary research; and second, by offering practical insights into the conditions under which such intermediaries can sustain their operations over time.

1.3 Research Objectives

The primary objective of this study is to develop an in-depth understanding of the business model of open data intermediaries described as *interactive apps without complementary products*. By analyzing how this type of intermediary structures, delivers, and sustains its value, the study aims to generate insights that support both conceptual understanding and practical considerations for long-term viability. To achieve this aim, the research is divided into four sequential objectives:

1. Before describing its business model, this study conducts desk research drawing on archival materials (e.g., the Wayback Machine), relevant articles, videos, and podcasts. Following the approach applied by Shaharudin *et al.* (2025) in the *Esri* case study, this section traces the emergence and evolution of 9292, outlining its current organizational and market context.

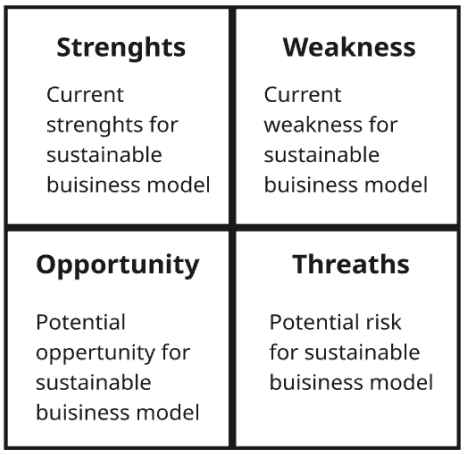
2. Next, a thick description of the business model is developed. This will be accomplished through desk research and interviews. Building upon the taxonomy proposed by Shaharudin *et al.* (in press), the description will be structured along three dimensions (which are further explained in conceptual framework:

1. **Value Proposition**: what value offers is offered to its users and partners
2. **Value Creation**: how it creates and delivers this value
3. **Value Capture**: how it maintains financial and operational viability.

This will ultimately allow for empirical testing of the taxonomy proposed by Shaharudin *et al.*, and enable an analysis of potential theoretical refinements to the model.

3. The third objective is to assess the viability and sustainability of the business model through a SWOT analysis. The swot analysis will focus on the sustainability of the business model. The swot analysis will not focus on internal and external factors however, it adopts the same method used in Shaharudin (2025). By examining strengths and weaknesses in the current situation, alongside future-oriented risks and opportunities (see Figure 1), the analysis will expose the long-term potential of ODIs and ultimately provide insights into the sustainability of their business models.

Figure 1: Alternative SWOT analysis (own work)



2 Conceptual Framework

The purpose of this conceptual framework is to establish the theoretical foundations for analyzing the business model of an open data intermediary, with specific attention to the archetype: *Interactive App without Complementary Products*. Because this research aims to produce a thick, empirically grounded description of a single archetype, the framework must clarify how business models are understood in general, how ODI business models have been categorized in existing literature, and which additional theoretical perspectives are needed to address limitations in current classifications.

The section, therefore, begins by outlining how open data intermediaries (ODIs) have been categorized in existing literature and the different approaches used to distinguish between ODI types. It then introduces the business model perspective, which represents the most recent and expansive approach to ODI categorization. Building on this, the section discusses the main domain-specific contribution: the taxonomy of ODI business model archetypes developed by Shaharudin *et al.* (in press), which offers a structured basis for analyzing value proposition, value creation, and value capture. Since this taxonomy forms the central analytical lens of the present study, it will be discussed as the foundation for examining the case of 9292. Finally, the chapter introduces a set of complementary perspectives that address areas which are not fully captured by the taxonomy. These include theoretical insights related to organizational resources, capabilities, ecosystem interactions, and institutional positioning. These perspectives help to explain how and why particular business model configurations emerge and persist, and they provide the analytical depth needed to interpret the empirical findings. Together, these components establish the conceptual basis for the analysis that follows and enables this research to both apply and critically refine existing understandings of ODI business models.

2.1 Taxonomy of ODIs

Since the acknowledged importance of ODIs, there have been several studies regarding the types of ODIs that exist. Janssen & Zuiderwijk (2014) did a case study of 12 ODIs and identified six distinct product types. The identified archetypes include single-purpose apps, interactive apps, information aggregators, comparison models, open data repositories, and service platforms. However, these are only described in the product/service they offer. Additionally, Germano *et al.* (2016) identified three business model archetypes through research on multiple case studies in Brazil: consultancy, advertising, and subscription. In more general research or business organizations, there has been research on non-open data intermediaries. The research is insightful for learning about concepts that relate to data intermediaries' business models. However, it usually focuses on value proposition during data gathering, for instance, by leveraging their contracts with their data supplier. Broader discussions of business models often overlook the specific characteristics and constraints of open data intermediaries. These organizations operate with datasets that are already freely accessible and reusable under open licenses, meaning they hold no exclusive ownership or control over the data. Consequently, their business models are not primarily concerned with providing or regulating access to data, such as through consent management, identity verification, or access control, but rather with creating additional value through the processing, presentation, or integration of openly available information. In an attempt to create a more extended view on ODI archetypes, Shaharudin *et al.* (in press) identified ODIs business model archetypes by creating and analyzing a taxonomy. The study was

the most extensive research on ODI business models to date, considering 190 samples of existing open data intermediaries. The taxonomy centered on three elements of a business model: value proposition, value creation, and value capture. The results identified nine archetypes: Collaborative open data platform, Paid self-service data delivery, Personalized open data service, Interactive app with complementary products, Open data repository funded by sponsorship, One-stop package around an (augmented) open data platform, Single-purpose app, Interactive app without complementary products, and Open data advocacy. The purpose of this research was to create a classification for the ODI business models. The power of this research lies within the large sample. Shaharudin *et al.* (in press) notes that: *"…the present study only aimed to provide a bird's-eye view of the existing business model archetypes*". Further research, particularly based on qualitative methodologies such as in-depth case studies, can be employed to investigate the business models of open data intermediaries more thoroughly and capture any missing nuances (p. 32). Identifying archetypes is one thing; however, to really understand one must look in depth at a business model. Now that the archetypes of ODIs are presented clearly. The next section will focus on reviewing the theoretical approach to the concepts of business model, specifically regarding ODIs.

2.2 Business Model Theory

The business model concept has been widely used in literature, ranging from macroeconomics to financial markets to innovative technology. Although widely used, the business model remains a fuzzy concept. More recently, Snihur and Markman (2023) described it as "a blueprint that outlines how an organization creates value, generates revenue, delivers offerings, and even interacts with its direct stakeholders (employees, customers, suppliers) and indirect stakeholders (rivals, regulators, community)" (p. e1). Similar definitions exist (Amit & Zott, 2001). Osterwalder & Pigneur (2010) argue that the business model basically tries to entail "everything a business does". In a report regarding ODIs in a European context. Micheli *et al* (2023) uses the definition of Coriat (2022): "the principles and mechanisms according to which an organization creates and delivers value to stakeholders while ensuring the conditions of its own long-term reproduction". They also note that "value" in this case is not only monetary or economic but could mean any form of value that is delivered to its stakeholder. For example, a data union can create value by giving its members the capacity to negotiate the terms on which a platform governs their personal data. For analytical clarity, this study deconstructs the business model concept into three interrelated dimensions: value proposition, value creation, and value capture. These dimensions are also adopted in related studies on open data intermediaries (Shaharudin *et al.*, in press; Shaharudin *et al.*, 2024). Although Shaharudin *et al.* (2025) present a robust and empirically validated taxonomy of open data intermediary (ODI) archetypes, it is based on a large-N cross-case analysis of about 190 organizations. As Bailey (1994) notes, the purpose of classification is to reduce complexity, which inevitably entails a loss of contextual detail. Large-sample taxonomies thus offer analytical clarity at the expense of contextual understanding. Shaharudin *et al.* (2025) also acknowledge that their study provides only a bird's-eye view and that qualitative approaches, such as in-depth case studies, are needed to capture missing nuances. In line with this, and as Usman *et al.* (2017) argue, case studies enhance the utility and validation of taxonomies. Accordingly, this study employs an in-depth case design to explore the organizational mechanisms and institutional dynamics that broad typologies cannot capture.

Other scholars have applied slightly different variations. For instance, Micheli *et al.* (2023) operationalized business models through *value proposition*, *key activities*, *key resources*, and *costs and revenue streams*, whereas Janssen & Zuiderwijk (2014) distinguished value proposition, value architecture, value network, and value finance. Similarly, Perić *et al.* (2017) use the concepts of value proposition, value capture, value creation, and value network. Although these frameworks differ in terminology and emphasis, they exhibit substantial conceptual overlap. Because this research builds upon the work of Shaharudin *et al.* (in press) a three-dimensional framework is employed as the primary conceptual lens. Since this research's goal is to synthesize a thick description, it will not only adopt the framework but also incorporate relevant elements from alternative frameworks where appropriate. The following sections outline these three dimensions and explicate the conceptual meaning of the constituent elements (see Table 1 for the dimensions and concepts).

Table 1: Taxonomy of Shaharudin et al. (in press). (own reworked version)

Core dimension	Description	Related concepts
Value proposition	What an ODI offers to its consumers and partners.	Type of main open-data-based product, Source of data, Product components, Other open-data-based product, Non-open-data-based product, Link of other product(s) to the main open-data-based product, Consumer segments, Offering.
Value creation	Resources deployed by organizations to deliver the value proposition.	Critical stage of the open-data lifecycle, Customer relationship.
Value capture	Compensation, not necessarily in monetary form, to the organizations offering the value.	Main revenue stream, Source of revenue.

2.2.1 Value proposition

The value proposition captures what an ODI offers to its consumers and partners, and how this offer contributes to the generation of value within the open data ecosystem. It encompasses the combination of products, services, and benefits that form the intermediary's market or societal promise (Osterwalder & Pigneur, 2010; Teece, 2010). OpenStreetMap's value proposition can be interpreted as providing a freely accessible, community-maintained, and highly detailed global map database that users can reuse and adapt under an open license. This interpretation draws on OSM's documented qualities, such as data accuracy, global coverage, and free reuse (Ochoa-Ortiz & Re, 2025).

Within the value proposition are interrelated concepts that collectively describe the structure and nature of the offering. At the center of the value proposition lies the type of main open-data-based product, which refers to the principal product that the organization offers. Such products are (but not limited to): single-purpose apps such as *Verbeterdebuurt*, which enables citizens to report local issues; interactive apps like 9292 or *Citymapper*, which provide real-time travel information; information aggregators such as *OpenCorporates*, which compile company data from official registers worldwide; comparison models like *Numbeo*, which contrasts cost-of-living data across cities; open data repositories such as data.overheid.nl or data.gov, which serve as national open data portals; and service platforms like *PDOK*, which offer tools and APIs for publishing and visualizing open data. The nature of this product shapes who the intended users are and therefore links directly to the ODI's consumer segment.

The type of products can be characterized by the degree to which the data is transformed along the data-to-information continuum. Rowley (2007) conceptualizes this continuum as a progression from data to information to knowledge, which can be applied to different forms of open-data products. At the lower end, data-to-data (D-D) products involve minimal transformation, such as a combined repository or standardization of datasets. Data-to-information (D–INFO) products incorporate processing steps that contextualize or structure the data for direct user interpretation. At the highest level, data-to-knowledge (D–K) products transform open data into insights or decision-support outputs, typically through analytical models or service layers.

At the lower end of this continuum, ODIs primarily focus on aggregation and accessibility. For example, *data.overheid.nl* makes existing datasets discoverable and reusable without altering their informational content (D–D). Progressing along the continuum, some intermediaries transform data into information by visualizing or contextualizing it for direct public use. *Waar is mijn stemlokaal*, for instance, displays polling station data in accessible maps that help citizens identify where and how to vote. At the same time, *GeoFluxus* converts raw waste-flow data into insights for municipalities and circular-economy projects (both D–INFO). At the upper end, intermediaries such as *Agroknow* integrate agricultural and environmental datasets into knowledge products that actively support decision-making in the agri-tech sector (D–K). Together, these examples illustrate how the level of transformation determines the type of consumer segment targeted, ranging from general users seeking accessible information to professional users requiring domain-specific analytical support. Importantly, an organization is not limited to being either a data producer, facilitator, or user (Wiener, 2020); some engage in forms of vertical integration, operating simultaneously as data producers, facilitators, and users depending on their service offerings.

Intermediaries may serve highly skilled data users, such as data-analysts, policymakers (e.g., *GeoFluxus*), generic users, including the general public (e.g., *Waar is mijn stemlokaal*), or mixed categories that combine both providers and users. Differentiating between these groups clarifies whether the intermediary addresses specialized professional needs or broader public demands.

The source of data refers to the origin and composition of the datasets on which the intermediary relies. Rather than being determined by product type. ODIs may depend exclusively on public-sector open data, combine data from multiple governmental sources, or integrate private or crowdsourced inputs to increase accuracy, timeliness, or relevance (van Loenen *et al.*, 2021; Shaharudin *et al.*, 2025; Micheli *et al.*, 2023).

Understanding the origin of data shows the intermediary's position within the open-data supply chain and its interdependence.

The product components concept refers to *how* an ODI structures its offering, rather than *how much* the data is transformed. Whereas the information continuum describes the degree of transformation from data to information to knowledge, product components instead capture the architectural composition of the ODI's product. An offering may take the form of a single integrated service or consist of modular sub-units such as APIs, visualization dashboards, mobile interfaces, or analytical tools. ODIs may also provide additional open-data-based products alongside their core service, which can expand functionality, support ecosystem integration, enhance brand visibility, or diversify revenue streams (Shaharudin *et al.*, 2025). In some cases, ODIs combine open data with proprietary or licensed datasets to produce hybrid products, thereby creating augmented services with higher precision, niche specialization, or greater commercial value (Jetzek, 2015).

The relationships among these products are captured by the link of other product(s) to the main open-data-based product. This element considers whether the products are independent, complementary, or fully integrated. Complementary products can strengthen the primary offer, foster cross-selling opportunities, and increase the intermediary's ecosystem presence (Amit & Zott, 2001).

The offering element captures the specific value attributes delivered to consumers. In line with the categorizations proposed by Osterwalder and Pigneur (2010), it encompasses the following dimensions: newness (satisfying an entirely new set of needs not previously perceived), performance (improving existing processes or organizational performance), customization (tailoring products or services to the specific needs of consumers), getting the job done (enabling consumers to accomplish particular tasks), and design (providing a more seamless or user-friendly experience).

In addition, the offering may create value through price (providing services at a lower price than alternatives), cost reduction (reducing development or operational costs for users), risk reduction (mitigating certain risks for consumers), accessibility (making products or services available to users who previously lacked access), convenience or usability (making particular aspects more convenient), brand (leveraging brand recognition or reputation), security and privacy (enhancing data security or privacy), and responsiveness or feedback (facilitating interaction and user feedback mechanisms).
On a critical note, Shaharudin's taxonomy narrows the conceptual distinction between commercial and public forms of value. Although the authors acknowledge that ODIs can generate both economic and societal value, they do not sufficiently address that fundamentally different mechanisms and institutional logics drive these forms of value. As Shaharudin *et al* (2025) note: "both for-profit and non-profit organizations require business models… [and therefore] we use the term organizations instead of companies" (p. 6), yet this observation does not address the substantive distinction between public-oriented and commercially oriented value.

Conceptually, open data–based value can take multiple forms. Economic value typically refers to market-based outcomes such as efficiency, innovation, or competitiveness generated when open data are reused to develop commercial products or services (Lorenz *et al.*, 2023). Societal value, by contrast, concerns improvements to collective welfare such as transparency, accountability, accessibility, and social cohesion.

Lautermann (2013) clarifies that the term *social* carries a "normative meaning: what is 'social' in this sense is good for society or any other human community" (p. 186) and is therefore grounded in ethical theories of "the good life" and "the good society" (pp. 186–187). These ethical underpinnings go beyond utilitarian cost–benefit reasoning and require consideration of societal improvement in a qualitative sense rather than merely through economic metrics. Especially since open data is often related to regulation, one must be aware of social and economic value.

Spieth *et al.* (2019) show that hybrid organizations must simultaneously navigate commercial and social logics, resulting in competing goals, ambiguous performance criteria, and resource trade-offs (pp. 428–429). Their empirical findings identify value drivers such as responsible efficiency, impact complementarities, shared values, and integration novelties, illustrating that social value creation often requires different organizational priorities than economic value creation. Real-world examples in the Dutch open-data ecosystem illustrate these differences. Boer and Bunder uses open agricultural data to offer precision-farming analytics that enhance productivity, reduce input costs, and support data-driven decision-making for individual farmers. Its value proposition is therefore strongly economic, aimed at increasing farm-level efficiency and competitiveness. By contrast, organizations such as Open State Foundation or OpenOV primarily create social value by improving transparency, enabling civic oversight, and supporting public access to information. These actors are not focused on profitability but on strengthening public accountability and democratic participation.

Building on this, Scupola and Mergel (2022) show that public value in digital ecosystems emerges through *co-production* among public authorities, private actors, and citizens. They identify four distinct forms of public value: economic value, expressed as cost savings, innovation, and resource efficiency; administrative value, seen in improved service delivery and coordination; societal value, encompassing rule of law, equity, and public trust; and citizen value, referring to transparency, privacy, and participation (pp. 3, 9). By comparison, Shaharudin's taxonomy identifies 'value' primarily within the firm, focusing on organizational strategies for value creation, capture, and delivery, without clarifying whether these values serve commercial goals or broader public purposes. This omission is not trivial: some ODIs are primarily commercially driven, focusing on monetizing open data through paid services or platform subscriptions (e.g., TransportAPI, Opencorporates), while others are public value–driven, aiming to generate societal benefits through open access, participation, and transparency (e.g., OpenStreetMap, Open Data Institute). Thus, when analyzing ODIs, attention should be given to whether value is commercially or public-value driven (or hybrid).

2.2.2 Value creation

The second dimension of the taxonomy, value creation, refers to the organizational activities, processes, and relationships through which an ODI delivers its value proposition. It bridges the strategic and operational levels of the business model (DaSilva & Trkman, 2014). For example, Esri's value proposition is to provide comprehensive, user-friendly geospatial solutions that enable organizations to visualize, analyze, and make decisions based on location data. It delivers this value by integrating open and proprietary spatial datasets within its ArcGIS platform, enriching them through advanced analytics, visualization, and mapping tools. By enabling public and private users to transform raw spatial data into

actionable insights, Esri demonstrates how value creation in ODIs relies on combining technical infrastructure, data processing, and user engagement into a cohesive ecosystem.

The taxonomy operationalizes this dimension through two interrelated concepts: the critical stage of the open-data lifecycle and the customer relationship. The critical stage of the open-data lifecycle situates an intermediary's primary function within the broader process of data generation and use. Following van Veenstra and van den Broek (2015), the lifecycle consists of five stages: *identification*, *preparation*, *publication*, *reuse*, and *evaluation*. Activities at the identification stage include articulating data demands, connecting stakeholders, and assessing risks associated with data release. During preparation, intermediaries compile, clean, or augment data, often by combining open and non-open sources. The publication stage involves curation and the enhancement of technical openness, while the reuse stage comprises data contextualization, visualization, product development, and interpretation. The final evaluation stage emphasizes validation and the collection of feedback. An intermediary's dominant position in one or several of these stages reveals how it contributes to value creation across the ecosystem. Although these distinctions are valid, research has shown that more often an ODI doesn't limit itself to one stage. ODIs tend to be involved in more than one of these critical stages (Shaharudin, van Loenen, & Janssen, 2023; van Schalkwyk *et al.*, 2016)

The second element, customer relationship, is described as the type of interaction between the intermediary and its clients (Osterwalder & Pigneur, 2010). It is operationalized by Shaharudin (2025), and can take various forms, including personal assistance, where users receive direct support from representatives; self-service, where users independently access data or applications; co-creation, in which the intermediary enables collaborative data development or enhancement; and community relationships, where users collectively participate in governance and decision-making processes (Osterwalder & Pigneur, 2010; Jetzek, 2015). This view focuses mainly on the organization and assumes a clear line between the intermediary and its users. In practice, these roles can sometimes be overlapping. Research on OpenStreetMap reveals that users and organizations can simultaneously act as data consumers, contributors, and governance participants, rather than being confined to a single category (Ochoa-Ortiz & Re, 2025). This indicates that when using the concept of customer relationship, one must be aware of overlapping roles.

2.2.3 Value capture

The third dimension, value capture, refers to the mechanisms by which an ODI sustains its operations and secures resources in exchange for the value it provides. It delineates how and from where compensation, monetary or otherwise, is obtained (Teece, 2010). Two interrelated concepts describe this dimension in the taxonomy: the main revenue stream and the source of revenue. For instance, Esri captures value in five main ways: through cross-subsidies, non-monetary marketing, a freemium model, consultancy services, and self-learning (Shaharudin *et al*, 2025).

The main revenue stream refers to the primary means by which value is monetized or otherwise compensated. Shaharudin *et al.* (2025) identify a diverse set of possibilities. Intermediaries may rely on asset sales (e.g., selling software), usage fees or service delivery charges, or subscription fees collected periodically. Alternative models include brokerage fees derived from commissions, advertising, and various

forms of sponsorship, public, private, or combined. In some cases, intermediaries adopt freemium or membership models, where basic services are offered free, while premium versions or memberships are paid. Non-market forms of value capture include volunteer contributions, crowdfunding, and cross-subsidy from related organizational units. This range highlights the heterogeneity of ODI funding structures, which may combine commercial and non-commercial elements (Magalhaes & Roseira, 2020). In practice, however, intermediaries such as OpenStreetMap demonstrate that traditional business model frameworks cannot fully explain how value is created and sustained. As Ochoa-Ortiz and Re (2025) demonstrate, OSM functions as a digital commons rather than a profit-driven enterprise. Its continuity relies on a hybrid governance model, in which volunteers produce and maintain the data, commercial organizations contribute funding, and the non-profit OpenStreetMap Foundation coordinates infrastructure and community standards.

The source of revenue complements this by identifying whether income or funding derives solely from open-data-related activities or from additional, unrelated sources. Some intermediaries depend exclusively on revenues generated through (augmented) open data, whereas others sustain themselves through a mix of sources, including consulting, software sales, or ancillary projects. A special case arises when the main revenue stream is based entirely on voluntary contributions, in which case no monetary income is recorded and the category is deemed not relevant. This element is crucial for assessing the degree of dependency of ODIs on open-data ecosystems and their long-term financial viability (Lambert & Davidson, 2013).

Collectively, these twelve concepts constitute a comprehensive and empirically validated framework for analyzing the business models of open data intermediaries. The taxonomy extends conventional business model theory by integrating characteristics specific to open-data value creation, such as the openness and provenance of data sources, the modular structure of data-driven products, and the coexistence of commercial and non-commercial funding mechanisms.

Within this research, the taxonomy serves as the principal analytical framework for the descriptive analysis of *the interactive app without complementary products* archetype. Business models are often characterized as the framework linking an organization's long-term strategy with its micro-level business processes (Veit *et al.*, 2014). To critically assess the specific archetype, the features of this archetype must be discussed.

2.3 Archetype A8: Interactive App without Complementary Products

Archetype A8 represents open data intermediaries that offer an interactive application, enabling users to search, visualize, and interact with open datasets in real-time. These intermediaries are characterized by their emphasis on usability, accessibility, and interface design, rather than product diversification or extensive data aggregation. The business model typically centers around a single, open-data-based service, without the inclusion of complementary or non-open-data products. In the context of the taxonomy, A8 intermediaries primarily operate at the reuse stage of the open-data lifecycle, transforming raw datasets into ready-to-consume, user-oriented information. Their customer relationship is largely self-service, relying on automated interfaces that enable users to explore and benefit from open data. In terms of value capture, these intermediaries often rely on hybrid or non-market funding mechanisms. Their revenue can be generated by combining advertising revenues, brokerage fees, and/or sponsorships from both public and

private entities. Overall, Archetype A8 represents a lean and user-focused form of open data intermediation, in which value creation stems from the transformation of open datasets into interactive, actionable insights for low-skilled, end users.

2.4 Additional Theoretical Perspectives

The current framework primarily focuses on what open data intermediaries (ODIs) do across the stages of the open data lifecycle, rather than examining how these ODIs sustain their operations and leverage their competitive advantage. Since the data they use are openly accessible and reusable, simply describing their activities is not sufficient to understand why some ODIs remain successful over time. While Shaharudin has referred to strategic management theories such as the Resource-Based View (RBV) in other work (Shaharudin *et al.*, 2025), this perspective is not applied within the taxonomy itself. Integrating the RBV (Barney, 1991; DaSilva & Trkman, 2014) and dynamic capabilities theory (Teece, 2010) could strengthen the analytical depth of the taxonomy by linking observed activities to the strategic resources and capabilities that enable them. The RBV emphasizes that organizations achieve sustained advantage through resources that are valuable, rare, inimitable, and non-substitutable (VRIN). Such resources can take the form of an organization's assets, capabilities, knowledge, brand, and internal attributes. In contrast, technological capabilities, such as IT infrastructure and data-processing skills, can also constitute VRIN resources (Seddon, 2014). Moreover, RBV research highlights that *inter-organizational networks, partnerships, and social capital* can function as strategic resources that enhance resilience and performance (Eisenhardt & Schoonhoven, 1996; Chen & Li, 2022). Applying these insights could reveal how ODIs' resources, such as exclusive partnerships with data providers, algorithmic expertise, or institutional legitimacy, shape their competitive advantage and strategic decisions, not just their operational roles. This would allow the taxonomy to move beyond describing organizational functions toward explaining the long-term sustainability among different ODI archetypes. As shown in the Esri case, "Esri leverages its VRIN resources to intermediate open data, particularly its network and technological capabilities, which it has established for decades as the pioneer in GIS software. At this point, these resources are hardly imitable by other companies" (Shaharudin *et al.*, 2025, p. 13). Esri's network advantages stem from its long-term relationships with government agencies and private-sector users, who are encouraged to publish and share data through ArcGIS platforms. Its technological resources include the ArcGIS Online and Living Atlas infrastructures, which allow data hosting, curation, and dissemination at a global scale. Such infrastructures act as proprietary assets that simplify open data intermediation for Esri distributors while reinforcing the company's position within the open data ecosystem.

2.4.1 Value Drivers

Another relevant concept in understanding business model structure is that of value drivers (Amit & Zott, 2001; Leppänen, George, & Alexy, 2023; Spieth *et al.*, 2019; Visnjic *et al.*, 2017). Value drivers describe the mechanisms through which organizations create and retain value for their users. Amit and Zott (2001) identify four main value drivers that extend the traditional resource-based view: novelty, which refers to new ways of connecting actors, data, or technologies; lock-in, the ability to maintain user relationships through switching costs; complementarity, the reinforcement between products, services, or datasets; and efficiency, the reduction of transaction costs and the simplification of processes. These dimensions often interact rather than operate independently. Later research introduced a fifth driver, accountability, which reflects an organization's ability to manage or internalize risks faced by its users (Visnjic *et al.*, 2017).

In the context of open data intermediaries (ODIs), value drivers provide an analytical lens for understanding how business model configurations emerge and evolve. They clarify how ODIs derive value not only from data reuse but also from how they organize their technological and institutional environments. For instance, Esri's intermediation model demonstrates novelty through the integration of open data with its ArcGIS ecosystem, enabling collaboration between public and private actors. Complementarity appears in the alignment between Esri's software, data services, and community tools, which together create added value for users. Its efficiency stems from cloud-based infrastructures that simplify data publication and access, while lock-in is evident in the proprietary nature of the ArcGIS platform, which ties users and data providers to Esri's ecosystem through established technical standards and high switching costs. Finally, accountability is reflected in Esri's role in ensuring data quality and platform reliability (Shaharudin *et al,* 2025). Together, these value drivers illustrate how ODIs structure their business models to generate and sustain value across technological, organizational, and network dimensions.

The Dynamic Capabilities Theory (DCT) complements this view by explaining how organizations use and adapt their resources in response to environmental or institutional change. As Eisenhardt and Martin (2000, p. 1107) describe, dynamic capabilities are "the firm's processes that use resources, specifically the processes to integrate, reconfigure, gain and release resources, to match and even create market change". In this sense, the RBV identifies which resources form the foundation of an ODI's business model, while the DCT clarifies how these resources evolve when data standards, partnerships, or regulations change.
These perspectives do not alter the taxonomy but provide a means to interpret the strategic logic behind the business model structures it identifies. They help explain why certain ODIs establish exclusive partnerships with data providers, invest in specific technical infrastructures, or rely on institutional legitimacy as a key resource. In doing so, they allow the taxonomy to move beyond a description of organizational functions toward an explanation of the resource and capability structures that shape the configuration of different ODI business models.

2.4.2 Ecosystem and Network Perspectives

Shaharudin *et al.* (2025) acknowledge that open data intermediaries (ODIs) depend on partnerships and governance arrangements, recognizing that collaboration and stakeholder interaction are essential components of ODI business models. However, these elements are presented mainly in a descriptive manner, outlining who the partners are; the distinction is made between users and funders. However, it does not pay attention to how these relationships function or influence coordination within the broader open-data ecosystem. Shaharudin does make a distinction between funders and users, yet this differentiation remains functional rather than relational; it categorizes actors by role rather than examining how they interact, share responsibilities, or co-create value. As a result, the taxonomy remains focused on organizational activities and direct exchanges, overlooking how ODIs align interdependent actors and manage shared responsibilities for value creation.

The ecosystem approach revolves around the idea that it is not a linear supply chain; rather, the actors within the ecosystem are interdependent. Oliveira and Lóscio (2018) identify four core elements of an open data ecosystem: resources, roles, actors, and relationships. Resources refer to datasets, data-driven software, and hardware that can be exchanged, individually or in combination, through relational transactions. Roles describe the functions that actors perform within the ecosystem, while actors represent autonomous entities

such as companies, public organizations, and individuals that may serve one or multiple roles. Finally, relationships capture the interactions among these actors, encompassing the flows of data, collaboration, and coordination that sustain the ecosystem's operation. This approach gives a much more comprehensive view. The related actors are not limited to funders or users but encompass a wider set of interactions involving data suppliers, government institutions, regulatory bodies, software developers, and civic organizations engaged in co-creation, governance, and standard-setting processes. The relational dimension of these interactions is a key aspect of how ODIs operate, as the configuration and quality of their relationships influence their ability to coordinate activities, exchange information, and create value within the open-data ecosystem.

The importance of analyzing these interdependencies becomes clear in the case of Esri, discussed in Shaharudin, van Loenen, and Janssen (2025). Esri's position within the open-data landscape relies on a dense network of collaborations with public authorities, private developers, and end-users. The company operates not only as a data service provider but also as an ecosystem orchestrator, coordinating data standards, APIs, and platform interfaces that enable other actors to build complementary applications (pp. 353–354). An ecosystem perspective helps to extend this understanding. Adner (2017) defines an ecosystem as "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (p. 4). This highlights that success depends on the coordination of activities among different actors, including data providers, regulators, funders, and users. From this perspective, ODIs are not isolated firms, but rather nodes in a broader network where outcomes depend on managing alignment, governance, and dependencies among participants. The critique proposes that the taxonomy would benefit from an ecosystem network model that incorporates the ODI. The business network-based value creation framework developed by Kauffman et al (2010) supports this view. They demonstrate that multiple firms jointly produce and deliver products and services that none of them could produce more economically on their own. That information technology enables flexible and dynamically reconfigurable business networks. Value is created through the ability to mobilize and orchestrate a business network, supported by both tangible elements, such as data exchange and funding, and intangible ones, such as trust, legitimacy, and shared governance. Together, these insights show that ODIs operate in networked environments where interdependence is central to their performance. Therefore, a descriptive overview of partners and funding is insufficient. The taxonomy should include an explicit model or mapping of the ODI's network, showing both tangible and intangible relations, to capture how coordination and alignment within the ecosystem generate and sustain value.

2.4.3 Institutional and Legitimacy Theories

The taxonomy of Shaharudin *et al.* (2025) divides business models primarily according to the internal organizational structures and strategic mechanisms of ODIs, a firm-centered approach that focuses on how intermediaries create, deliver, and capture value within their own boundaries. However, an institutional perspective offers a complementary and distinctive lens for understanding ODI business models. Institutionalism emphasizes how historical positioning, legitimacy structures, and long-term partnerships shape organizational behavior and sustainability. These institutional conditions can function as defining features of an ODI's business model, influencing access to data, funding, and collaboration. As David (2007) argues, economic and organizational development processes are often path dependent, meaning that "history matters" because early institutional arrangements and partnerships create self-reinforcing

dynamics that constrain or enable future decisions. For instance, Esri's long-term collaborations with public agencies and its role in shaping data standards illustrate how institutional continuity and network alignment contribute to organizational stability and influence. In contrast, emerging intermediaries such as Boer & Bunder must actively build legitimacy, trust, and institutional alignment to achieve comparable recognition and access.

Institutional theory provides tools to analyze this dimension. Scott (2014) distinguishes three pillars through which institutions stabilize and legitimate organizations: regulative (compliance with laws and policies), normative (alignment with social and professional values), and cultural-cognitive (shared understandings that make organizational forms seem natural or necessary). Similarly, Suchman (1995) defines legitimacy as a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions. Applying this lens helps explain why some ODIs endure despite limited commercial revenue: they derive legitimacy by fulfilling public mandates, maintaining trust, and integrating into established policy frameworks.

For instance, Esri has become a historically embedded intermediary within the global geospatial information domain. Since the 1990s, the company has consistently positioned data as central to its mission, already emphasizing that "a GIS without data has no information" (Esri, 1996, as cited in Shaharudin, van Loenen, & Janssen, 2025, p. 6). Its long-term engagement in initiatives such as the ArcData Publishing Program, Data Hound, and the Geography Network established enduring relationships with public authorities and other data providers, laying the foundation for its later platforms like ArcGIS Online and the Community Maps Program. These collaborations enabled Esri to act as both a technical facilitator and an institutional orchestrator of data exchange, contributing to the development of shared infrastructures and governance arrangements across national contexts. More recently, Esri's participation in initiatives such as the Overture Maps Foundation, alongside Amazon, Meta, Microsoft, and TomTom, demonstrates its continued influence in defining data standards and interoperability frameworks within the global open-data ecosystem (Shaharudin, van Loenen, & Janssen, 2025, p. 10). Through these long-standing partnerships, Esri has accumulated institutional legitimacy and become a taken-for-granted actor in the field, exemplifying Scott's (2014) notion of cultural-cognitive legitimacy, where conformity to established norms and expectations reinforces organizational continuity and authority over time. Integrating institutional and legitimacy theory would strengthen Shaharudin's taxonomy by extending the "value capture" dimension. Path dependency and legitimacy operate as a form of non-monetary capital, a resource that builds credibility, attracts data-sharing partnerships, and facilitates access to funding. A refined taxonomy could therefore include "path dependency and legitimacy" as an additional analytical element.

In sum, this conceptual framework brings together the theoretical elements required to analyze the business model of an open data intermediary by combining the core dimensions of business model theory with critical extensions. At its foundation are the three dimensions that structure business models; value proposition, value creation, and value capture, which, together, describe what value an ODI offers, how it delivers this value, and how it sustains its operations. In the context of ODIs, these dimensions offer a systematic way to analyze organizational activities; however, each dimension also presents conceptual gaps that must be acknowledged. Within the value proposition, the taxonomy of Shaharudin *et al.* (in press,) does not fully distinguish between commercial and public forms of value, nor does it address the coexistence of hybrid value logics. In value creation, the taxonomy captures activities across the open-data

lifecycle. However, it overlooks overlapping roles between users, contributors, and intermediaries, as well as the relational dependencies inherent to open-data ecosystems. For value capture, the taxonomy identifies common revenue mechanisms. However, it does not fully account for non-market forms of sustainability, nor for the institutional conditions that enable certain intermediaries to endure despite limited direct income. In practice, some ODIs remain operational through public funding, mandated sector roles, or long-standing institutional legitimacy, rather than through market-based revenue streams. These arrangements shape not only how value is captured, but also whether value capture is necessary for organizational survival, a distinction that is not made explicit in the current taxonomy.

To address these shortcomings, this study adopts an analytical framework that integrates theoretical perspectives beyond the taxonomy's classificatory focus. While Shaharudin *et al.*'s taxonomy provides the primary structure for analyzing value proposition, value creation, and value capture, complementary theories are used to interpret mechanisms that the taxonomy does not specify. The Resource-Based View and the VRIN framework highlight the role of strategic, often non-imitable resources, such as partnerships, technical infrastructures, or institutional legitimacy, in shaping an ODI's ability to create and maintain value. Dynamic capabilities theory adds an understanding of how ODIs reconfigure resources and adapt their business models in response to regulatory, technological, or ecosystem-level change, processes not visible in a static taxonomy. Ecosystem and network theories foreground the interdependencies among data providers, intermediaries, regulators, and users, showing that business models are embedded within multilateral structures rather than isolated organizational choices. Finally, institutional and legitimacy theories illuminate how historical positioning, policy mandates, and normative expectations influence an ODI's role, authority, and long-term viability, factors that the taxonomy treats only implicitly.

Together, these components provide both the structural overview and the interpretive basis needed for this study. The taxonomy offers the main framework for describing the business model of Archetype A8, while the additional theoretical perspectives help to explain how and why certain business model features develop and continue over time. Combined, these perspectives form the conceptual foundation for the empirical analysis and guide the design of the interview questions used in this research by explaining how ODI business models emerge and how they persist over time. This integrated framework therefore establishes a comprehensive basis for the empirical analysis that follows and supports a more nuanced and theoretically grounded understanding of sustainable ODI business models.

3 Methodology

3.1 Research Design

A single-case study design was chosen for this research. As Yin (2018, p. 5) notes, the distinctive need for case studies arises from the aim to understand complex phenomena. Case studies enable in-depth exploration of a "case" while retaining a holistic and real-world perspective, making them particularly suitable for examining organizational and managerial processes such as the business model of an open data intermediary. The aim here is not statistical generalization but analytical generalization, where insights from the case are linked back to broader theoretical frameworks (Hammersley, Gomm, & Foster, 2009).

A single case is justified because the phenomenon under investigation, the business model of open data intermediaries (ODIs), remains underexplored in academic literature. Gustafsson (2017) argues that single cases are especially useful in such contexts because they allow for rich, in-depth analysis that can uncover mechanisms overlooked in broader surveys. Following Yin (2018), this research is best characterized as a descriptive–exploratory case study. It is descriptive in that it develops a detailed, empirically grounded account of the business model of the archetypal interactive app. At the same time, it is exploratory because the empirical findings are used to assess, refine, and extend the existing taxonomy of ODI business models. Also, Løkke and Sørensen (2014) argue that single-case studies can play a central role in theory refinement by evaluating, modifying, or extending existing theoretical propositions. Their analysis shows that case studies are especially suitable for examining an existing theoretical framework in depth and assessing its boundaries or applicability in new contexts. This supports the use of a single, information-rich case for advancing the taxonomy of open data intermediary business models.

The research follows an abductive approach (Dubois & Gadde, 2002). Abduction involves a continuous interplay between theory and empirical data, where insights from the data collection are iteratively confronted with, and may reshape, the theoretical framework. This approach is particularly appropriate for this study, as the objective is not to test a predetermined hypothesis but to refine conceptual understanding.

3.2 Case Study Rationale

This research focuses on the case of 9292, a Dutch public transport information service. The choice of 9292 is relevant for several reasons. First, the organization exemplifies an interactive app within the typology of ODI business models developed by Shaharudin *et al.* (in press). Because 9292 is specifically categorized as an interactive app in the typology, the case is strongly theoretically embedded, ensuring that the empirical analysis is anchored in an existing conceptual framework. It uses open public transport and geospatial data. Including transport schedules and updates, but more importantly, a geospatial data component such as routes, location of stations and stops, and real time data. 9292 transforms this temporal geospatial data in personalized travel advice. The travel advice can also be viewed through an interactive map. However, it is also involved with other activities such as advertising, API services, and ticket sales. Studying this archetype offers the opportunity to move beyond abstract typologies and develop a qualitative

understanding of how such intermediaries function in practice. Second, 9292 holds national importance as one of the most widely used travel information platforms in the Netherlands (Mobiliteit.nl, 2024).

A further rationale lies in the platform's longevity. Established in 1992, 9292 has successfully maintained its position over three decades, adapting to technological change and evolving institutional environments. This longevity provides a valuable opportunity to investigate how ODIs can sustain their relevance over time. Finally, 9292 illustrates a hybrid business model that combines public service with commercial activities. While its primary mission is to provide accessible public transport information, the organization sustains itself through revenue from advertising, ticketing partnerships, and the provision of professional API services. This hybrid position makes 9292 particularly suitable for examining how ODIs navigate the tension between organizational sustainability and the creation of public value.

The boundaries of this case are defined by the data ecosystem of 9292 and its business model practices, including its interactions with key external actors. The analysis, therefore, incorporates the perspectives of regulators and staff members of 9292, as these stakeholders play an active role in shaping 9292's business model and its position within the broader open-data ecosystem. While the primary focus remains on 9292's internal business logic, these external relationships are examined as integral components of its operational context.

3.3 Data Collection Strategies

The use of archival research is an essential component of this study's methodological design. First, archival data have been employed effectively in comparable qualitative case studies on open data intermediaries, most notably in Shaharudin *et al.*'s (2025) case study of Esri and Ochoa-Ortiz and Re's (2025) study of OpenStreetMap. These studies demonstrate that historical records, organizational documents, and earlier versions of digital platforms provide important insights into how ODIs develop their roles, capabilities, and business models over time. Using archival material, therefore, aligns this research with established methodological practice in the field.

Second, incorporating archival data strengthens the study's empirical validity by enabling cross-validation between sources. Archival documents, such as historical website versions, policy reports, regulatory documents, and earlier organizational statements, serve to triangulate and verify information obtained from interviews. This reduces the risk of retrospective bias and improves the accuracy of the business model description by grounding it in evidence that spans multiple time periods.

Third, the use of archival research is consistent with general methodological guidance on case study research. Yin (2018) emphasizes that combining contemporary interview evidence with background documentation improves the completeness and credibility of a case analysis, allowing the researcher to describe the present-day case while also accounting for the conditions from which it emerged. Similarly, Welch (2000) highlights three central functions of archival sources in qualitative case studies: adding empirical depth, enabling cross-verification of other data, and supporting developmental explanations of organizational evolution. In this study, archival materials play all three roles by documenting the historical

development of 9292's data infrastructure, institutional relationships, and position within the NDOV ecosystem. Taken together, these considerations justify the use of archival research as a necessary and appropriate methodological choice. It situates the study within established practice in ODI research, strengthens the evidentiary base through triangulation, and adheres to recognized methodological standards for high-quality case study design.

The second source of evidence consists of semi-structured interviews. These interviews will be conducted with individuals who possess direct knowledge of 9292's operations, such as current employees. As outlined in the theoretical framework, analyzing the business model of an open data intermediary requires attention not only to internal organizational processes but also to perspectives from the wider ecosystem, including institutional influences and resource dependencies. For this reason, interviewees are not limited to staff members of 9292 but also include stakeholders situated within the broader network, such as regulators involved in the development of public-transport data policy. Semi-structured interviews are appropriate for this study because they offer a balance between structure and flexibility. A predefined set of guiding questions ensures consistency across interviews, while the open format allows respondents to elaborate on issues that may not have been anticipated by the researcher (Taherdoost, 2022). The interviews serve three main purposes: first, to support the development of a detailed description of 9292's business model; second, to provide primary empirical material for assessing and refining the existing theoretical framework; and third, to identify the strengths and weaknesses of the current business model, including potential risks and opportunities for its long-term sustainability. The interviewing was an ongoing process in cooperation with 9292; the same respondents may have been interviewed several times.

3.4 Operationalization of Theoretical Concepts into Interview Questions

The interview guide was constructed through a systematic operationalization process, in which each theoretical dimension from the conceptual framework was translated into concrete, observable indicators. These dimensions, such as value proposition, value creation, resource dependencies, institutional embeddedness, multi-sided market dynamics, and sustainability, were linked to specific types of organizational practices, behaviors, relevant to 9292. For each dimension, I identified the underlying concepts (e.g., strategic resources, key processes, cross-side interactions, regulatory influences, public versus commercial value). I formulated corresponding questions that would elicit empirical evidence of these constructs.

This process ensured that the interview questions did not emerge arbitrarily, but were directly anchored in theory. For example, indicators of value proposition were operationalized through questions about the services 9292 provides and who benefits from them. In contrast, value creation was translated into questions about internal activities, expertise, and data processes. Concepts from the resource-based view and the dynamic-capabilities framework were operationalized into questions that probed strategic assets and adaptive capabilities, whereas institutional theory informed questions on historical positioning, legitimacy, and regulatory alignment. Likewise, multi-sided market logic shaped questions about value flows between travelers, operators, and institutional stakeholders, and sustainability theory guided questions about future risks, opportunities, and lessons learned.

By linking each concept to empirical prompts, the interview guide maintains conceptual validity, facilitates comparability across respondents, and ensures that the data generated corresponds directly to the analytical constructs of the study. An overview table of this operationalization, including dimensions, indicators, and example questions, is provided in Appendix 1.

By combining archival data with interview evidence, the study is able to cross-verify information and mitigate the limitations of relying on a single source (Yin, 2018). Additionally, interview transcripts will be coded systematically and analyzed iteratively, ensuring consistency and transparency in the interpretation of the evidence.

3.5 Analysis strategy

The data analysis is guided by theoretical propositions, following Yin's (2018, p. 194) recommendation that case study analysis should be structured around the theoretical orientation that informed the research design. The conceptual framework, therefore, provides the main structure for coding and interpreting the empirical material. At the same time, the analysis follows the abductive logic of "systematic combining" described by Dubois and Gadde (2002). This means that coding and interpretation move iteratively between the data and theoretical assumptions. Initial codes are derived from the conceptual framework, but the coding process remains open to new themes, anomalies, or unexpected patterns that emerge from the interviews or archival material. When such insights appear, they are compared with, and where necessary used to refine, the existing theoretical propositions.

By combining Yin's proposition-driven analysis with the abductive and iterative logic described by Dubois and Gadde (2002), the study maintains a structured analytical lens while remaining open to emerging insights from the data. This means that the empirical material may confirm aspects of the existing theoretical assumptions, but it may also reveal nuances, inconsistencies, or extensions that were not previously identified. This orientation is fully consistent with the recommendation by Shaharudin *et al.* (in press) that further research on open data intermediary business models should proceed by using empirical cases to challenge, refine, or extend the current taxonomy. The chosen analytical approach, therefore, supports both a detailed description of 9292's business model and a theoretically informed contribution to the broader understanding of ODI business models.

4 Case Study Context

4.1 REISinformatiegroep B.V.

9292, as part of REISinformatiegroep B.V., states its mission as *"helping everyone find their way from A to B by combining all forms of shared mobility with public transport."* (9292, n.d.(a)). The organization fulfills this mission by providing multimodal and real-time travel advice that integrates all public-transport modes in the Netherlands, including trains, buses, trams, metros, and ferries, alongside complementary options such as shared bicycles and e-scooters. From its headquarters in Utrecht, 9292 reaches a vast user base. It has over 5 million installs on devices (Visser, 2024), the platform records more than 2 million travel advisories per day, attracts over 2.1 million unique visitors each month, and generates around 40 million monthly pageviews (9292, 2025a). These figures illustrate 9292's status as the primary national intermediary for public transportation information (Visser, 2024).

Market research by Visser (2024) further underscores 9292's strong position within the Dutch mobility-information landscape. Together with NS, it dominates the market for digital travel planners. NS achieves the highest reach, approaching 80% of surveyed users, closely followed by 9292, with both platforms exceeding 70% reach. Notably, 66% of respondents used both the NS app and 9292 in the past year, indicating substantial overlap and complementary usage. Google Maps follows at a distance with a reach of 38%, while all other travel planners individually remain below 16% market penetration. This distribution demonstrates that, despite increasing competition from general-purpose navigation platforms, 9292 remains one of the two dominant, sector-embedded sources of public transport travel information in the Netherlands. The mobile-installed application is used by 75% of its users, the other 25% use the web (9292, 2025a). Historic data

According to published figures, 9292 currently serves approximately 5 million users per month, generating around 450 million pageviews and processing more than 2.5 million travel advice requests per day (9292, 2025a). These figures illustrate the large operational scale at which open public-transport data are transformed into personalised journey information within the Dutch mobility ecosystem.
Historically, request volumes have increased dramatically (see figure 2). From approximately 12 million annual telephone-based travel advices in the early years, volumes rose to 155 million in 2011 and 457 million in 2012 (REISinformatiegroep B.V., 2013). Following the launch of the mobile application in 2010 and the growth of smartphone use, annual volumes continued to expand, reaching 661 million in 2015 (Mobiliteit.nl, 2016) and exceeding 1 billion in 2019 (Androidworld, 2019). Although usage temporarily declined during the COVID-19 pandemic, current figures of over 2.5 million daily requests indicate sustained large-scale digital mediation of public transport information (9292, 2025a).

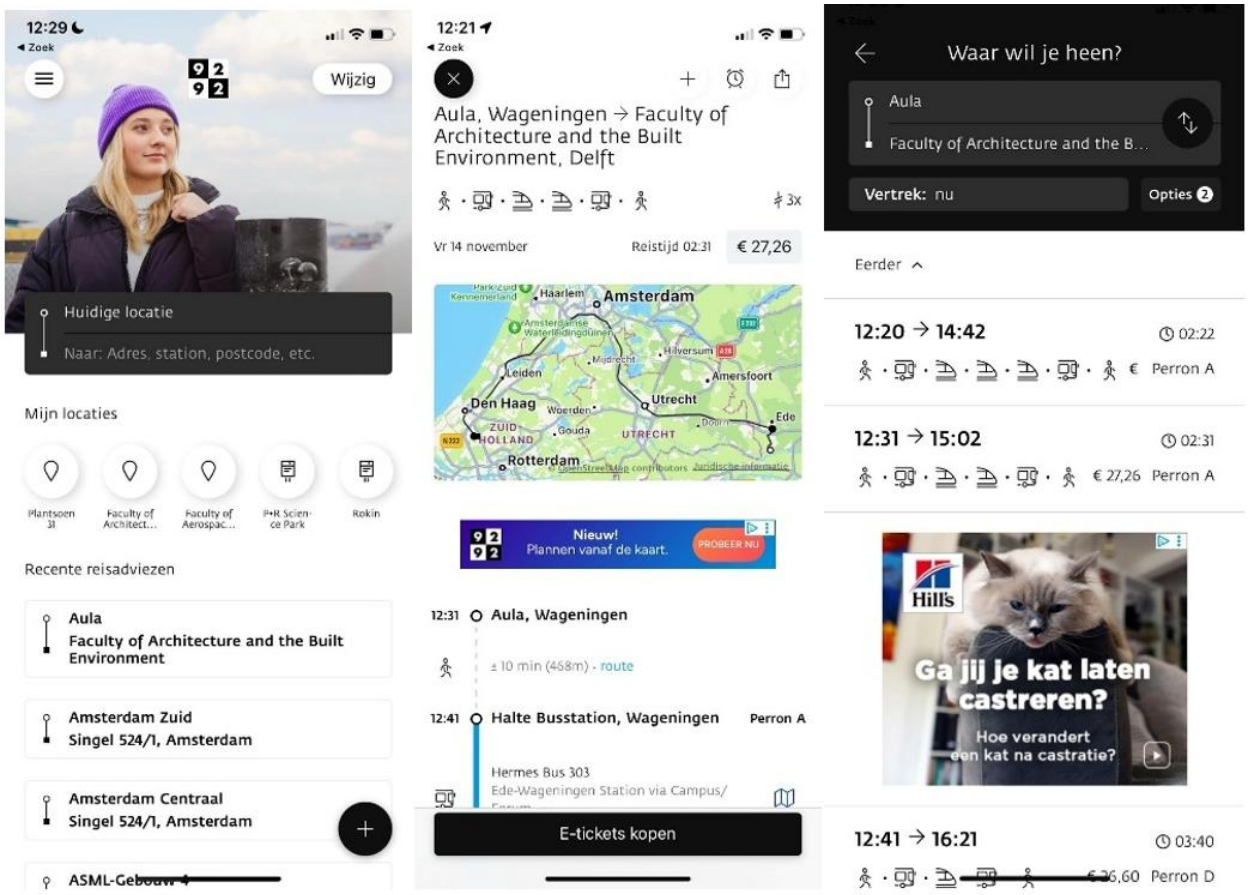
Figure 2: Annual travel advice given

4.1.1 Offerings

9292's main product is its public transport travel planner, which provides personalized travel advice to passengers across the Netherlands. In addition to this core service, 9292 also offers APIs that provide access to integrated public transport data, ticketing services, and advertisement space on its app. Together, these form 9292's overall product offering, as identified through desk research.

9292 offers multimodal travel advice, enabling users to plan journeys between any two locations in the Netherlands. The travel planner interface displays detailed information, including departure and arrival stations, platforms, estimated travel times, intermediate stops, and other relevant travel details. It also includes an interactive map that visualizes the selected route (see figure 3). Users can customize their travel plans by filtering preferred modes of transport, selecting specific stations, and adjusting parameters such as walking speed.

Figure 3: 9292 app interface version 2.33.3 viewed on iOS 16 (11 nov, 2025)



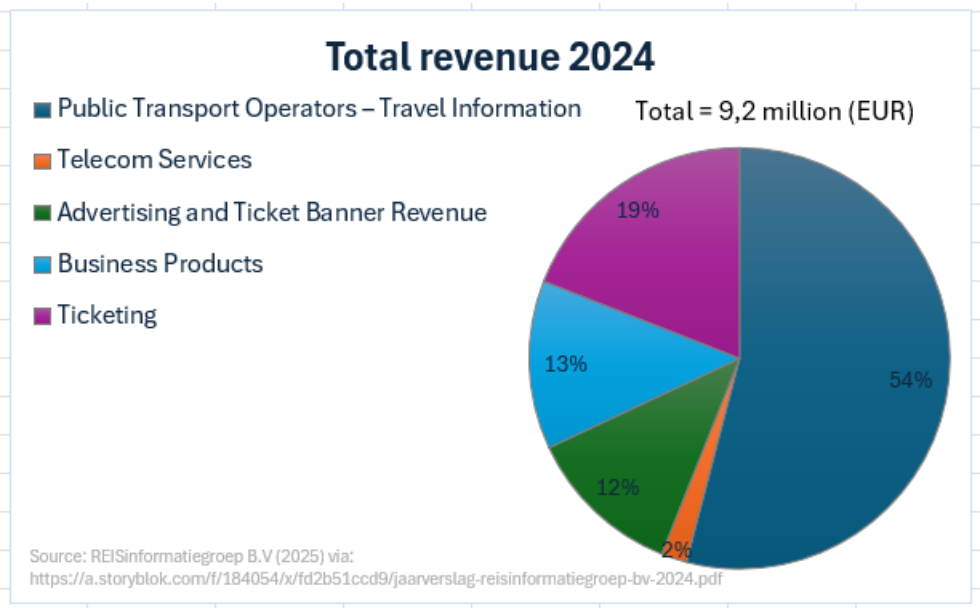
4.1.2 General infrastructure

Multimodal journey-planning applications integrate multiple categories of input data to support routing and personalization. Static data, such as timetables, stop locations, and route structures, form the baseline network on which routing algorithms operate (Zhang, Arentze, & Timmermans, 2011). Dynamic data captures short-term variations in network conditions, including delays, cancellations, and disruptions (Carrese *et al.*, 2021). Following the framework identified by Vredenborg *et al.* (2025), these systems generally involve a sequence of data collection, cleaning, and aggregation followed by algorithmic routing, and user-interface presentation. Based on this literature, it is assumed that 9292 applies a similar process, integrating static and dynamic datasets from transport operators to generate optimized, multimodal travel advice through an interactive interface (see 4.3 for more in-depth technical infrastructure). Besides its travel planner, 9292 also provides business services, such as APIs, so that other parties can build their own travel planners tailored to business goals or personal preferences. This can include personalized travel advice, travel messages, or departure times. This is done in accordance with service costs (9292, 2025b). It also allows users to purchase all-in-one tickets for their journey; the ticketing service charges a service fee for this option.

4.1.3 Revenue structure

9292 is organized as a private limited company (*Besloten Vennootschap, B.V.).* The company is funded primarily through annual service contributions from participating public transport operators, which account for the core of its income. Additional revenues come from advertising, e-ticketing, and API and business-to-business products, including data interfaces. According to its 2024 annual report (see figure 4), REISinformatiegroep B.V. achieved net turnover of € 9.17 million, maintaining stable operations in a competitive digital mobility market (REISinformatiegroep B.V., 2025).

Figure 4: Annual sources of revenue of 9292 in 2024



Within the Dutch public transport data ecosystem, 9292 occupies a distinctive position that combines service provision and data-publishing responsibilities. In addition to its partnerships with public transport operators, 9292 serves as one of two official data portals designated by the Ministry of Infrastructure and Water Management to publish open public transport data through the *Nationaal Dataportaal Openbaar Vervoer* (NDOV) [National Public Transport Data Portal]. REISinformatiegroep, acting on behalf of Dutch public transport operators, publishes raw public-transport data according to the national Open Data Model and under CC0 conditions, to make these source datasets as accessible and unrestricted as possible. These data, including GTFS feeds, tariff files, and various technical interfaces, enable developers and market actors to build new travel information services, thereby expanding the future possibilities for travelers to access mobility information (REISinformatiegroep, n.d.).

The other data portal is managed by Stichting OpenGeo, which operates the OpenOV platform. Both organizations are responsible for publishing static and dynamic travel information supplied by transport operators, ensuring that these datasets are freely accessible under open-data conditions. This dual role

positions 9292 both as a service intermediary that delivers personalized travel advice to end users and as an actor that contributes to the governance and dissemination of open transport data in the Netherlands. As a result, 9292 is not merely a downstream re-user of open data, but also participates in shaping data standards, data quality practices, and access conditions within the national public transport data infrastructure.

The publication of open public-transport data was not part of 9292's original activities, which were focused on providing travel information services on behalf of public-transport operators. When the Dutch government decided to establish a unified national public-transport data infrastructure (NDOV) around 2009–2012, 9292 was *not* automatically appointed to manage or publish this data. Although Parliament suggested designating 9292, the Minister for Transport insisted that the NDOV services had to be assigned through an open bid process, rather than awarding the task directly to 9292 (Meijer, 2014).

Since the national adoption of open public-transport data in 2012, 9292 has operated in an increasingly competitive environment in which multiple actors reuse the same underlying datasets. Several journey-planning alternatives exist, including the NS Reisplanner, Google Maps, and travel planners offered by individual transport operators.

Because the underlying datasets are made openly available and are not subject to exclusive control or proprietary gatekeeping, platforms cannot compete on data ownership. Instead, differentiation may emerge from the ways in which actors interpret, process, and present openly available data, including, though not limited to, routing logic, interface design, service integration, branding strategies, and ecosystem relationships. A community discussion highlighted that the NS Reisplanner sometimes produces travel advice different from that of 9292, prompting NS to note that route recommendations may reflect operator-specific optimization choices (NS Community, 3 July, 2024). In response, 9292 emphasizes that it is organizationally independent and does not operate any transport services, stating explicitly that it "provides travel advice based on the fastest route (9292, 2025b). To understand 9292's current competitive and institutional position within this ecosystem, it is necessary to consider its historical evolution and the institutional arrangements that shaped it.

4.2 The Evolution of 9292

9292 was established in 1992 as a collective initiative of all Dutch public transport operators, who sought to unify their previously fragmented information services into a single multimodal travel advice system. The underlying rationale was that improving the accessibility and completeness of public transportation information, particularly by offering coherent door-to-door advice, would lower informational barriers and thereby stimulate public transportation use (9292, 2002). At the time, public-transport operators were still subject to strong state regulation, and national coordination of passenger information aligned with broader governmental objectives to support the efficiency, integration, and attractiveness of the public-transport system. 9292 operated as a phone call center, and customers would get personalized travel advice or updates on trains by call or SMS. At this point 9292 was the only organization that had access to the travel data of all public transport (PT) operators. In 2000, the first online version of the 9292 website became available.

Instead of obtaining travel information via telephone services, users could, for the first time, enter an origin and destination directly on the website and receive personalized travel advice online. This marked a significant shift from analogue, call-based information provision to a digital, user-interactive travel-planning service (9292, 2000).

In 2000, a new law came into effect: the Wet Personenvervoer 2000. This introduced a free market mechanism into the PT market, regulated by concessions. A concession means that a governmental body (whether the national government or municipal bodies) grants legal rights to the PT operator for a specified period (6-15 years) under a regulated monopoly. After this period, other PT operators may be able to make a better offer, or if the government is not satisfied with the results, they may opt for another operator. In this way, there's competition which would enhance efficiency, thus benefiting all. Until the year 2002, the state provided funding for the independent travel advice (9292, 2002). Dutch public-transport operators are legally required to provide timetable data, planned changes, and disruption information for the development and maintenance of a national travel-information system. Under the Besluit personenvervoer 2000, operators are required to collectively contribute to the annual financing of an efficient, nationwide, and traveler-accessible travel-information system, thereby ensuring its continued operation (Besluit personenvervoer 2000, article 11.4, 2025). While this obligation concerns the system rather than a specific organization. Historically, this national system was fulfilled by 9292. An audit commissioned by the Ministry of Infrastructure and Water Management notes that, following its establishment in 1992, 9292 evolved into the nationally supported PT travel information system, with operators contributing to its costs under Article 14 of the passenger-transport legislation (Audit Business Case NDOV, 2010).

Since 2012, Dutch public-transport operators have been required to make both static and real-time data publicly available through the National Public Transport Data Portal (NDOV-loket). Consequently, the datasets used by 9292 to operate its travel-advice platform became openly and freely accessible to any third party under the NDOV license conditions (e.g., CC0). Although 9292 contributes to the data infrastructure and publishes data through the NDOV portal, its core business activities remain centered on providing personalized, multimodal travel advice rather than on data publication itself. As a result of this mandatory open-data publication regime, from 2012 onwards the information underpinning the 9292 travel planner also became available to competitors, enabling other journey-planning applications to enter the market and offer similar services.

Wayback Machine archives show historical snapshots of the 9292 website between 2000 and 2012, revealing that during this period, 9292 offered access to its raw data through a paywall. The website (9292, 2005, March 7) offers, for instance, raw data on all stops and explicitly states that they can be purchased. In 2005 the organization launched a paid service called *9292 Professional*, targeting companies that made large volumes of travel-advice requests or reused 9292's data for commercial purposes. At the time, the website explicitly noted:
"Many companies use the 9292 site with travel advice for their own commercial activities. In addition, large travel-advice requests from employees often come in via one (IP) address. Therefore, REISinformatiegroep has decided to ask these companies for a contribution to the costs, or otherwise deny them access to our heavily used servers." (9292 OV, 2005, March 6).

9292 also made its organizational mission clear:
"The mission of REISinformatiegroep is primarily aimed at service provision to individual travelers and not at large users who, for example, use our freely provided data for commercial purposes." (9292 OV, 2005, March 6).

This demonstrates that, prior to the establishment of the NDOV, 9292's primary focus was on providing personalized journey advice to individual travelers, rather than facilitating the reuse of third-party data. Commercial use of its data was explicitly monetized through subscriptions, showing that open data publication was not yet part of 9292's mandate. Also, 9292 provided data delivery or analytics for companies and/or governmental bodies (9292, 2005). In 2012–2013, 9292 began openly publishing its static and real-time public-transport data through the NDOV infrastructure, making the datasets freely accessible for reuse by third parties. This marked a turning point: once other actors, such as Google Maps, OpenGeo, and independent app developers, could build their own travel information services on top of the same data, 9292 moved from being the sole national provider of public transportation information to operating within a competitive environment. As a result, its role shifted not only to using the data in its own journey planner but also to enabling broader ecosystem reuse through standardized, openly available datasets. Although the introduction of the NDOV infrastructure and the 9292 Open OV Data License formally ended 9292's exclusive access to public-transport data, this did not remove its dominant position in the ecosystem. Open data eliminated the technical monopoly; any actor could legally reuse the timetable and real-time information. This makes the current business model of 9292 exciting, as it now serves as an ODI.

After the opening of the PT data, 9292 has been keeping up with its competition. According to Visser 2024 it has the most user-friendly UI. Moreover, it offers features like walking speed, preferred track, preferred station, and preferred mode of transport. 9292 has also attempted to innovate further with additional travel mode services, such as electric scooters, bikes, or shared cars. This shifts the focus away from public transportation.

In recent years, 9292 has increasingly invited other mobility providers, such as flexible transport and shared-mobility services, to join its platform. In return, participating operators gain visibility through dedicated profile pages, inclusion in travel advice and departure overviews, and the ability to display fare, disruption, and contact information directly to travelers (9292, n.d. (b)). This reciprocal exchange reinforces 9292's role as a central intermediary that creates cross-side value between travelers, transport operators, and emerging mobility services.

To conclude, based on desk research, 9292 appears to hold the second-largest market share in the Dutch travel-planning market (Visser, 2024). Its main products include real-time and personalized travel advice, analytical services for businesses and public authorities, and API tools that allow external developers to build travel-related applications or extend existing functionalities. Over time, 9292's portfolio has evolved in response to technological and institutional developments within the mobility sector. More recently, the platform has also begun to include data on shared mobility services such as Felyx and Check, presented in a separate section of the app titled *"renting nearby."* (9292, n.d. (b)). This suggests a continuing process

of adaptation in which 9292 incrementally broadens its scope beyond public transport, reflecting an ongoing evolution within the wider mobility ecosystem.

4.3 Technical infrastructure

This thesis primarily examines 9292 through a business-model lens; however, an understanding of its operational and data-technical foundations remains essential. The value-creation logic of a multimodal travel planner is inseparable from how it integrates, harmonizes, and operationalizes the underlying data infrastructure. As outlined in Section 4.2, multimodal journey planners generally follow a pipeline of data collection, cleaning, aggregation, algorithmic routing, and user-interface presentation (Zhang et al., 2011; Carrese et al., 2021; Vredenborg et al., 2025; Heppe et al., 2017; Hill et al., 2024).

Rather than reiterating this generic architecture, the following section focuses on how this logic materializes within the Dutch public-transport data ecosystem. Specifically, it outlines the standardized datasets, exchange frameworks, and spatial data harmonization processes that constitute the technical backbone of the NDOV ecosystem within which 9292 operates.

4.3.1 Data sources and harmonization

The 9292 travel planner operates upon data from the NDOV portal, which provides a nationally coordinated data portal of standardized public transport datasets. The NDOV portal consists of multiple standardized data exchange frameworks operating at different institutional levels. These datasets comprise a combination of geographical data (e.g., stops/stations and network geometries), static planning data (e.g., timetables and service structures), and real-time operational data (e.g., vehicle movements, punctuality messages, and disruptions). Although all datasets are formally standardized, they are governed by distinct standard families that reflect different levels of European, national, and operator-specific coordination.

At the European level, NeTEx (Network Timetable Exchange) constitutes a formal CEN standard (EN 16614) for the exchange of static public transport data. NeTEx is conceptually grounded in the Transmodel reference architecture (EN 12896), which provides a semantic framework for modelling public transport entities such as StopPlace, JourneyPattern, and ServiceJourney. The NL NeTEx profile explicitly refers to Transmodel concepts in its definitional structure, indicating that NeTEx operationalises these conceptual entities in an XML-based exchange format (BISON, 2021).

Within the Dutch context, several national standards are explicitly based on NeTEx. The BISON *Haltestructuur standard underlying the Centraal Halte Bestand* (CHB) states that it is "based on the CEN-NeTEx standard (versie NeTEx v1.1)" (BISON, 2022, p. 7). This demonstrates that Dutch stop and station data are modelled in alignment with the European NeTEx framework. The CHB further incorporates NeTEx identifiers for Quay and StopPlace objects to support international interoperability (BISON, 2022). In this respect, the national BISON framework embeds European modelling principles within the NDOV ecosystem.

In parallel to NeTEx, real-time European standardisation is represented by SIRI (Service Interface for Real-Time Information; (see BISON, 2020), which similarly builds upon Transmodel but focuses on operational

information exchange. However, the Dutch NDOV environment also retains nationally developed BISON interfaces such as KV6 (vehicle and punctuality information) and KV15 (disruption messaging), which structure real-time data flows between operators and integrators.

The coexistence of European standards (NeTEx, SIRI), national BISON specifications, international practice-driven formats (GTFS), and operator-specific implementations creates a structurally layered and heterogeneous data environment. The KV6 specification explicitly defines stop references as “Stop number of the most recently served stop within the operator’s domain.” (BISON, 2020, p. 22), indicating that identifiers are operator-specific rather than nationally harmonized. This confirms that semantic alignment across datasets cannot be assumed and must be performed at the integrator level. So while syntactic interoperability is ensured through standardized file structures and interface specifications (e.g., IFF, GTFS, KV6), the underlying datasets model transport entities at different levels of abstraction. Semantic alignment of identifiers and spatial harmonization of geometries must therefore occur at the integrator level, where heterogeneous representations are reconciled into a unified, computationally routable network structure.
Geographic transformations

Within the NDOV portal, geographic coordinates are not provided in a single unified coordinate reference system (CRS). BISON-based datasets, such as the Centraal Halte Bestand (CHB), define stop and quay coordinates in the Dutch Rijksdriehoeksstelsel (RD New; EPSG:28992), a projected national CRS optimised for spatial accuracy within the Netherlands. In contrast, real-time vehicle coordinates in the global geodetic system WGS84 (EPSG:4326) are expressed as latitude and longitude because GNSS systems are used on the vehicle. These coordinate systems are not directly interoperable: RD New is a planar projection designed for national cartographic precision, whereas WGS84 is a global geographic reference system.

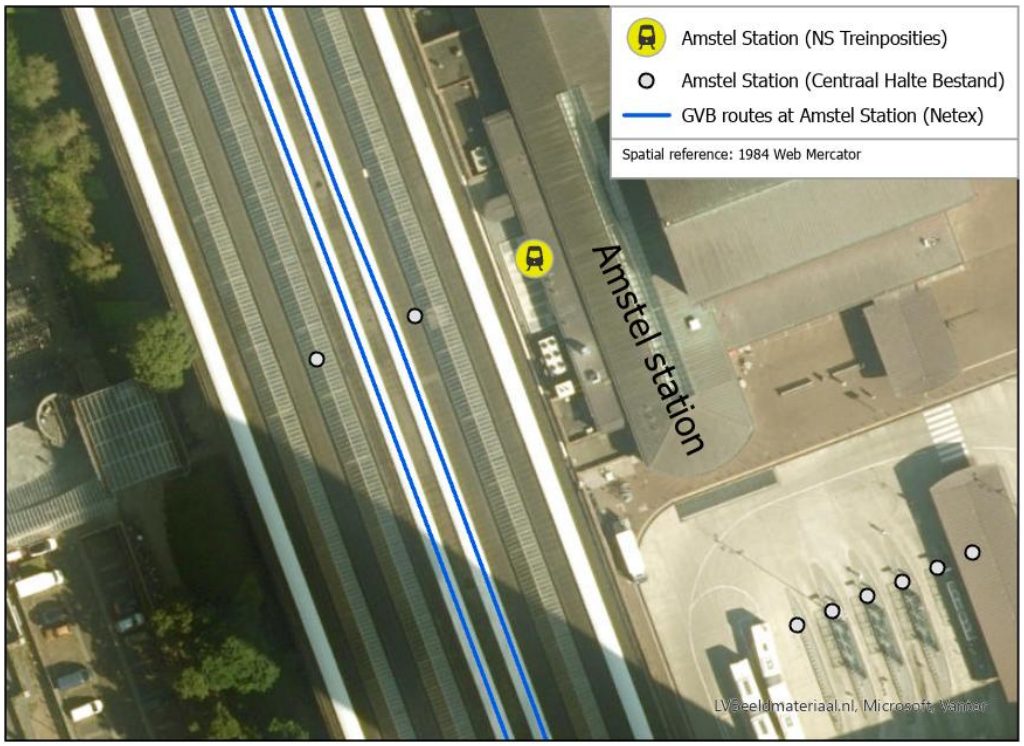
Complicating this further, the spatial rendering of 9292’s user interface is based on OpenStreetMap tiles, which are typically served in the Web Mercator projection (EPSG:3857). Smartphone-based positioning relies on GNSS constellations such as GPS and Galileo. These are most often processed as WGSS84 (Shaner, 2015, 10 Aug). As a result, the application operates within a structurally multi-CRS environment. Data originating in RD New must be transformed into WGS84 or directly into Web Mercator for visualisation, while GNSS-derived user locations are in WGS84. Ultimately, all spatial entities rendered in the interface must be projected into Web Mercator to align with the OpenStreetMap basemap. The application's operational functioning, therefore, depends on continuous coordinate transformation pipelines across multiple CRS environments. Spatial harmonisation is not incidental but structurally embedded in the application's architectural design.

4.3.2 Interoperability Example

The NDOV ecosystem operates within a heterogeneous technical environment in which interoperability must be actively constructed, even where formal standards exist. Amstel station serves as an illustrative example of how datasets referring to the same semantic entity require multi-layered harmonisation before they can be operationalised within a routing system.

Figure 4 visualises the spatial representations of *Amstel station* across three datasets. The white circular markers represent quay locations derived from the Centraal Halte Bestand (CHB), which defines stop and quay entities within the national BISON framework (BISON, 2022). The yellow symbol indicates the station-level coordinate from the NS station dataset, while the blue polylines depict GVB route geometries derived from NeTEx timetable exports (BISON, 2021). The locations are published originally in RD new, and transformed to Web Mercator to match 9292's output map. Although all three layers refer to the same semantic entity, Amstel station, their spatial positions do not coincide exactly. CHB quays represent administratively defined passenger boarding locations, the NS dataset provides a station-level coordinate approximating the station entity, and the NeTEx RouteLinks model planned network topology. The observed spatial divergence therefore reflects distinct modelling abstractions rather than data inconsistency.

Figure 5: Divergent Spatial Representations of Amstel Station Across Open Datasets



Interoperability in this context requires several harmonisation processes. First, syntactic harmonisation is necessary, as CHB and NeTEx data are distributed in XML-based structures following different schema definitions (BISON, 2021; BISON, 2022), while NS provides station-level data in a separate specification. These datasets must be parsed and transformed into a unified internal representation. Second, a coordinate transformation is required: CHB coordinates are defined in RD New (EPSG:28992) (BISON, 2022), whereas NS station coordinates are expressed in WGS84 (EPSG:4326). For visualisation in the user interface, all geometries must ultimately be projected into Web Mercator (EPSG:3857). Third, identifier reconciliation ensures that references to Amstel station, whether as StopPlace, Quay, or station entity, are aligned across datasets. Finally, geometric alignment connects quay locations to planned route geometries, compensating for differences in abstraction between boarding points and the network topology.

The Amstel case illustrates only a limited segment of the broader harmonization process. It addresses static spatial abstractions but does not yet incorporate temporal dimensions such as timetable integration, service mutations, or the reconciliation of real-time vehicle positioning, multiple transport options or routing.

5 Results

This chapter presents the empirical findings of the study. To answer the main research question, the results are structured around the three analytical sub questions derived from the conceptual framework: value proposition, value creation, and value capture. While the desk research provided essential background on the institutional, legal, technical and historical context of open data in Dutch public transport, the results presented in this chapter are based exclusively on the qualitative interviews. These interviews were conducted with experts embedded in the Dutch public transport open data ecosystem and focus on their experiences, interpretations, and practices. The analysis therefore reflects insider perspectives on how open data intermediaries operate in practice, rather than a synthesis of policy documents or secondary sources. An overview of the interviewees included in the empirical analysis is provided below.

Table 2: Pseudonyms of respondents

Affiliated organization	Role	pseudonym
9292	Data Engineer	DE
9292	Product Manager	PM
9292	Relationship manager	RM
Dutch Government: Ministry of Infrastructure & Water (I&W)	Policy officer: Advocate for open data in public transport	GOV

5.1 Value Proposition

The value proposition captures what an open data intermediary (ODI) offers to its consumers and partners. In this study, the value proposition is examined specifically for 9292 as a travel planner application, which constitutes the organization's primary open-data-based product. Although 9292 is also involved in activities related to the NDOV portal, these activities are treated here as infrastructural and enabling functions that support data availability across the ecosystem, rather than as part of the value proposition of the travel planner itself.

5.1.1 Type of Main Open-Data-Based Product

Interviewees consistently identified the travel planner app as the principal open-data-based product offered by 9292. This application provides personalized door-to-door travel advice. Respondents described the planner as the most visible outcome of their work, emphasizing that data is "processed and turned into travel information and other travel information in the form of planners and other things". Within the typology outlined in the theoretical framework, this positions 9292 as an free interactive app whose primary function is to translate open public transport data into usable travel information for low skilled-end users. All respondents described the travel planner as an independent information service whose ultimate goal is to support the full transport chain, enabling end-to-end journeys from origin to destination. Users cannot use, or download the data for other goals. Based on the taxonomy definitions, this corresponds to a D-INFO single purpose interactive app. One interviewee emphasized that the travel planner is intended for "a very

broad target group," indicating that the service is designed to be accessible beyond technically skilled users (PM). Another respondent explained that users "don't need any technical knowledge" to use the application, as the complexity of the underlying data is handled within the system (DE).

5.1.2 Source of Data

With regard to the source of data, interviewees confirmed that the travel planner relies on open data supplied by public transport operators. The organization does not act as a data owner or producer, but as a re-user of externally open supplied datasets. Also, the basemaps are built on open data from Open Street Map (OSM). Interviewees explicitly state that 9292 is by law only allowed to build upon open data from the NDOV portal (DE). Other interviewees said 9292 does not only wait for the NDOV portal to update it's data, it also anticipates certain changes to ensure real timeliness. The price of fare's is also a part of the open data source.

Interviewees highlighted that, in practice, reliance on real-time open data alone is sometimes insufficient, particularly during disruptive situations such as extreme weather. One respondent described a case in which a transport operator was unable to immediately deregister all cancelled services in the real-time feed:
"Qbuzz once had a situation with winter weather where they said: we have to deregister buses, but we cannot keep track of all of them, so some buses are still registered even though they are not running. If you rely only on real-time data, you then become dependent on whether a carrier has actually been taken out of the system" (RM).

The respondent explained that, due to established relationships with transport operators, 9292 can intervene directly at a higher level of aggregation:
"Because we have that relationship with those parties, we can say: that is fine, then we remove the entire region, for example Drenthe or Groningen. With one action in the planner, all those trips are removed and users receive a notification. That way, the information is available sooner and we are not dependent solely on the real-time feed."(RM)

This example demonstrates that 9292's data sourcing extends beyond automated real-time feeds and includes relational and discretionary interventions, enabling faster and more reliable communication to travelers during disruptions.

5.1.3 Consumer Segments

The interview data indicate that the main product of 9292 addresses two distinct consumer segments: travelers who use the application, and transport operators who interact with the organization as clients and beneficiaries of the platform's reach.

Interviewees consistently described travelers as the direct users of the travel planner. One respondent explained that the application is designed so that "the passenger knows how to get from A to B," framing travelers as the end users of the information provided through the app (PM). Another interviewee emphasized that the planner is meant to be used by a broad audience and that users "don't have to think about the data behind it; it just has to work," highlighting the consumer-oriented nature of the product (RM). Also in all interviews it was emphasized that they ultimately serve the user.

On the other hand, interviewees explicitly referred to transport operators as clients rather than as users of the application. One respondent stated that transport companies are "actually our clients," indicating that operators engage with 9292 in a fundamentally different role than travelers (PM). "Yes, the passengers are our customers, but also the transport operators, in principle". Interviewees further described that the travel planner functions as an *"uithangbord,"* literally translated as a "shop window" or "billboard," through which operators' services become visible to travelers (RM). In this sense, the planner serves operators by presenting their services within travel advice. Since the distinct consumer segments, the results will be split into these two consumer segments.

5.1.4 Offering to Travelers

Based on the offerings according to Osterwalder & Pigneur, 2010, the interview data indicates that *convenience and cost reduction* are the most immediately observable characteristics of the value proposition of 9292 for travelers. Interviewees repeatedly described the travel planner as a single point of access where multiple transport services and datasets are brought together. One respondent noted that travelers benefit from having "everything in one place," rather than needing to consult separate applications or information sources for different operators (DE). This can conceptually be seen as cost reduction since it reduces operational cost of consulting separate information silo's and aligning them. This consolidation was described as central to how travelers interact with the service in practice.

Beyond convenience, interviewees emphasized *performance,* particularly in relation to data quality, reliability, and active data management. Respondents stressed that producing usable travel advice requires continuous processing, correction, and integration of incoming data. As one interviewee explained, "you get the rough data, and we have to make sure that it all comes together in good travel advice" (RM), indicating that the quality of the output depends on active data handling rather than passive reuse. Performance was further linked to operational responsiveness. One respondent described maintaining short communication lines with transport operators and proactively contacting them early in the morning or late in the evening to verify disruptions, ensuring that buses not running are reflected promptly in the planner. This illustrates that performance is not limited to technical integration, but also involves active coordination to safeguard the reliability of travel advice. Another respondent directly associated performance with reliability, stating that "from reliable and good information, you create a high-quality product" (PM). In this sense, performance primarily refers to ensuring high data quality and dependable outputs."… reliable is indeed important. I think independence is important, and that large platform that you already are."(RM). Independence from individual transport operators contributes to trust in the information provided, while the platform's reach reinforces its role as a central point of reference for travelers.

Brand & design was also mentioned as a relevant element of the offering. Interviewees referred to the familiarity of the interface and the fact that many users already know how to navigate the application. One respondent noted that travelers are accustomed to the way the planner presents information, suggesting that continuity and recognizability play a role in how the product is experienced (DE). Others state that because of longstanding brand of 9292 users are already familiar with it.

Finally, *responsiveness and feedback* were described in relation to how user reports and questions are handled. Interviewees explained that feedback from travelers about incorrect or missing information is actively monitored and followed up. As one respondent stated, when issues are reported, "we get to work

on those and see if we can solve them," often by contacting the relevant transport operator to correct the underlying data (RM)." Because we also use the feedback we get, and that gives us a system where we can integrate that data much better than other parties". The feedback mechanism is in return also a valuable offering for the transport operators.

5.1.6 Offering to Transport Operators

The interview data indicate that the value proposition of 9292 for transport operators is primarily characterized by *brand* and *accountability*, with additional elements corresponding to *efficiency*, *complementarity*, and *lock-in* as described in the value-driver literature. Interviewees consistently referred to the strong recognizability of 9292 and its large, established user base as a key reason for operators to engage with the platform. One respondent noted that 9292 already reaches "a very broad target group," making it an effective channel for ensuring that transport services are visible and accessible to travelers (PM). Brand value was also linked to long-standing relationships within the sector. As one interviewee explained, cooperation is facilitated because operators "know what they can expect from us," (PM). referring to institutional familiarity developed over time

Accountability emerged as a central characteristic of the offering to transport operators. Interviewees emphasized that operators rely on 9292 to correctly process, integrate, and present their data to the public, particularly in situations where inaccuracies or disruptions occur. One respondent explained that 9292 ensures data are *"processed properly and consistently in the planning systems"*, indicating an ongoing responsibility for data quality rather than a one-off technical task (DE). This sense of accountability is closely linked to accumulated expertise, as another interviewee noted: *"A correct way can be developed that is also easy to read and clear, well, we have 30 years of experience with that."*. Another interviewee highlighted that when problems arise, 9292 *"steps in to make sure the information towards the traveler remains reliable"*, reflecting an expectation among operators that the intermediary will actively intervene and take responsibility for public-facing accuracy (RM). This suggests that accountability is not only operationally embedded, but also a valuable function for operators, who can rely on 9292 to manage complexity and reputational risk during disruptions. Accountability is operationalized through continuous organizational support structures. As one interviewee explained, "Only if you have a management club or a service desk, which we have, that can actually provide that support day and night" (RM). This indicates that accountability is embedded as a strategic offering, enabling transport operators to rely on 9292 to manage disruptions and safeguard public-facing information beyond regular working hours. As PM noted, "if one of [NS's] planners happens to be unavailable today, they can use our planner" (PM). This illustrates that transport operators treat 9292 as a dependable fallback infrastructure, entrusting it with continuity of public-facing travel information when their own systems fail.

For public transport operators, the value proposition lies in the exposure of their services within a widely used national travel planner. By making public transport easier to use, the planner contributes to increased accessibility and attractiveness of public transport services. Although the travel planner does not necessarily generate direct revenue for 9292 through user payments, the interviews indicate that it creates value for operators who support the organization financially. In this sense, while the travel planner may appear to serve primarily public-value objectives, its continued existence depends on the generation of value for actors within the ecosystem who have an incentive to sustain it. Implicitly, interviewees suggested that if each operator were to develop and maintain its own fully multimodal travel planner, this would require

duplicating complex integration, maintenance, and reliability functions that are now centralized within 9292. This is, for instance, showcased through the use of white-label applications, where, as one interviewee explained, “everything that runs underneath is just the 9292 app … so they don’t have to set up their own management and maintenance team. We actually take care of everything” (RM).

The interview data indicate that enhanced visibility constitutes a central element of the offering of 9292 to transport operators. Interviewees repeatedly described the platform as a channel through which operators’ services become visible to a large and established user base. One respondent explicitly referred to 9292 as an *“uithangbord,”* literally translated as a “shop window” or “billboard,” explaining that the platform functions as a public-facing showcase through which travelers can see which transport services are available to them (RM). This framing emphasizes that inclusion in the travel planner enables transport operators to present their services to users who might otherwise not be aware of them. Interviewees further described that much of the value generated by 9292 accrues to transport operators and travelers rather than being captured internally. One respondent explained that 9292 “makes their transport product usable,” while noting that “the value doesn’t necessarily come back to us one-on-one” (PM).

Interviewees further linked this visibility to the scale and reach of the platform. One respondent noted that 9292 already reaches “a very broad target group,” making it an effective channel for operators to ensure that their services are accessible to a wide audience without relying solely on their own communication channels (PM). Visibility was thus described as an inherent outcome of being embedded within a nationally used travel planner, rather than as a separate promotional activity. Visibility in a way of a large user reach is not reflected in the current framework.

In terms of efficiency and complementarity, interviewees indicated that 9292’s offering to transport operators extends beyond data processing to include the provision of reusable digital components. Rather than requiring operators to develop and maintain their own applications or interfaces from scratch, 9292 enables them to build on existing infrastructure. One respondent explained: *“Well, I (an operator) also need to introduce my own app. Then we can develop that, and we often do that with white label apps, right? We can also create white label websites. Then we own the underlying data infrastructure.” (RM)*
This illustrates how 9292 complements operators’ own services by reducing development effort and time-to-market, thereby increasing operational efficiency while maintaining consistency in the presentation of travel information.

5.1.7 Product Components

The main product consists of 2 components, which are firstly, the travel advice and secondly, the all-in-one ticket. Besides the consumer-facing travel planner app, 9292 also offers in app chain journey ticketing and tailor-made data management and travel planner development services for third parties. The in-app ticket sales are not built on open data, but are organized by proprietary license with Tranzer, an organization that specializes in all-in-one payment systems. 9292 gains a small brokerage fee if a ticket is bought through the app. Respondents emphasized that its seen as an extra income not, as a core offering of 9292.
Interviewees described a range of customized assignments and project-based services that build on the technical and organizational capabilities developed through operating the national travel planner. These projects draw on the same open data development experience, data-integration infrastructure, and system-level knowledge required to maintain the core planner, indicating that their feasibility depends on

capabilities accumulated through the primary offering. These activities are not treated as part of the travel planner's primary value proposition in this analysis. Instead, they are interpreted as spillover effects arising from the open data development expertise and operational experience generated by the core travel planner.
Commercial value

Interviewees explicitly emphasized that 9292 should not be understood as a commercially driven organization in the traditional sense. One respondent stated: "We're not really a for-profit organization… but we do believe that, yes, we have to, people who work here get paid" (PM). This description reflects how the travel planner is not positioned as a profit-maximizing product, even though it is sustained through multiple revenue-related arrangements. RM highlighted that not only 9292 is engaged with providing the best value chain but even the transport operators as well, he stated: So you do it for the public interest and from that point of view you want to improve it together." (RM). This perspective highlights that cooperation between 9292, transport operators, and public authorities is legitimized through a shared public-value rationale, which shapes both strategic choices and boundaries around monetization.

The interview data indicate that the value created by 9292 cannot be understood solely in commercial terms, but reflects multiple value logics described in the open data and public value literature. Interviewees consistently framed the organization's activities around accessibility, reliability, and coordination within the public transport system, rather than profit maximization. This description aligns with the distinction made by Jetzek, Avital, and Bjørn-Andersen (2019) between economic value generated through market mechanisms and societal value generated through information-sharing and coordination mechanisms.

This observation aligns with distinctions in the literature between economic value and public or societal value generated through open data, particularly where accessibility, reliability, and coordination are concerned (Lorenz *et al.*, 2023; Jetzek *et al.*, 2019). Interviewees emphasized that 9292 is widely perceived as responsible for ensuring correct and timely information, especially during disruptions. As one respondent noted, when information is incorrect, "people expect us to fix it," and service failures are often the first source of complaints from travelers seeking to be well informed (RM). This framing, positions information provision as a public responsibility rather than a purely commercial service, with value created through information-sharing and system-wide coordination. This responsibility is further reinforced by 9292's independent positioning within the transport ecosystem, as discussed in the preceding subsection.

5.2 Value Creation

In the case of 9292 as a travel planner, interview evidence shows that value creation is driven by intensive data-processing activities and by differentiated relationships with two customer segments: end users of the travel planner and public transport operators. This section describes how value is created through the critical stages of the open-data lifecycle and through these customer relationships.

5.2.1 Critical Stage of the Open-Data Lifecycle

A making of personalized travel planner is arranged around several stages of open data lifecycle that include preparation and reuse. While the end-product is a result of reuse, the interviewees emphasized the time spent on data preparation and cleaning. Interviewees consistently identified data management as the core activity through which 9292 creates value. Respondents emphasized that their work begins once public transport data has been supplied by transport operators. One interviewee emphasized that most time is spent on data management. As one respondent noted "it is one thing to use the open data, but one has to maintain it and ensure quality" (PM).

When asked about the most important qualities of 9292's work, interviewees consistently pointed to data management and the continuous refinement of information. Respondents referred to this core activity as "data management" and "fine-tuning the information," emphasizing that quality is achieved through ongoing effort rather than a single technical intervention.

Although the travel planner ultimately constitutes a form of data reuse, interviewees emphasized that the core performance value of the service is created during the preparation stage of the open-data lifecycle. Organizational work begins once transport operators supply raw data, after which substantial time is devoted to cleaning, aligning, validating, and maintaining datasets. As one respondent noted, "it's one thing to use the open data, but one has to maintain it and ensure quality." Fine-tuning was described as both time- and labor-intensive, involving tasks such as harmonizing stop identifiers across operators, clustering stops, and correcting geographical inconsistencies. These activities demonstrate that the reliability and functional quality of 9292's travel advice depend on sustained human coordination and data stewardship, rather than on automated processing alone.

Finally, interview evidence shows that value creation continues into the evaluation stage through ongoing validation and feedback. Interviewees explained that comments and questions from both users and transport operators are used to identify errors and trigger corrections. One respondent described this iterative process as follows: "we often get comments and questions from passengers or transport operators. Well, we get to work on those and see if we can solve them ourselves. If a passenger comes to us with something, we have to go back to the transport operator". This demonstrates how evaluation and feedback are embedded in the organization. Taken together, the interviews show that 9292's dominant contribution to value creation spans the preparation, reuse, and evaluation stages of the open-data lifecycle, with active fine-tuning functioning as a continuous activity across these stages.

5.2.2 Key resources

From a Resource-Based View (RBV) perspective, the open data on which 9292 operates cannot be considered a valuable resource in itself, as these data are openly accessible to all potential users. Interviewees acknowledged that data management and fine-tuning are, in principle, replicable activities, requiring expertise, time, and organizational investment. However, respondents emphasized that the effectiveness of fine-tuning at 9292 is not derived from technical processing alone, but from its relational network and embedded position within the Dutch public-transport ecosystem.

Interviewees described fine-tuning as a core activity that combines continuous data refinement with structured feedback and direct points of contact with transport operators. One respondent explained that this interaction allows 9292 to integrate feedback in ways others cannot: *"that also comes too, because we also use the feedback we get, and that gives us a system where we can integrate that data much better than other parties. Google can also make a planner, but it doesn't have the finer details of the whole story that we have."* Another interviewee emphasized the depth of these ties, stating: "*Well, if you only use that real-time data, then you may be dependent on whether your carrier in the area has been taken out, right? But we have such a relationship with those parties that we say, oh, that's fine if you're not in Drenthe or Groningen at all."* The emphasis on such a relationship indicates that 9292's coordination with transport operators extends beyond standard data provision, reflecting direct communication channels and mutual understanding.

From a Resource-Based View perspective (Barney, 1991), it is therefore not the open data itself that constitutes the strategic resource, but the locally embedded knowledge and strong, long-standing relationships with data partners. These relationships enable privileged feedback loops, rapid coordination, and contextual interpretation of disruptions in ways that purely technical competitors cannot replicate. In this sense, 9292's embeddedness within the Dutch public-transport network functions as a key strategic resource underpinning sustained value creation.

5.2.3 Customer Relationship

The relationship with app users was described primarily as a self-service relationship. Users independently access the travel planner via the app or website and use it to plan multimodal journeys. Interviewees referred to passengers as customers because "they use our app and website," indicating that interaction with this segment is mediated through the digital interface rather than through direct personal assistance.

In contrast, the relationship with public transport operators was described as more intensive and ongoing. Interviewees emphasized that operators are not only data suppliers but also direct customers who support 9292 financially and operationally. As one respondent stated, *"We are partly paid by transport companies. They are actually our clients for processing and making that data available"*.

Interviewees described the relationship between 9292 and transport operators less in terms of direct transactions and more as a form of operational extension that can be described as co-creation. In this arrangement, 9292 functions as a lead body that facilitates the contribution and use of data, products, and services, rather than as a detached platform. As one respondent stated, *"I see us more as an extension of those partners and transport operators who actually use our knowledge and our channels."* Value for operators thus emerges through facilitated interaction and integration, consistent with a co-creation logic rather than standalone use of the application.

5.3 Value Capture

Value capture refers to the mechanisms through which an open data intermediary sustains its operations and secures resources in exchange for the value it provides. 9292 offers multiple mechanisms for value capture.

5.3.2 Main Revenue Stream

Interviewees explained that the funding of 9292 by transport operators is not mandated by concession agreements, but emerges indirectly from the requirements placed on operators to provide adequate travel information. Regional authorities may set conditions within concessions regarding passenger information, while leaving the concrete implementation to the concession holder. One respondent illustrated this using the Province of Utrecht, where the U-OV concession requires the operator to provide its own travel-information app: *"It's fine that you have your own app, and that's the free market. It's up to U-OV to make sure they display the travel information correctly and report it to the province."*

At the same time, the respondent emphasized that 9292 continues to play a complementary role by ensuring that travelers retain access to neutral, integrated travel information across platforms: *"It's fine that you have your own app, but we also keep the information in 9292 so that travelers still have a choice."* In this configuration, transport operators, who are semi-private entities operating under public concessions, may either develop and maintain their own travel-information systems or rely on an existing intermediary such as 9292. Although there is no formal obligation for concession holders to fund 9292, its role as an established provider of integrated travel information makes it a practical solution for meeting concession-related information requirements.

The interviews consistently identified financial contributions from public transport operators as the primary revenue stream supporting the travel planner. Transport operators were repeatedly described as direct clients of 9292, despite not being the end users of the application. As one interviewee explained, *"we are partly paid by transport companies. They are actually our clients for processing and making that data available."* Another respondent stated even more explicitly that *"we are basically kept afloat by the public transport companies."* This indicates that value capture within 9292's business model is structurally embedded in the operator side of the ecosystem rather than in the user side. Although the platform delivers its value proposition to travelers through accessible, reliable travel information, the organization's financial sustainability depends on arrangements with transport operators.

5.3.3 Additional revenue

In addition to its core funding model, 9292 captures value through ticketing, advertising, and project-based services. Ticketing represents a brokerage-based form of value capture, whereby the platform facilitates transactions between travelers and transport operators and receives a fee per completed sale. In this role, 9292 acts as an intermediary, integrating ticket purchasing into the travel-planning process and thereby lowering transaction costs. Ticketing revenue is complementary to the core travel-information function and depends on contractual and technical arrangements with operators, implemented through a partnership with Tranzer, rather than on open data alone.

Advertising was described by interviewees as an embedded feature of the planner interface, with value derived from access to a large and relevant user base at moments of travel planning. Advertising revenue is generated through user attention and platform visibility, not through the reuse of open public-transport data. While open data enables the functioning of the planner, advertising monetizes the interface and user traffic rather than the data itself.

Interviewees indicated that revenue sources remain closely aligned with the travel planner and its supporting activities, with no reliance on unrelated commercial ventures. As one respondent noted, *"it's not that we have all kinds of other commercial activities next to this; it's really about making this work."*
A final category of revenue consists of customized and project-based services. These activities are best understood as spillover effects of the core platform rather than as open-data-based revenue streams. Although the underlying expertise has developed through long-term work with open public-transport data, the value captured derives from specialized capabilities in data integration, system design, and coordination. Consistent with platform literature, these projects repurpose knowledge and capabilities accumulated through operating the national travel planner, complementing the core platform without altering its primary value proposition.

5.3.4 Spillover effects

The final source of revenue consists of business-related and project-based services. With regard to their source, it is not straightforward to classify these revenues as open-data-based. While the expertise underlying these projects has developed through 9292's work with open public-transport data, the expertise itself is not open and cannot be freely reused by third parties.

Conceptually, these activities can be understood as spillover effects of 9292's core platform operations. As Van Alstyne, Parker, and Choudary (2016) argue, platform organizations often generate ancillary revenue streams by repurposing capabilities and knowledge developed for their primary platform function. In the case of 9292, capabilities related to data integration, system design, and coordination, originally developed to operate the national travel planner, enable the organization to undertake customized business projects for third parties.

These project-based revenues are therefore not derived directly from open data, but from specialized expertise accumulated through sustained platform operation. As such, they complement the core platform without redefining its primary value proposition, and illustrate how open-data-based platforms may indirectly support additional forms of value capture through capability spillovers rather than direct data monetization.

\

Table 3: Summary of the results of the interviews

Core Dimension	**Empirical Findings**
Value Proposition	Interviewees consistently described 9292 as a neutral and reliable travel information provider. For travellers, the platform offers accessible, integrated, and accountable travel advice. For public transport operators, it provides visibility, large user reach, and coordinated presentation of services. Several respondents emphasized brand recognition and trust as key differentiators.
Value Creation	Respondents highlighted continuous data integration, validation, and fine-tuning of static and real-time datasets as core activities. Value creation relies on close coordination with operators regarding data accuracy and compliance. Interviewees also referred to feedback mechanisms and accountability towards users, particularly during disruptions.
Value Capture	Interview data indicate that financial contributions primarily originate from transport operators. Additional revenue streams include advertising and complementary services. End users do not directly pay for the core application. Funding structures were described as intertwined with regulatory and concession arrangements.
Institutional and Relational Context	Interviewees referred to 9292's historical origins in the public sector prior to privatization of transport operators. Respondents described long-standing partnerships with transport operators and accumulated sector trust, as well as close alignment with regulatory frameworks. Several interviewees indicated that these durable relationships have contributed to brand familiarity among both operators and users, which in turn is associated with broad market reach and organizational stability.

5.4 Swot

The Swot analysis is conducted to assess the viability and long-term sustainability of the organization's business model. Instead of applying a conventional framework that strictly distinguishes between internal and external factors, this chapter adopts the alternative approach proposed by Shaharudin (2025), which differentiates between the current situation (strengths and weaknesses) and future-oriented developments (opportunities and threats). By examining the present configuration of the business model alongside anticipated risks and opportunities, the analysis provides a structured, forward-looking assessment of organizational sustainability. In doing so, this chapter elucidates the organization's long-term resilience and strategic positioning, thereby offering insight into the strategic considerations that shape the sustainability of its business model within a dynamic open data ecosystem.

5.4.1 Current strengths

A central strength of 9292's business model is its combination of data management, ensuring reliability and user independence, and a large, established user base, and historical dpendency in the ecosystem. The scale and neutrality make the platform an attractive channel for transport operators seeking to reach travelers. As one interviewee explains, *"You mentioned that we are indeed reliable. I think independence is important, and that large platform that you already are. So indeed, from reliable and good information, you create a high-quality product, a good service that provides good information, and you already have a very broad target group, so that makes us interesting for transporters, but also provinces."* (RM). This position is reinforced by long-standing relationships and accumulated experience, which are perceived as difficult for alternative information providers to replicate: *"That doesn't just build itself in another party."* (RM). From a technical perspective, fine-tuning and continuous maintenance of data are identified as core capabilities underpinning this reliability: *"You can have open data that everyone can use, but if the information is not kept up to date at some point, then it becomes a problem."* (DE). Together, these operational and realtional assets form a key strength of the current business model.

5.4.2 Current weaknesses

Despite its strong position, the business model operates within a competitive and institutionally constrained environment in which continuity of cooperation cannot be fully guaranteed. The interviews indicate that 9292 cannot unilaterally secure its position, as decisions are shaped by concession structures and external policy requirements: *"That market is free, so it is possible, it could happen, that a party chooses another party after all."* (RM). From a public-sector perspective, this is linked to the governance of open data itself, where responsibilities are deliberately separated from commercial exploitation: *"You can't just start earning money on public transport data, because then you immediately run into questions about competition and state aid."* (GOV This constrains strategic autonomy in value capture and limits the range of monetization options available to the intermediary. Another weakness is the dependency on operators: QUOTE VAN DAT ZE WERKEN MAAR DAT ZE OOK BETAALD MOETEN WORDEN.

5.4.3 Future opportunities

Interviewees consistently identify future opportunities in the further broadening of mobility services toward the full travel chain. This expansion is framed explicitly around improving the traveler experience across modes: *"Mobility broadens, and I think that's a great opportunity. Ultimately, it's all about the traveler.*

Providing optimal information about the entire journey." (RM). Opportunities are associated with integrating flex transport, shared mobility, and potentially regular taxi services: *"Not just having shared taxis and flexi taxis, but also regular taxi companies perhaps doing something. That makes you more interesting and also creates opportunities."* (RM). In addition, technological developments such as artificial intelligence are viewed as complementary channels rather than substitutes for existing services: *"People use the app, people use the websites, people use other social media, and there will also be people who will indeed use AI to facilitate their journey."* (RM). From a managerial perspective, this multi-channel reach reinforces the intermediary's role as a central access point within an increasingly complex mobility landscape.

5.4.4 Future threats

A major future threat identified in the interviews concerns structural reductions in public transport provision. Cuts to concessions and service levels directly affect the relevance and funding base of a platform centered on public transport information: *"If those public transport companies are increasingly challenged to actually cut back in a concession, then I think that will be at the expense of public transport."* (RM). At the same time, interviewees point to the asymmetric innovation capacity of large global platforms as an additional threat. While 9292 operates within public-sector constraints, large technology firms can rapidly develop alternative solutions using open data: *"Google has a certain profit motive and they won't care how they show it."* (PM). This creates competitive pressure not through data access itself, but through differences in speed, scale, and development capacity

6 Discussion

Although Shaharudin's taxonomy of open data intermediaries explicitly adopts an ecosystem perspective, it remains largely structured around concepts derived from classical business-model logic. In particular, the framework builds on value dimensions that are closely aligned with Osterwalder and Pigneur's business model canvas, which was originally developed for firm-centric and product-oriented business models. As a result, even where multiple actors are acknowledged, value proposition, value creation, and value capture are still implicitly framed through a linear value-chain logic. This limits the framework's ability to distinguish between intermediaries that operate primarily as products and those that function as platforms. Building on the empirical case of 9292, this study suggests that an additional analytical distinction between product-oriented intermediaries and intermediaries operating as multi-sided platforms (MSPs) may be useful. In the value proposition, 9292 clearly addresses at least two distinct customer groups: travelers and public transport operators. While the existing framework recognizes multiple stakeholders, it does not conceptualize these groups as customer sides with interdependent value creation. Interview evidence indicates that the offering to transport operators is centered on enhanced visibility and reach towards travelers, rather than on a discrete product or service. This form of value provision aligns closely with MSP logics but is not explicitly captured in the current taxonomy.

The case of 9292 also does not align directly with the archetype of a collaborative open data platform (archetype A1). Although collaboration with transport operators is central, the platform is not community-driven in the sense of collective data contribution or shared governance. Instead, 9292 operates as a centrally coordinated intermediary that facilitates data integration and use within a regulated public-transport context. This positions 9292 differently from collaborative platforms such as OpenStreetMap, where co-creation is driven by a distributed contributor community.

At the same time, comparison with other intermediaries classified under the same archetype of interactive apps without complementary products (A8) highlights further analytical limitations. Several examples within this category operate through a more traditional product logic, offering a standalone application directly to users, with value capture occurring through app sales, subscriptions, or usage-based fees. In such cases, multi-sidedness plays a limited role, as value is primarily generated and captured on a single user side. The empirical findings suggest that grouping these intermediaries together with 9292 under a single archetype obscures important differences in economic logic.

In terms of value creation, the findings largely align with existing claims that open data itself does not constitute a strategic resource due to its non-exclusive nature. Instead, interviewees emphasized continuous data management, fine-tuning, and accountability as core activities. These practices are directed at both travelers and operators, reinforcing the platform's role as an intermediary coordinating across multiple sides rather than delivering a one-off product. Value creation in this case is therefore relational and processual, rather than purely technical.

Shaharudin's taxonomy provides a structured classification of open data intermediary business models by focusing on value proposition, value creation activities, and revenue mechanisms. However, the empirical findings suggest that such a functional categorization does not fully capture how intermediaries structurally differentiate themselves within the ecosystem. In the case of 9292, value creation extends beyond the

technical processing and presentation of open data. It is deeply embedded in differentiated relational configurations across stakeholder groups. More specifically, 9292 operates through a co-creation relationship with transport operators, who share responsibility for data accuracy, updates, and compliance with legal passenger information obligations. Simultaneously, it maintains a distinct relationship with travelers, characterized by accountability, reliability, and mechanisms for feedback and service correction. These relationships are not peripheral; they are central to the business model.

This finding refines Shaharudin's taxonomy by demonstrating that relational embeddedness, rather than technical data integration alone, constitutes the intermediary's primary strategic resource. In line with the Resource-Based View (Barney, 1991), sustained value creation may stem from embedded network relationships and accumulated local knowledge that are difficult to replicate outside the established ecosystem. While the taxonomy effectively captures activities and revenue streams, it under-theorizes differentiated relational configurations as a source of competitive advantage and long-term sustainability.
These findings also align with the institutional perspective outlined in the conceptual framework. As David (2007) argues, organizational development processes are often path dependent, meaning that early institutional arrangements create self-reinforcing dynamics that shape future behavior and strategic options. In the case of 9292, historical positioning within the Dutch public transport system, originating in the public sector prior to market liberalization, has contributed to accumulated legitimacy for both operators and users, established partnerships, and sector-wide trust. Sustainability therefore emerges not solely from current revenue mechanisms, but from historically embedded legitimacy structures and long-standing network alignment and brand recognition.

The value capture mechanisms observed further support this interpretation. End users contribute only marginally to revenue, primarily through advertising exposure, while transport operators provide funding in exchange for visibility, integration, and compliance with information obligations. Although the existing framework categorizes such arrangements as sponsorship, interviewees described them more as investments tied to strategic and regulatory considerations. This suggests that the intermediary does not primarily sell an app as an end product, but rather provides structured access to and visibility within a platform that mediates between user groups.

In doing so, the case demonstrates that an intermediary formally classified as an "interactive app without complementary products" may in practice operate as a multi-sided and institutionally embedded platform. Archetypical categories may therefore conceal hybrid configurations that combine product logic with platform coordination. Consistent with Lambert and Davidson (2013), who argue that business models reflect ecosystem positioning, the analysis shows that 9292's sustainability cannot be explained solely through its digital product. Branding, institutional legitimacy, and long-standing relationships are structurally embedded in the business model and shape how value is created and captured across sides.
Addressing Micheli's (2023) concern about ODI sustainability, the findings suggest that hybrid configurations, combining open -data services with sectoral funding and complementary revenue streams, can constitute a viable model. At the same time, the case raises the question whether such sustainability depends on continued sectoral support, and to what extent the model could remain viable under purely market-based conditions.

Finally, the SWOT analysis underscores the importance of regulatory conditions. Regulation both enables open data availability and constrains monetization strategies, shaping how value can be captured in practice. Ambitions to expand the planner across all transport modes reinforce cross-side network effects, whereby increased user adoption enhances the platform's attractiveness for operators. Such dynamics are characteristic of MSPs but are not explicitly addressed in the current framework.

Taken together, the findings indicate that in regulated open-data environments, competition extends beyond technical reuse and integration to encompass institutional embeddedness, relational capital, and the capacity to maintain trust-based legitimacy within the ecosystem. Open data reshapes, but does not eliminate, competitive dynamics. While the existing ODI framework provides a useful foundation, engagement with multi-sided platform theory may allow for a more precise differentiation between product-oriented intermediaries and relationally embedded platforms within open data ecosystems.

7 Conclusion

This study addressed the following research question: *How does 9292, as an open data intermediary characterized as an interactive app without complementary products, fit within and extend the business-model framework of open data intermediaries?*

With respect to value proposition, the findings show that 9292 operates in a structurally two-sided manner. For travellers, it offers accessible, reliable travel advice supported by accountability mechanisms and brand-based trust. For public transport operators, it provides large-scale reach, coordinated visibility, and alignment with public information obligations. The value proposition is therefore not limited to end-user functionality but extends to ecosystem positioning and exposure for operators.

In terms of value creation, the core technical activity lies in ensuring high data quality and reliable integration of static and real-time transport information. However, the results demonstrate that this process is sustained through relational capital: ongoing coordination with operators regarding data accuracy and compliance, combined with user feedback that reinforces accountability. Value creation thus emerges not only from technical integration but from the management of relationships.

Regarding value capture, revenue is generated primarily through financial contributions from transport operators and complementary service offerings. This emphasizes a structural dependence on operators and reflects a cross-side compensation mechanism rather than a single-sided monetisation model based on end users.

Taken together, 9292 cannot be understood merely as a single-purpose interactive app. It also functions as a multi-sided platform that co-creates value with transport operators while maintaining accountability towards travellers. It actively maintains its relationships with transport operators. While it formally aligns with the interactive app archetype, its business model is defined by relational coordination, operator dependence, and institutional embeddedness.

Regulatory and institutional conditions decisively shape these dynamics. Open data availability is closely tied to concession structures and public oversight, which remove competition at the data-gatekeeping level while shifting differentiation to reuse and service integration. At the same time, 9292's historical positioning within the Dutch public transport system has contributed to accumulated legitimacy and long-standing sector relationships. Sustainability therefore rests not only on financial arrangements, but also on institutional and relational embeddedness.

Taken together, the case shows that although 9292 formally aligns with the interactive app archetype, it functions more accurately as a multi-sided, platform. The study thus extends the ODI framework by demonstrating that interactive open-data applications may exhibit hybrid characteristics in which branding, relational alignment, data provider dependence, and institutional positioning are as decisive as technical data reuse. By displacing exclusive data control as the primary source of advantage, open data fundamentally reconfigures competition, elevating performance, relational trust, and sustained ecosystem coordination as the new foundations of competitive strength.

7.1 Societal Relevance and Contribution

From a practical perspective, this study provides insights for policymakers and open data intermediaries (ODIs) concerned with long-term sustainability. As Micheli (2023) notes, viable business models remain a key challenge for ODIs. The findings indicate that hybrid configurations, combining operator funding, advertising revenue, and complementary services, can support sustainability without restricting data access. At the same time, the opening of public transport data has expanded consumer choice by enabling multiple travel-planning alternatives to enter the market. For policymakers, this suggests that open data ecosystems require governance arrangements that balance competition and innovation with institutional stability, rather than relying solely on market forces.

For ODIs, the case demonstrates that sustainability extends beyond technical data reuse. Branding, accountability, relational trust, and institutional alignment emerge as critical enabling conditions within regulated ecosystems. Sustainable operation, therefore, depends not only on application quality but also on ecosystem positioning and institutional embeddedness
.

7.2 Limitations & Further research

This study is subject to several limitations. First, the analysis is based on a single qualitative case study within the Dutch public transport context. While this allows for in-depth exploration, the findings cannot be generalised to all open data intermediaries or regulatory environments. Second, the study relies primarily on interviews and document analysis; access to detailed financial data or internal strategic documentation was limited. As a result, conclusions regarding sustainability mechanisms are based on reported practices rather than quantitative performance indicators. Finally, the regulatory and institutional context of the Netherlands is relatively cohesive and structured. ODIs operating in less regulated or more fragmented ecosystems may face different competitive dynamics and funding conditions.

7.2.1 Further research

To further advance understanding of ODI sustainability and the added value of open data, future research could more explicitly integrate multi-sided market logics into the analysis of ODI business models. In particular, examining accountability mechanisms, relational capital, and branding as structural components of value proposition. This may deepen insight into how ODIs generate and sustain advantage beyond technical data reuse. Such work could enhance theoretical understanding of competitiveness in regulated open-data ecosystems and inform the design of more resilient and sustainable intermediary models, ultimately contributing to the realization of open data's full potential. Future research could also further explore the hybrid positioning of ODIs, which may operate at the intersection of commercial logics and societal value creation, raising questions about how to balance public value, legitimacy, and financial sustainability in practice.

Literature

9292 (2025a), Mediakit. Retrieved November 13 from https://a.storyblok.com/f/184054/x/78d59b6193/mediakit-adverteren-9292.pdf

9292. (2025b). *Reisadvies API additional documentation: License agreement*. https://a.storyblok.com/f/184054/x/859b6292fa/en-reisadvies-api-additional-documentation-20250523.pdf.

9292. (n.d.)(a). *This is 9292* [Web page]. Retrieved November 13, 2025, from https://www.9292.nl/en/about-9292/this-is-9292/

9292 (n.d.)(b). *Your timetable in the 9292 planner*. Retrieved November 14, 2025, from https://9292.nl/en/sales-and-business/timetables-in-the-9292-planner/

9292 OV. (2000). 9292ov.nl [Archived webpage]. Internet Archive Wayback Machine. https://web.archive.org/web/20001018090833if_/http://www.9292ov.nl:80/

9292 OV. (2002). *Tien jaar in vogelvlucht*. https://web.archive.org/web/20050302190137/http:/www.9292ov.nl/ovr_files/pdf/Tien%20jaar%20in%20vogelvlucht.pdf

9292 OV. (2005, March 7). *Title unknown*. Retrieved November 14, 2025, from https://web.archive.org/web/20050307072910/http://www.9292ov.nl/9292ov528.asp

9292 OV. (2005, March 6). *Title Unknown*. Retrieved November 14, 2025, from https://web.archive.org/web/20050306131318/http://www.9292ov.nl/9292ov572.asp

9292 (2014). *Beschrijving GTFS 9292, versie 1.1.0*. 9292 ReisinformatieGroep. https://reisinformatiegroep.nl/ndovloket/Data/DownloadDocumentation/32

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management, 43*(1), 39–58. https://doi.org/10.1177/0149206316678451

Al-Debei, M. M. & Avison, D. (2010). Developing a unified framework of the business model concept, European Journal of Information Systems, 19:3, 359-376. https://dx.doi.org/10.1057/ejis.2010.21

Amit, R., & Zott, C. (2001). Value creation in e-business. Strategic management journal, 22(6-7), 493-520. https://doi.org/10.1002/smj.187

Androidworld. (2019). App van de week: 9292 is vandaag jarig en wordt 31 jaar. https://androidworld.nl/apps/app-van-de-week-9292-is-vandaag-jarig-en-wordt-31-jaar/

Audit Business Case NDO V. (2010, March). *Business case NDO V: Context; historie* (pp. 1–73). Dutch Ministry of Infrastructure and Water Management. https://zoek.officielebekendmakingen.nl/blg-69857.pdf

Barney, J. (1991) “Firm Resources and Sustained Competitive Advantage.” Journal of Management 17, no. 1: 99–120. https://doi.org/10.1177/014920639101700108

Besluit personenvervoer 2000, Chapter 1, Paragraph 3 (in force from 01-07-2025 to present). (2025). Government of the Netherlands. Retrieved November 14, 2025, via Internet Archive file upload from https://wetten.overheid.nl/BWBR0011982/2025-07-01/0

BISON. (2020). *TMI8 actuele ritpunctualiteit en voertuiginformatie (koppelvlak 6), versie 8.1.3.1*. Platform Beheer Informatie Standaarden OV Nederland. https://reisinformatiegroep.nl/ndovloket/Data/DownloadDocumentation/15

BISON. (2021). NL NeTEx profile specificatie. Platform Beheer Informatie Standaarden OV Nederland. https://reisinformatiegroep.nl/ndovloket/Data/DownloadDocumentation/23

BISON. (2022). *Centraal Halte Bestand (CHB) specificatie*. Platform Beheer Informatie Standaarden OV Nederland. https://reisinformatiegroep.nl/ndovloket/Data/DownloadDocumentation/8

Boardman, A. E., & Vining, A. R. (2012). The political economy of public-private partnerships and analysis of their social value. *Annals of public and cooperative economics*, *83*(2), 117-141.. https://doi.org/10.1111/j.1467-8292.2011.00452.x

Bostoen, F. (2019). Online platforms and pricing: Adapting abuse of dominance assessments to the economic reality of free products. Computer Law & Security Review, 35(3), 263-280. https://doi.org/10.1016/j.clsr.2019.02.004

Carrese, F., Carrese, S., Patella, S. M., Petrelli, M., & Sportiello, S. (2021). A framework for dynamic advanced traveler information systems. Future Transportation, 1(3), 590–600. https://doi.org/10.3390/futuretransp1030031

Coriat, B., Quels Modèles Économiques Pour Les Communs ? Le Cas Des Plateformes Substantives Programmes de Recherche TAPAS et EnCommuns WP EnCommuns N° 41, 2021.https://doi.org/10.13140/RG.2.2.14345.57449

David, P. A. (2007). *Path dependence: A foundational concept for historical social science. Cliometrica, 1*(2), 91–114. https://doi.org/10.1007/s11698-006-0005-x

DaSilva, C. M., & Trkman, P. (2014). Business model: What it is and what it is not. Long Range Planning, 47(6), 379–389. https://doi.org/10.1016/j.lrp.2013.08.004

Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information. Official Journal of the European Union, L 172, 26 June 2019, 56–83. https://eur-lex.europa.eu/eli/dir/2019/1024/oj

Dove, G., Shanley, J., Matuk, C., & Nov, O. (2023). Open data intermediaries: Motivations, barriers and facilitators to engagement. Proceedings of the ACM on Human-Computer Interaction, 7(CSCW1), 1-22. https://doi.org/10.1145/3579511

Dubois, A., & Gadde, L.-E. (2002). Systematic combining: An abductive approach to case research. Journal of Business Research, 55(7), 553–560. https://doi.org/10.1016/S0148-2963(00)00195-8

European Commission. (n.d.). *What is open data*. data.europa.eu. Retrieved October 2025, from https://data.europa.eu/en/dataeuropa-academy/what-open-data

Eisenhardt, K. M., and C. B. Schoonhoven. (1996) "Resource-Based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms." Organization Science 7, no. 2: 136–150. https:// doi.org/10.1287/orsc.7.2.136.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal, 21*(10–11)Eisen, 1105–1121. https://www.jstor.org/stable/i355661

Filistrucchi, L. (2018). Market definition in multi-sided markets. In Rethinking antitrust tools for multi-sided platforms (pp. 37-55). OECD. https://one.oecd.org/document/DAF/COMP/WD(2017)27/FINAL/en/pdf

Germano, E. C., Souza, C. A. de, & Sun, V. (2016). Business models adopted by intermediaries in the use of open government data. REBRAE, 9(1), Article 1. https://doi.org/10.7213/rebrae.09.001.AO05

Gustafsson, J. (2017). Single case studies vs. multiple case studies: A comparative study. *Academy of Business, Engineering and Science, Halmstad University*, 1–15. https://www.diva-portal.org/smash/get/diva2:1064378/FULLTEXT01.pdf

Hammersley, M., Gomm, R., & Foster, P. (2009). Case study and theory. In R. Gomm, M. Hammersley, & P. Foster (Eds.), Case study method (pp. 234–259). Sage. https://doi.org/10.4135/9780857024367.d17

Heppe, L., & Liebig, T. (2017, September). Real-time public transport delay prediction for situation-aware routing. In *Joint German/Austrian Conference on Artificial Intelligence*.(Künstliche Intelligenz) (pp. 128-141). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-319-67190-1_10

Hill, C., Young, M., Blainey, S., Cavazzi, S., Emberson, C., & Sadler, J. (2024). An integrated geospatial data model for active travel infrastructure. *Journal of Transport Geography*, *117*, 103889. https://doi.org/10.1016/j.jtrangeo.2024.103889

Jetzek, T. (2015). The sustainable value of open government data: Uncovering the generative mechanisms of open data through a mixed methods approach [Doctoral thesis]. Copenhagen Business School. https://research.cbs.dk/da/publications/the-sustainable-value-of-open-government-data-uncovering-the-gene/

Jetzek, T., Avital, M., & Bjorn-Andersen, N. (2019). The Sustainable Value of Open Government Data. Journal of the Association for Information Systems, 20(6). https://doi.org/10.17705/1jais.00549

Janssen, M., & Zuiderwijk, A. (2014). Infomediary business models for connecting open data providers and users. Social Science Computer Review, 32(5), 694-711. https://doi.org/10.1177/0894439314525902

Johnson, P. A., Sieber, R., Scassa, T., Stephens, M., Robinson, P. (2017). The Cost(s) of Geospatial Open Data. Transactions in GIS 21(3): 434–445. https://doi.org/10.1111/tgis.12283

Kauffman, R. J., Li, T., & van Heck, E. (2010). Business network-based value creation in electronic commerce. *International Journal of Electronic Commerce, 15*(1), 113–144. https://doi.org/10.2753/JEC1086-4415150105

Bailey, K. D. (1994). Typologies and taxonomies: An introduction to classification techniques (Vol. 12). Sage. https://www.researchgate.net/profile/Costas_Drossos/post/What_is_the_difference_between_a_typology_and_a_taxonomy/attachment/59d63753c49f478072ea4bf1/AS%3A273684877512704%401442262968252/download/%5BKenneth_D._Bailey%5D_Typologies_and_Taxonomies_An_Introduction_to_Classification_Techniques.pdf

Lambert, S. C., & Davidson, R. A. (2013). Applications of the business model in studies of enterprise success, innovation and classification: An analysis of empirical research from 1996 to 2010. European management journal, 31(6), 668-681.https://doi.org/10.1016/j.emj.2012.07.007

Leppänen, P., George, G., & Alexy, O. (2023). Business model design: A review and research agenda. *Journal of Management, 49*(1), 300–333. Via: https://digitalcommons.sacredheart.edu/cgi/viewcontent.cgi?article=1406&context=neje

Løkke, A. K., & Sørensen, P. D. (2014). Theory testing using case studies. *Electronic journal of business research methods*, *12*(1), pp66-74. https://academic-publishing.org/index.php/ejbrm/article/view/1315

Lorenz, S., Heigl, B., Palmié, M., & Oghazi, P. (2024). From business models for public actors to public service provision models: Extending the business model concept to the public sector. *Technological Forecasting and Social Change*, *201*, 123273. https://doi.org/10.1016/j.techfore.2024.123273

Magalhaes, G., & Roseira, C. (2020). Open government data and the private sector: An empirical view on business models and value creation. Government Information Quarterly, 37(3), 1–10. https://doi.org/10.1016/j.giq.2017.08.004

Meijer, R. (2014). *Understanding the dynamics of open data: From economic value to societal benefit* (pp. 1–23). In *Open Data in Public Transportation*. Utrecht University. https://dspace.library.uu.nl/bitstream/handle/1874/414396/Meijer2014_Chapter_UnderstandingTheDynamicsOfOpen.pdf

Micheli, M., Farrell, E., Carballa-Smichowski, B., Posada-Sánchez, M., Signorelli, S. *et al.*, Mapping the landscape of data intermediaries – Emerging models for more inclusive data governance, Publications Office of the European Union, 2023. https://data.europa.eu/doi/10.2760/261724

Mobiliteit.nl. (2016, January 15). Flinke groei van aantal reisadviezen 9292 in 2015. https://www.mobiliteit.nl/ov/2016/01/15/flinke-groei-van-aantal-reisadviezen-9292-in-2015/

Mobiliteit.nl. (2024, January 29). Andere reisplanner-apps kunnen niet op tegen dominantie 9292 en NS. https://www.mobiliteit.nl/ov/2024/01/29/andere-reisplanner-apps-kunnen-niet-op-tegen-dominantie-9292-en-ns/

NS. (2016). *Publicatiedocument NDOV NS-Treinposities*. NS Reizigers. https://reisinformatiegroep.nl/ndovloket/Data/DownloadDocumentation/21

NS Reizigers. (2025). Publicatiedocument IFF Standaard (versie 2.1). NDOV Loket. https://reisinformatiegroep.nl/ndovloket/Data/DownloadDocumentation/2

NS Community. (3 July, 2024). *Verschil 9292* [Forum discussion]. NS Community. Retrieved November 14, 2025, from https://community.ns.nl/de-ns-reisplanner-58/verschil-9292-86399

Ochoa-Ortiz, H., & Re, B. (2025). Exploring why and how commercial organizations contribute to OpenStreetMap. Annals of GIS, 31(2), 221–232. https://doi.org/10.1080/19475683.2025.2457396

Oliveira, M. I. S., and B. F. Lóscio. 2018. "What Is a Data Ecosystem?." Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age, 1–9. https://doi.org/10.1145/3209281.3209335

Osterwalder, A., & Pigneur, Y. (2010). Business model generation: A handbook for visionaries, game changers, and challengers. Hoboken, NJ: John Wiley & Sons.

Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. Communications of the Association for Information Systems, 16(1), 1–25. https://doi.org/10.17705/1CAIS.01601

Perić, M., Vitezić, V., & Đurkin, J. (2017). Business model concept: An integrative framework proposal. Managing Global Transitions, 15(3), 255-274. https://doi.org/10.26493/1854-6935.15.255-274

REISinformatiegroep B.V. (2013, July 12). *9292 open data licence agreement (SLA)*. Internet Archive: Wayback Machine. Retrieved from https://web.archive.org/web/20130712043429/http://9292opendata.org/sla

REISinformatiegroep B.V. (2013). Jaarverslag 2012. https://a.storyblok.com/f/184054/x/8d7c1ed0a7/jaarverslag-reisinformatiegroep-bv-2012.pdf

Reisinformatiegroep B.V. (2025). Jaarrekening 2024. https://a.storyblok.com/f/184054/x/fd2b51ccd9/jaarverslag-reisinformatiegroep-bv-2024.pdf

REISinformatiegroep. (n.d.). *OV Data site – ND-OV loket*. Retrieved November 14, 2025, from https://reisinformatiegroep.nl/ndovloket/

Rochet, J.-C., & Tirole, J. (2003). Platform competition in two-sided markets. Journal of the European Economic Association, 1(4), 990–1029. https://doi.org/10.1162/154247603322493212

Rowley, J. (2007). The wisdom hierarchy: Representations of the DIKW hierarchy. *Journal of Information Science, 33*(2), 163–180. https://doi.org/10.1177/0165551506070706

Ruijer, E., Grimmelikhuijsen, S., & Meijer, A. (2017). Open data for democracy: Developing a theoretical framework for open government data use. Government Information Quarterly, 34(1), 45–52. https://doi.org/10.1016/j.giq.2017.01.001

Scupola, A., & Mergel, I. (2022). Co-production in digital transformation of public administration and public value creation: The case of Denmark. *Government Information Quarterly, 39*(1), 101650. https://doi.org/10.1016/j.giq.2021.101650

Scott, W. R. (2014). Institutions and organizations: Ideas, interests, and identities (4th ed.). Sage Publications. DOI:10.22439/cjas.v32i2.4764

Seddon, P. B. (2014). Implications for strategic IS research of the resource-based theory of the firm: A reflection. The Journal of Strategic Information Systems, 23(4), 257-269. https://doi-org/10.1016/j.jsis.2014.11.001

Shaharudin, A., van Loenen, B., & Janssen, M. (2024). Exploring the contributions of open data intermediaries for a sustainable open data ecosystem. Data & Policy, 6, e56. https://doi.org/10.1017/dap.2024.63

Shaharudin, A., van Loenen, B., & Janssen, M. (*in press*). Business model archetypes of open data intermediaries: Empirical insights from practice. *Electronic Markets*. [Accepted]

Shaharudin, M. F., Van Loenen, B., & Janssen, M. (2025a). Developing an open data intermediation business model: Insights from the case of Esri. Transactions in GIS, 29(2), 345–366. https://doi.org/10.1111/tgis.13304

Shaner, J. (2015, 10 Aug). Using GNSS receivers with Collector for ArcGIS. ArcGIS Blog. https://www.esri.com/arcgis-blog/products/field-mobility/field-mobility/using-gnss-receivers-with-collector-for-arcgis#:~:text=Most%20cellular%2D%20enabled%20iOS%20and,time%20Kinematic%20system%20(R

TK).&text=Understanding%20how%20Collector%20for%20ArcGIS,be%20provided%20in%20this%20system.

Snihur, Y., & Markman, G. (2023). Business Model Research: Past, Present, and Future. Journal of Management Studies, 60(8), e1–e14. https://doi.org/10.1111/joms.12928

Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review, 20*(3), 571–610. https://doi.org/10.5465/amr.1995.9508080331

Spieth, P., Roeth, T., Schneckenberg, D., & Matzler, K. (2019). Value drivers of social businesses: A business model perspective. *Long Range Planning, 52*(3), 427–444. https://doi.org/10.1016/j.lrp.2018.04.004

Taherdoost, H. (2022). How to conduct an effective interview: A guide to interview design in research study. International Journal of Academic Research in Management, 11(1), 39–51. https://hal.science/hal-03741838v1

Teece, D. J. (2010). Business Models, Business Strategy and Innovation. Long Range Planning, 43(2), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

Temiz, S, Holgersson, M, Björkdahl, J & Wallin, M. W. (2022). Open data: lost opportunity or unrealized potential? Technovation 114, 102535. https://doi.org/10.1016/j.technovation.2022.102535

Usman, M., Britto, R., Börstler, J., & Mendes, E. (2017). Taxonomies in software engineering: A systematic mapping study and a revised taxonomy development method. *Information and Software Technology*, *85*, 43-59. https://10.1016/j.infsof.2017.01.006

van Loenen, B. (2018). Towards a User-Oriented Open Data Strategy. In: van Loenen, B., Vancauwenberghe, G., Crompvoets, J. (eds) Open Data Exposed. Information Technology and Law Series, vol 30. T.M.C. Asser Press, The Hague. DOI: https://doi.org/10.1007/978-94-6265-261-3_3

van Loenen, B., Zuiderwijk, A., Vancauwenberghe, G., Lopez-Pellicer, F. J., Mulder, I., Alexopoulos, C., Magnussen, R., Saddiqa, M., Dulong de Rosnay, M., Crompvoets, J., Polini, A., Re, B., Casiano Flores, C. (2021). Towards value-creating and sustainable open data ecosystems: A comparative case study and a research agenda. JeDEM - EJournal of EDemocracy and Open Government 13(2): 1–27. https://doi.org/10.29379/jedem.v13i2.644

van Veenstra, A. F., & van den Broek, T. (2015). A Community-driven Open Data Lifecycle Model Based on Literature and Practice. In I. Boughzala, M. Janssen, & S. Assar (Eds.), Case Studies in e-Government 2.0: Changing Citizen Relationships (pp. 183–198). Springer International Publishing. https://doi.org/10.1007/978-3-319-08081-9_11

van Veenstra, A. F., & van den Broek, T. A. (2013). Opening Moves – Drivers, Enablers and Barriers of Open Data in a Semi-public Organization. In M. A. Wimmer, M. Janssen, & H. J. Scholl (Eds.), Electronic Government (pp. 50–61). Springer. https://doi.org/10.1007/978-3-642-40358-3_5

van Schalkwyk, F., Cañares, M., Chattapadhyay, S., & Andrason, A. (2016). *Open data intermediaries in developing countries. The Journal of Community Informatics, 12*(2), 1–23. https://doi.org/10.15353/joci.v12i2.321

Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T., Kundisch, D., Leimeister, J. M., Loos, P., & Spann, M. (2014). Business Models. Business & Information Systems Engineering, 6(1), 45–53. https://doi.org/10.1007/s12599-013-0308-y

Verhulst, S. G., Young, A., Zahuranec, A. J., Calderon, A., Gee, M., & Aaronson, S. A. (2020, October 28). The emergence of a Third Wave of Open Data: How to accelerate the re-use of data for public interest purposes while ensuring data rights and community flourishing. SSRN. https://dx.doi.org/10.2139/ssrn.3937638

Visser, F. (2024). Reisadvies op maat: ROVER reisplanner test (pp. 1–77). Reizigersvereniging ROVER. Via: https://www.rover.nl/images/PDFs/20240118_Reisadvies_op_maat_-_Rover_Reisplannertest_-_def.pdf

Visnjic, I., M. Jovanovic, A. Neely, and M. Engwall. 2017. "What Brings the Value to Outcome-Based Contract Providers? Value Drivers in Outcome Business Models." International Journal of Production Economics 192: 169–181. https://doi.org/10.1016/j.ijpe.2016.12.008.

Vredenborg, M., Graus, M., & Ferwerda, B. (2025). Personalization in public transport passenger information systems. ACM Computing Surveys, 57(9), Article 226. https://doi-org/10.1145/37214

Welch, C. (2000). The archaeology of business networks: the use of archival records in case study research. *Journal of Strategic Marketing*, *8*(2), 197-208. https://doi-org/10.1080/0965254X.2000.10815560

Wiener, M., Saunders, C., & Marabelli, M. (2020). Big-data business models: A critical literature review and multiperspective research framework. Journal of Information Technology, 35(1), 66–91. https://doi.org/10.1177/0268396219896811

Zhang, J., Arentze, T., & Timmermans, H. (2011). A multimodal transport network model for advanced traveler information systems. Journal of Ubiquitous Systems & Pervasive Networks, 4(1), 21–27. https://doi.org/10.5383/JUSPN.04.01.004

Yi, Y., Y. Chen, and D. Li. (2022). "Stakeholder Ties, Organizational Learning, and Business Model Innovation: A Business Ecosystem Perspective." Technovation 114: 1–13. https://doi.org/10.1016/j.technovation.2021.102445

Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications.

Appendix

Appendix table 1: interview for 9292 members

Dimension / Theoretical Lens	Concepts / Indicators	Operationalization (What to look for)	Interview Questions
Value Proposition	Type of main open-data-based product, Source of data, Product components, Other open-data-based product, Non-open-data-based product, Link of other product(s) to the main open-data-based product, Consumer segments, Offering.	Understand what 9292 offers to whom and how their stakeholders value from that.	• Could you describe the services or products that 9292 provides? • What groups benefits from your service? And how do they benefit? • How does 9292 gain from delivering these services? • What qualities are most important in what 9292 offers (e.g., accessibility, reliability, innovation)? • Besides end-users, do transport operators or data publishers also benefit directly from the work 9292 performs? If so, how?
Value Creation	Key processes and resources; Critical stage of the open-data lifecycle, Customer relationship.	Examine how value is produced and delivered through open data and partnerships	• Wat are the main activities for delivering 9292's services? •What are the main costs or efforts, whether financial, technical, or human, that are involved in delivering and maintaining 9292's services? • What kind of internal expertise or capabilities are crucial for delivering 9292 service?
Value Capture	Main revenue stream, Source of revenue	Understand how 9292 gets its revenue or funding.	• How does 9292 cover or sustain the resources required for its operations such as data, human resources, or technical expertise? • Which stakeholders contribute financially to 9292, and what motivates them to do so? • How does 9292 evaluate its success, for instance, through reliability, usage, or societal impact?

RBV & Dynamic Capabilities	Strategic assets (VRIN); adaptive capabilities; innovation capacity	Identify resources or capabilities that make 9292 resilient and adaptive	• What internal resources do you consider most important for 9292's success? These might include tangible assets like technology or staff, but also intangible ones such as knowledge, partnerships, or reputation.
Ecosystem & Network Perspective	Partnerships; interdependencies; coordination mechanisms; shared standards	Analyze 9292's position in a networked open-data ecosystem	• Who are the most important stakeholders in the ecosystem around 9292? • What benefits does 9292 bring to these partners, and what does it receive in return? • How does 9292 collaborate with individual transport operators? • Do any regulatory or governance bodies (e.g., Ministry of INews) influence your role or interactions? How? • How does adding a non-public-transport mode like e-scooters fit within 9292's traditional role as a public-transport information provider?
Multi-Sided Market Logic	Multiple stakeholder groups; cross-side value exchange; user–provider interactions	Explore value flows between travelers, operators, and institutional actors	•9292 connects travelers, transport operators, and other organizations. How do you see these groups benefiting from each other through the platform
Institutional & Legitimacy Theory	Historical embeddedness; trust; alignment with norms and policy frameworks	Examine institutional conditions that enable stability and credibility	•9292 has existed for more then 30 years, how do you think it's history play a role in its current position?
Public vs. Commercial Value Orientation	Societal vs. market goals; hybrid value creation; public impact	Assess how 9292 balances public-service aims with operational sustainability	• In your view, what type of value does 9292 mainly create: societal, commercial, or both? • How does 9292 balance creating societal value for the public with maintaining its own organizational sustainability and effectiveness?
Sustainability & Future Outlook	Risks, opportunities, lessons learned	Identify long-term viability conditions and innovation potential	• What developments or challenges do you expect will most affect 9292 in the near future? • What opportunities or innovations are most promising? • What lessons could other open-data initiatives learn from 9292's experience?