Stockholm School of Economics
Department of Management & Organization
Master Thesis 30 ECTS
Spring 2022

Driving the Change

A qualitative case study on how the adoption of a new technology can influence, enable and hinder companies' resource integration processes in a B2B context

Authors:
Simon Taillefer Dellenholt (41811) & Jamil Summaq (41805)

Supervisor:
Kaisa Koskela-Huotari, Department of Marketing and Strategy

Abstract

Service-dominant logic moves the focus from goods to service provision, suggesting that all value is co-created as actors engage in exchange. Although resource integration is central to service-dominant logic as it is necessary in order for actors to create value, more empirical research is needed on the topic. While there appears to be a general belief that companies always need to innovate and change, successful change initiatives require customer processes to be understood. This study researches resource integration in the fast-changing and nascent empirical context of hydrogen trucks, using an inductive, qualitative research approach with a multiple case study design. Semi-structured interviews were conducted to discover how the adoption of a new technology can influence, enable or hinder beneficiaries' resource integration processes. This study bridges theory with practice, something that has been much needed within the field of resource integration. The findings and analysis reveal that the adoption of a new technology influences beneficiaries' resource integration processes in several ways, showing that actors' roles were redefined, changing the ecosystem constellation and relational ties. Furthermore, other resources in the ecosystem were identified to be crucial for beneficiaries' resource integration processes. In some instances, routines were shown to be sticky, operant resources demonstrated a general resistance to change and there was a mismatch between knowledge and skills. These aspects hindered resource integration. The technical specifications of the new truck showed to be enabling resource integration. Several practical implications were also identified, enabling companies to co-create more value as this study has demonstrated empirical customer insights and the identification of key resources in the hydrogen truck ecosystem.

Keywords: resource integration, service-dominant logic, hydrogen, heavy trucks

Acknowledgments

First, we would like to start by thanking our supervisor Kaisa Koskela-Huotari for her advice and support. She brought our discussions forward many times with her great knowledge, and she also introduced us to the topic of resource integration which was unexplored territory for us. We also believe that we have had lots of fun together!

Second, Anna Douglas. Thank you for opening our eyes about a highly relevant and fast-moving industry that has sparked a great personal interest. We have for sure had lots of fun too at Sjökringlan, laughing over not so good food.

Third, we would like to thank the interviewees who came from all across the world and went to great lengths to help this study, inspire our study's title and most importantly infect us with their "big smile" that we promised to add in the acknowledgement section. We have gotten a spectacular opportunity to meet all of you and learn from your immense experience in the field. You have given us new perspectives and insights into the sustainable transport industry, something that we are very thankful for.

Finally, thank you friends, family, and cheap takeout restaurants for supporting us during long days and nights the last two years. See you in the real world!

Stockholm, May 2022
Simon Taillefer Dellenholt and Jamil Summaq

Glossary

Service-Dominant Logic: A marketing logic introduced by Vargo and Lusch, suggesting that service provision is the center of economic exchange. Service-dominant logic is an evolution of goods-dominant logic, as it focuses on value co-creation, intangible resources and relationships (Vargo & Lusch, 2004).

Goods-Dominant Logic: A marketing logic common before service-dominant logic. Goods-dominant logic suggests that goods are the center of economic exchange, focusing on embedded value, transactions and tangible resources (Vargo & Lusch, 2004).

Resource Integration: A central part of the service-dominant logic, which argues that all social and economic actors are resource integrators (Vargo & Lusch, 2008) who integrate resources in order to create value (Kleinaltenkamp et al., 2012).

Operand Resources: The first of two types of resources according to the service-dominant logic. Operand resources are often physical, such as goods and raw materials, and need to be acted upon in order for value to be created (Vargo & Lusch, 2004).

Operant Resources: The second of two types of resources according to the service-dominant logic. Operant resources are often intangible, such as knowledge and skills, act upon other resources and can contribute to value creation (Vargo & Lusch, 2004).

FCEV: Fuel cell electric vehicles are electric vehicles equipped with fuel cells that are fueled with hydrogen.

BEV: Battery electric vehicles are electric vehicles equipped with batteries that are charged with electricity.

Table of Contents

1. Introduction

Since Vargo and Lusch (2004) first introduced *service-dominant (S-D) logic*, much has been uncovered. S-D logic has developed to become central to the academic field of marketing, as researchers continue to iterate on the theory and shift it towards new directions (Vargo & Lusch, 2016). Furthermore, S-D logic has been popularized in more practical contexts such as for companies in the transport industry, where incumbents have become increasingly service-centered (Schulz et al., 2021).

S-D logic challenges the traditional goods-dominant (G-D) logic, moving the focus from goods to service provision and thereby from embedded value, transactions, and tangible goods to relationships, value co-creation and intangible resources (Vargo & Lusch, 2004). The idea that value is created by companies and destroyed by customers is disagreed upon by S-D logic, instead suggesting that all value is co-created as actors (such as companies and customers) engage in exchange. Since all actors are service providers, boundaries previously separating customers from companies dissolve. S-D logic proposes a systems-oriented view which considers all actors to be networked, engaging in multiple constellations (Vargo & Lusch, 2011).

According to S-D logic, there are two types of resources: *operand* and *operant*. Differentiating the two types of resources is necessary to understand value co-creation. First, operand resources need to be acted upon in order to be valuable, and often take a physical form such as goods or raw materials. Second, operant resources are able to act upon other resources, both operand and operant, and can contribute to value creation. Operant resources include knowledge and skills (Madhavaram & Hunt, 2008; Vargo & Lusch, 2004), and create main strategic benefits for actors (Vargo & Lusch, 2008).

Integrating resources is necessary for actors to co-create value (Kleinaltenkamp et al., 2012). The idea of *resource integration* has been discussed long before S-D logic existed (Peters et al., 2014), but since S-D logic argues that all social and economic actors are resource integrators (Vargo & Lusch, 2008), resource integration has become central to the logic and the concept of value co-creation in particular. Findsrud et al. (2018) argue that even though many researchers have tried defining resource integration, consensus regarding its definition remains lacking. Therefore, the

same authors performed an extensive literature review, and propose that resource integration is an empirical phenomenon consisting of three elements. First, resource integration requires competence, that is, knowledge and skills. Second, resource integration requires activity. Third, the outcome of resource integration is value co-creation. Furthermore, Vargo and Lusch (2011) argue that resource integration is contextual because the value of a company's services and offerings are dependent on its customers' access to other resources, their capabilities of integrating them, and the removal of barriers to utilize them.

1.1 Problematization

The number of studies trying to define and conceptualize resource integration are still relatively few (Findsrud et al., 2018). To improve the understanding of resource integration, more research and empirical studies need to be conducted (Akaka et al., 2012; Findsrud et al., 2018). This goes in line with Vargo and Lusch (2017) who argue that studies of S-D logic have so far been abstract and that there is a need for evidence-based research to take on a more prominent role in future research. Furthermore, Simeoni and Cassia (2019) suggest that researchers should develop a more practical S-D logic framework. As resource integration studies have previously mainly explored established service ecosystems, Schulz et al. (2021) propose that nascent service ecosystems need to be explored.

The electrification of the heavy-duty trucks industry and the adoption of hydrogen trucks makes for an interesting empirical context to be analyzed from a resource integration perspective, as it represents a fast-changing, nascent ecosystem. Trafikverket (2018) explains that there has been an increase in regulations and demand for a fossil free future and reduced carbon footprint, which have led to manufacturers developing new technologies such as *battery electric vehicles (BEVs)* and *fuel cell electric vehicles (FCEVs)*. As the market for electric vehicles is expected to grow from USD 1.15 billion in 2020 to 14.19 billion in 2027 (Grand View Research, 2020), vehicle manufacturers are fiercely competing to reach their goals. For example, Scania (2021) predicts that its total vehicle sales volume will consist of 10% EV in Europe by year 2025, and 50% EV by 2030. Volvo Group (2021) expects that their vehicle sales will consist of a minimum 35% EV by 2030. Drawing on a parallel in an empirical resource integration study, Nosi et al. (2017) show that technology, which in their case represents electric vehicles, can result in barriers to resource

integration. Therefore, it would be interesting to analyze the context of hydrogen trucks as it would increase knowledge about how the adoption of a new technology can hinder resource integration.

Considering companies' ambitious goals, the availability of energy infrastructure in Europe for electric vehicles is insufficient (Osieczko et al., 2021). Therefore, as Alp et al. (2019) suggest, early adopters must take on an increasingly active role as they buy electric vehicles and may need to invest in their own energy production and infrastructure, a phenomenon which can already be identified today (Colruyt Group, 2020; Transportnytt, 2020). This relates to a previous empirical resource integration study by Koskela-Huotari et al. (2016), showing that ecosystem reconfigurations can redefine both new and existing actors' roles with an empirical case where passive customers have become more active.

Although it has been somewhat taken for granted that one of companies' main goals is to continuously innovate new products and services in order to prosper, most companies' change initiatives fail (Tohidi & Jabbari, 2012; Beer & Nohria, 2000). The large share of failures could potentially be attributed to the lack of knowledge on navigating change initiatives. Changes in *business-to-business (B2B)* situations are especially complex, where stakeholder constellations are heterogeneous, actors have different goals and challenges such as meeting sustainability demands are making change initiatives more difficult (Lievens & Blazevic, 2021). Following the electric vehicle development, it becomes crucial for *original equipment manufacturers (OEMs)* such as Scania and Volvo Group to understand the multitude of resources which have to be integrated, and what enablers and hindrances exist to doing so. Companies need to be knowledgeable about stakeholder processes as their products and services are intertwined in stakeholders' value creation and resource integration processes. A company that does not properly understand the customer processes and resources that need to come together may lose customers, because the beneficiary of a service always determines its value (Vargo & Lusch, 2008).

By conducting this study, the generated knowledge can guide companies to co-create more value, since studying service ecosystems and their reconfiguration suggestively helps companies facilitate accessibility, adaptability and integrability of resources (Akaka et al., 2012) and a

company can improve value co-creation by solving its customers' problems to integrate resources (Simeoni & Cassia, 2019).

1.2 Purpose and Research Questions

The purpose of this study is to develop the understanding of S-D logic, and resource integration in particular, by empirically studying how a new technology can influence, enable or hinder resource integration in a B2B context. Furthermore, this study aims to generate practical implications for beneficiaries to act on and enable more value creation by discovering critical information of changing customer processes.

Based on the purpose of this study, the following two research questions have been formulated:

1. *How does the adoption of a new technology influence beneficiaries' resource integration processes in a B2B context?*
2. *What enables or hinders beneficiaries from changing their resource integration processes in a B2B context?*

1.3 Contribution and Scope

This study will contribute both theoretically and practically by improving understanding in several aspects. First, it will contribute to the research field of resource integration, bridging theory and practice with evidence-based research which is currently much needed in this field. Second, practical implications will be generated based on insights, aiming to improve company practices and increase value co-creation. Third, this study will suggest new areas for future research to look into.

The scope will be limited to studying beneficiaries who have adopted hydrogen trucks and used them in operation, as they are required to be able to compare experiences of the new technology to the previous one. Furthermore, only customers operating in developed countries where hydrogen trucks have already started to be available in an early phase will be studied. This requirement is necessary to ensure that the customers have had relatively similar conditions for deployment and operation of the trucks, in turn allowing for more accurate comparison.

2. Theory

In the following chapter, a literature review of S-D logic is presented (2.1), introducing the logic's core concepts, showing how the metatheoretical framework was conceived, how it has developed during recent years and what current academic discussions can be observed (2.1.1, 2.1.2 and 2.1.3). Following, the scope of the literature review is narrowed down to focus more specifically on resource integration (2.1.4). The research gap is then established (2.2) and a theoretical framework is introduced to summarize this chapter's discussions (2.3).

2.1 Service-Dominant Logic

2.1.1 Introduction

Vargo and Lusch first introduced S-D logic to the field of marketing in 2004, presenting an alternative to the more traditionally prominent G-D logic which revolved around the exchange of goods and focused on embedded value, transactions and tangible goods. S-D logic differs from G-D logic as it suggests that service provision is fundamental for exchange, and emphasizes relations, value co-creation and intangible resources (Vargo & Lusch, 2004). Simply put, *"it is all about service"* (Vargo & Lusch, 2011, p.181). Since its introduction, S-D logic has become a central theoretical framework for many researchers who have continued to develop it with new insights, moving it into multiple directions as well as consolidating the logic to five axioms from its former 11 foundational premises (Vargo & Lusch, 2016). In addition to academics, transport industry incumbents have become increasingly service-centered, as they no longer restrict themselves to providing goods but to a larger extent services as well (Schulz et al., 2021).

2.1.2 Actors

S-D logic and G-D logic differ from each other in their views on actors (that is, companies, customers, etc.) and the role these actors play in value creation. On the one hand, G-D logic distinguishes companies from customers, arguing that companies produce and add value whereas customers consume and destroy value. In contrast, S-D logic suggests that all actors involved in exchange are service providers and value creators. Therefore, all exchanges should be regarded as B2B, or even actor-to-actor, broadening the understanding and application of marketing theory (Vargo & Lusch, 2004; Vargo & Lusch, 2008; Vargo & Lusch, 2011).

More recently, S-D logic has broadened its perspective further by taking on a systems-oriented view of value creation and considering all parts to be networked actors engaging in multiple constellations (Vargo & Lusch, 2011), highlighting that the theory has taken a significant turn (Vargo & Lusch, 2016). The aggregated actor relationships make up what Vargo and Lusch (2011) refer to as a service ecosystem, defined as *"a relatively self-contained, self-adjusting system of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange"* (Vargo & Lusch, 2018, p.16).

2.1.3 Resources

As goods shift from being the foundation of exchange in G-D logic to being mere distribution mechanisms for integrated knowledge and skills according to S-D logic (Vargo & Lusch, 2004; Vargo & Lusch, 2008), Vargo and Lusch (2004) propose a new distinction of resources. The authors suggest that there are two different types of resources; operand and operant. On the one hand, operand resources take a tangible, physical form and need to be acted on in order to become valuable. Operand resources can be goods, such as raw materials or trucks, and they have therefore been more central to G-D logic. On the other hand, operant resources are often intangible, either being human, organizational, informational or relational. First, examples of human operant resources are individuals' knowledge and skills. Second, examples of organizational operant resources are routines, competencies, cultures and controls. Third, examples of informational operant resources are knowledge about competitors, markets or technology. Fourth, examples of relational operant resources are relationships with other actors such as suppliers, customers or competitors. Operant resources are defined by their ability to act upon other resources, that is, either operand or operant, and that they can contribute to value creation (Madhavaram & Hunt, 2008; Vargo & Lusch, 2004). As operand resources were more central to G-D logic, operant resources have received more focus by S-D logic (Vargo & Lusch, 2004) as they, especially knowledge and skills, lay the ground for actors' main strategic benefits (Vargo & Lusch, 2008). Since S-D logic considers both companies and customers to be actors, both of these are to be regarded as operant resources.

2.1.4 Resource Integration

Resource integration is a central part of S-D logic. Although resource integration has been discussed long before the first research on S-D logic was published (Peters et al., 2014), it has more recently gained priority in shaping S-D logic. The very foundations of S-D logic have been updated, as every social and economic actor is seen as a resource integrator, and *"it is this unique application of uniquely integrated resources that motivates and constitutes exchange, both economic and otherwise"* (Vargo & Lusch, 2008, p.8-9). Therefore, resource integration is necessary for actors to co-create value (Kleinaltenkamp et al., 2012). Resource integration is also necessary for continuous creation of new service provisions, which are defined as *"the ongoing combination of resources, through integration, and their application, driven by operant resources — the activities of actors"* (Vargo & Lusch, 2011, p.184). When actors interact with each other and integrate resources to co-create value, the result is always temporary. Therefore, the process of resource integration is to be regarded as continuous (Akaka et al., 2012).

Findsrud et al. (2018) suggest that resource integration is generally seen as an empirical phenomenon, but that a specific definition of the phenomenon is yet to be agreed upon. Therefore, they have performed a significant search and review of previous research to compare definitions of resource integration, and highlight three characteristics that are prominent in previous attempts at defining the concept and that seems to be agreed upon. First, resource integration requires competence, that is, knowledge and skills. Second, resource integration requires activity, of which there are different levels. Activity nonetheless implies the combining of resources, by for example the application of resources, operation on resources, or incorporation of resources. Third, value co-creation is the outcome of resource integration. An analogy could be made of a human that is driving a car. The human has competencies that are necessary to drive and control a vehicle. The competencies are knowledge and skills, thus, operant resources. Combining these operant resources with an operand resource, in this case the car, and therefore activating the operand resource means that value can be created.

So far, it has been established that actors must integrate resources in order to create value. However, it is also helpful to understand where these resources come from. According to Vargo and Lusch (2011), potential resources to integrate can stem from several sources, either separately,

or most frequently, combined. They argue that there are three different types of sources: private, market-facing or public. First, private sources can include self or relatives. Second, market-facing sources can include sources enabled from economic exchange with other actors. Third, public sources can include open access to governmental sources.

Furthermore, since each value creation context and interaction is unique, the beneficiary of a service always subjectively determines the experiential value created (Vargo & Lusch, 2008). This implies that resource integration is contextual, which can be better understood by the following quote: *"the usefulness of any particular potential resource from one source is moderated by the availability of other potential resources from the other sources, the removal of resistances to resource utilization, and the beneficiary's ability to integrate them"* (Vargo & Lusch, 2011, p.184). Simply put, value co-creation is determined by the ability to access, adapt and integrate resources (Akaka et al., 2012). Simeoni and Cassia (2019) exemplifies this with a more practical approach from the perspective of a vehicle supplier, suggesting that companies can increase value creation by supporting their customers (the beneficiaries) to integrate its offered resources with the beneficiaries' private resources, such as driving skills, or public ones, such as roads.

2.2 Research Gap

S-D logic has mainly been studied at a metatheoretical level, therefore, Vargo and Lusch (2017) recommend bridging research activities to midrange theoretical level. As S-D logic research progresses, Vargo and Lusch (2017) encourage and expect to see an increase in evidence-based research and empirical exploration. However, it is important to note that this type of research has previously not been neglected in S-D logic, but has mainly been discussed in practice-oriented publications. Practice-driven and theory-generating activities will therefore most likely become increasingly prominent in academic S-D logic research (Vargo & Lusch, 2017). Furthermore, research is largely striving to develop a more practical S-D logic framework for value co-creation in service ecosystems, and research is also taking on a focal actor perspective (Simeoni & Cassia, 2019). This perspective is *"aiming at designing or managing actor engagement with the intent of improving resource integration and value co-creation"* (Storbacka et al., 2016, p.3009).

Many academic S-D logic studies taking on a resource integration perspective have been conducted with a central focus on analyzing a service ecosystem's resource integration and value co-creation processes (Schulz et al., 2021). Although the importance of resource integration has been established, there are still unexplored areas of the phenomenon where the understanding needs to be improved. More resource integration studies are necessary as relatively few have tried to define and conceptualize the phenomenon (Findsrud et al., 2018; Peters et al., 2014). Akaka et al. (2012) also suggest that more research and empirical studies are necessary to increase the understanding of resource integration. This goes in line with the suggested increase in evidence-based research, empirical exploration (Vargo & Lusch, 2017) and development of a more practical framework (Simeoni & Cassia, 2019). Akaka et al. (2012) suggest studying service ecosystems and how the reconfiguration of these can help companies facilitate resource accessibility, adaptability and integrability. Furthermore, Schulz et al. (2021) recently conducted a resource integration study and argued that there was a need for more studies of this kind to explore nascent service ecosystems, as theirs was one of the first to do so itself and previous studies have mainly researched established service ecosystems.

Recent empirical studies have raised new inquiries towards the future of resource integration. Taking on a resource integration perspective to explore a nascent service ecosystem, Nosi et al. (2017) studied the role of value co-creation for private consumers' electric car buying intentions. The findings showed that new technologies can generate barriers to value co-creation, and customers seemed to prefer relying on company resources rather than on their own. Furthermore, the findings also showed that as a consumer, trusting one's own competencies and being involved in initiatives for value co-creation could be drivers for incentivizing the buy of an electric car (Nosi et al., 2017). These insights reveal unanswered resource integration questions that demand to be explored, such as *"what barriers can new technologies generate for resource integration?"* and *"do customers wish to be involved in value co-creation initiatives?"*. Continuing, Koskela-Huotari et al. (2016) conducted a resource integration case study that aimed to improve the understanding of innovation in service ecosystems. The authors showed that the roles of both existing and new actors were redefined when reconfigurations occur in an ecosystem. For example, one company had seen its customers go from traditionally being passive to taking on a more active role. Based

on this, it would be interesting to know more in detail from a resource integration perspective how this can occur in other empirical contexts, demanding exploration of the topic.

2.3 Theoretical Framework

The literature review highlighted the growing importance of S-D logic and resource integration to academics and industries. Combined with the established research gap, this allowed for the construction of a theoretical framework. Illustrated in Figure 1, the theoretical framework is based on a framework presented by Kleinaltenkamp et al. (2012) that conceptualizes resource integration. The following three parts of the conceptual framework by Kleinaltenkamp et al. were deemed to be particularly relevant for this study as they go in line with- and neatly summarize core literature review concepts: 1) Resource integrators (actors) 2) use resources (operand or operant) 3) for integrating resources. These parts are illustrated in the vertical process on the right-hand side of Figure 1. Furthermore, the problematization narrowed down the focus on resource integrators from being actors in general to being B2B beneficiaries in particular. This is because the B2B context was deemed to be especially interesting, providing complex change processes, and service beneficiaries are in this study's focus. Thus, resource integrators are depicted as B2B beneficiaries in Figure 1. Studying how the adoption of a new technology influences resource integration is an idea that stems from this study's established research gap. The theoretical framework incorporates this study's research questions in the horizontal process starting from the left-hand side in Figure 1.

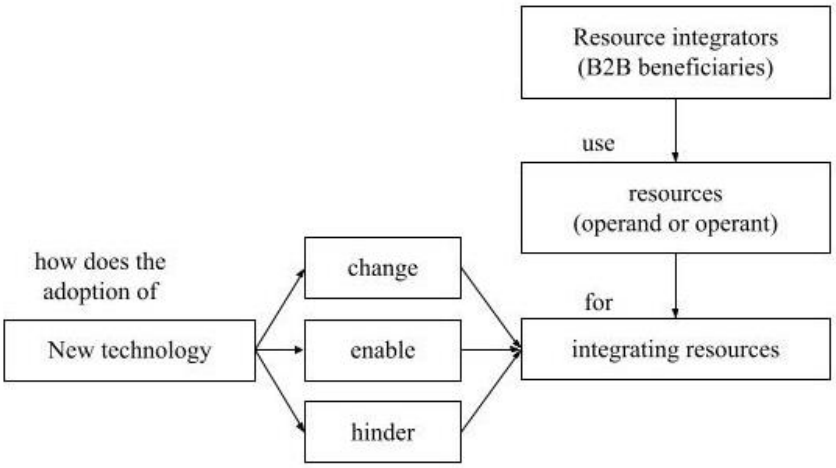

Figure 1: Theoretical Framework (inspired by the Kleinaltenkamp et al. (2012) resource integration framework).

To summarize the theoretical framework depicted in Figure 1, it illustrates that resource integrators use operand or operant resources for integrating resources. Furthermore, the theoretical framework has been adapted to answer this study's research questions by exploring how the adoption of new technology can change, enable and hinder resource integration.

3. Methodology

In the following chapter, the processes that were undertaken to produce this study are presented. First, the choice of taking an inductive qualitative approach is motivated (3.1) and the research approach is discussed (3.2). Then, the processes of data collection (3.3) and analysis (3.4) are presented. Finally, the trustworthiness of the collected data and the performed analysis is evaluated (3.5).

3.1 Methodological Fit

This study used an inductive qualitative approach. Several reasons motivated the use of this approach. First, a nascent empirical context was explored with an aim to generate new theory, and qualitative research typically narrows down such open-ended inquiries (Bell et al., 2019). Second, the FCEV industry was highly uncertain with many questions to be answered, why the inverted pyramid approach of asking a broad question that narrows down to the how's and why's (Agee, 2009) was found to be applicable for this study. Third, it was deemed important to incorporate human interactions and experiences to understand the shaping of the industry. Although qualitative research generates deep insights, it falls short on delivering generalizable, more tangible insights (Adams, 2015). However, Bell et al. (2019) explain that the goal of qualitative research is not to generalize to population but to theory, and quality should be assessed based on the theoretical inferences made from empirical data.

3.2 Research Approach

An inductive qualitative research approach was deemed preferable for deep diving into interviewees' environment. The research approach also helped avoid the "test room method" where researchers control the environment and manipulate specific variables leading to an inorganic approach, as explained by Bell et al. (2019), and therefore derive theory from observations as opposed to the contrary. As the FCEV industry was assessed, it was deemed most relevant to lead with understanding the market without getting cornered into a static approach (Denzin & Lincoln, 2005).

3.2.1 Case Study

The case study approach was chosen for this study as it allowed the generation of deep insights on a clearly defined topic. More specifically, a multiple case study approach examines multiple companies operating with a common work scope that is unique to them (Denzin & Lincoln, 2005). The multiple case study approach is better for cross-analyzing data between situations (Yin, 2003) and was therefore deemed suitable for this study. The FCEV industry makes for a particularly interesting context as it is still in its infancy in terms of market development and is being discussed as a viable sustainable alternative to current technologies. As the case study approach allows for answering "how" and "why" questions (Eisenhardt & Graebner, 2007; Yin, 2009), it was deemed effective for answering the research questions in this study. Because resource integration in the FCEV industry was expected to be full of complexities and kinks due to the industry being nascent, and it was a relatively bound situation seldom replicated in other fields, this study demanded a case study approach. An ideographic approach, unique to case studies, is used for its purpose of highlighting the unique traits of each company that was interviewed (Denzin & Lincoln, 2005).

3.2.2 Considerations

This study was conducted in a joint effort with Scania, whose involvement was limited to requesting the general scope of the study. All of this study's parts, such as the empirical findings and analysis, were written at the authors' sole discretion.

3.3 Data Collection

Data for this study was collected through semi-structured interviews, a design which allows for shifting discussions and elaboration on new insights while remaining structured, methodical, and time conscious (Bell et al., 2019). A total of 17 interviews were conducted with an average length of 49 minutes.

Interviewees were selected based on a predefined set of criteria, and a snowball sampling method was used to establish contact with the interviewed actors. Interviewees had diverse roles and were knowledgeable about their companies' FCEV projects, thus enabling a deep understanding of the situation. Methodological choices regarding data collection, including choosing a semi-structured interview design and selecting interviewees, are elaborated on in the following paragraphs.

3.3.1 Understanding the Problem

In order to arrive at a thorough understanding of the chosen topic, the authors relied on academic backgrounds in management, finance and economics. However, the study explored theories that the authors were initially unfamiliar with. In order to reach a level of knowledge that would allow for deeply diving into the theory and the problem, multiple meetings and discussions were attended with the supervisor of this study who is a prominent researcher in the field of S-D logic, in addition to having read publications and articles. Moreover, in order to develop an understanding of an equally unfamiliar industry, several informal discussions were undertaken with Scania employees and a hydrogen vehicle conference was attended. Furthermore, two interviews with companies using BEVs were conducted in order to draw comparisons and contrast that knowledge to the FCEV oriented discussions.

3.3.2 Interviewee Selection

Interviewees were selected based on criteria that predominantly sought to only include companies that had already adopted and operated hydrogen trucks. The reason for this was that interviewees were required to be able to describe their actual experiences of using the new technology. In two exceptional cases, interviewees were selected for their nature of work that was closely involved with FCEVs. Furthermore, companies were required to operate in developed countries where it was possible to purchase hydrogen trucks, as this ensured relatively similar conditions for the trucks' deployment and operation. A wide set of companies was selected to gain a more diverse set of insights, that would in turn be more generalizable as explained by Polit and Hungler (1991).

As the FCEV technology was nascent and the trucks had just recently started to be produced and delivered to customers, potential interviewees were few and hard to find. Additionally, language acted as a barrier as it reduced the potential number of companies and employees to interview. Companies were mainly discovered by means of attending a conference, reading articles and approaching actors that worked with FCEVs. These actors were contacted directly, seeking the most knowledgeable personnel on the topic, mostly were not more than one or two individuals as a result of the hydrogen technology only representing a small part of total truck operations.

Interview	Company	Country	Role	Date	Duration
1	A	DE	Process and Project Manager	2022-03-11	55 min
2	B	NO	Hydrogen Project Leader	2022-03-11	58 min
3	C	SE	Development Manager	2022-03-15	60 min
4	D	DE	Mobility Concept Manager	2022-03-16	57 min
5	E	DE	Business Unit Manager	2022-03-17	60 min
6	F	CH/AT	Head of Quality and Environmental Management	2022-03-23	53 min
7	E	DE	Product Manager	2022-03-23	44 min
8	G	CH	CEO	2022-03-24	45 min
9	H	NL	Owner	2022-03-24	30 min
10	I	CH	Business Strategy Manager	2022-03-24	32 min
11	J	GB	Chairman	2022-03-25	61 min
12	K	BE	Project Engineer	2022-03-25	55 min
13	L	US	Technology Program Manager	2022-03-25	60 min
14	M	SE	Transport Manager	2022-03-29	37 min
15 (follow-up)	L	US	Technology Program Manager	2022-03-29	40 min

16	B	NO	Corporate Logistics Manager	2022-03-30	41 min
17	N	CH	Managing Director Switzerland	2022-03-30	50 min

Table 1: Overview of Interviewees.

Interviewees included Project Managers, Transport Managers, Managing Directors amongst others. Due to the limited number of relevant employees at each company, one to two individuals at 14 different companies were interviewed, representing a large share of the actors who had adopted hydrogen trucks at the time. An overview of interviewees is presented in Table 1. The diversity of interviewees' roles was important as each individual had a different scope that was able to contribute to the study and depict different practices occurring in the organization allowing the study to reach saturation. Furthermore, an aim was to interview employees with deep insights into company operations, thus, individuals with significant responsibility were interviewed. A snowball sampling method, as explained by Bell et al. (2019), was used as interviewees were asked to recommend professional peers to approach for interviews.

3.3.3 Interview Design

A semi-structured interview design was used for this study's data collection. The semi-structured interview design allowed for a methodical way of collecting data, and enabled depth in exploring the research question while maintaining relevancy and time-efficiency (Gill et al., 2008). The interviews were planned around several rough themes aimed at understanding actors' operations and business development and other interesting arising themes, for which strategically worded questions were attached that enabled pivoting in pursuit of any new insights that arose during the interviews. The questions were curated to promote relaxed and insightful interviews, commencing with easy and less sensitive questions to lead the interview and help build rapport with the interviewee. Questions that sought to go deeper into the research topic and could be considered as challenging were asked during a later stage of the interview. The interview guide is shown in Appendix A.

Interview themes were crafted to understand suitable aspects for building knowledge around the topic, and they were loosely worded to allow for adaptation to new learnings that could potentially unfold from the interviews. Examples of new themes that unfolded from the interviews included infrastructure, truck drivers and maintenance.

3.3.4 Conducting Interviews

The interviews were held exclusively online due to the nature of participants operating in different countries, thus being difficult to meet in person. The Microsoft Teams conferencing tool was exclusively used for the interviews, as it offered a secure and reliable method of communication with an embedded transcription feature. The interviews were recorded to allow the authors to return to the recordings along the research process and ensure that everything was correctly understood. Furthermore, the interviews were conducted in English, as interviewees were diverse and English was the main common language. When conducting interviews, there is a risk of interviewee fatigue (Adams, 2015), which is why a target was set to achieve an interview length of 45 minutes. In the end, the interviews ranged from 30 to 61 minutes with an average length of 49 minutes, therefore meeting the intended interview length. Table 1 presents an overview of interviewees.

3.3.5 Data Documentation

Responsibilities to document and lead the interviews were alternated between the authors as one led the interview and the other took notes, ensuring cohesiveness and efficiency. The interviews were recorded and information was handled in accordance with GDPR regulations: the required GDPR documents were submitted to the Stockholm School of Economics (the university), consent forms to collect personal data were signed and obtained from the interviewees and personal data was deleted upon the completion of this study.

3.4 Data Processing and Analysis

The 17 interviews conducted resulted in more than 101,500 transcribed words. In order to maintain efficiency and use the most accurate information and avoid data pileup, the interviews were transcribed within 24 hours. Then, a thematic coding method was applied to the transcripts, as constantly referring back to the transcribed interviews would have been tedious and inefficient,

risking that insights would be lost along the way (Bell et al., 2019). Furthermore, the interviews were coded independently by the authors to allow triangulation of insights and reduce the risk of bias.

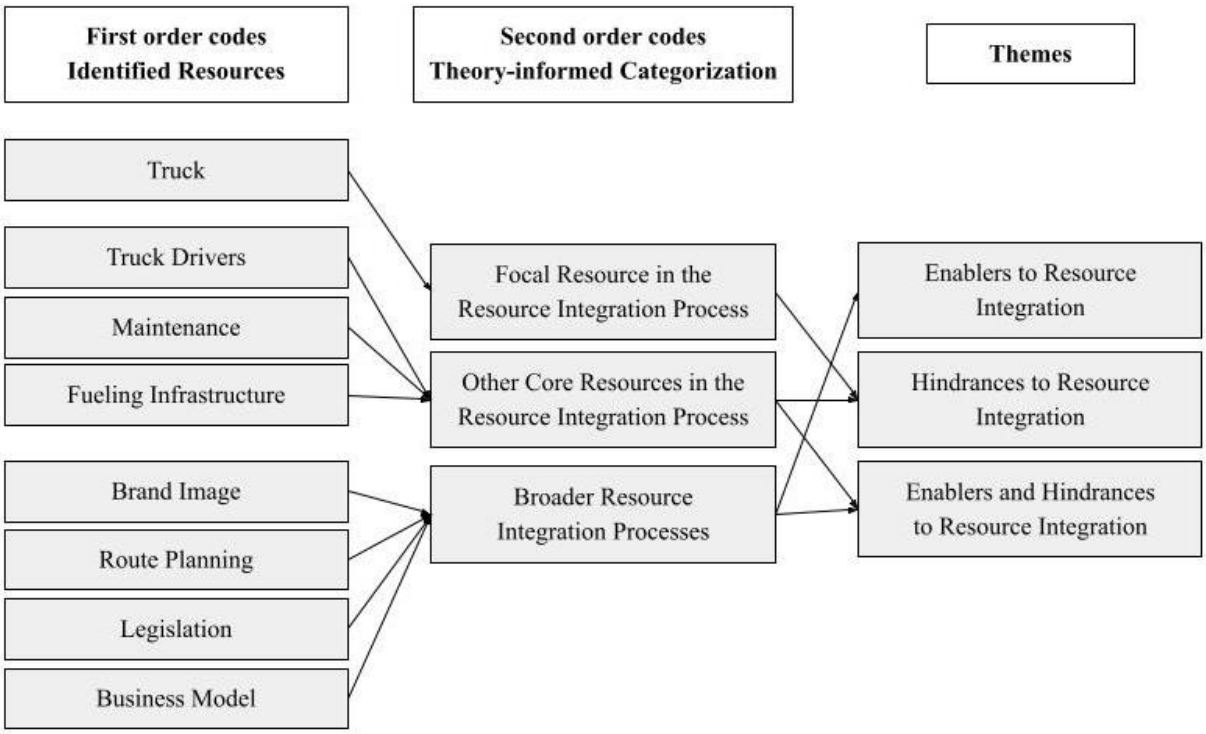

Figure 2: The Coding Process.

Figure 2 illustrates the coding process that was performed on the interview transcripts. Initially, the main topics that were raised by interviewees were highlighted and categorized into first order codes. The categorization of topics was done more practically-oriented, as they were categorized based on the resource discussed. This structure was meant to be intuitive since the aim of this study is to examine how the adoption of a new technology can influence, enable and hinder companies' resource integration processes. Therefore, it was also necessary to identify the types of resources that beneficiaries were integrating and categorize these before diving deeper into the details. The first order codes were then consolidated into second order codes, performing a more theory-informed categorization. First, the truck was identified to be a focal resource in the resource integration process, as it was the new technology and absolutely central to the interview discussions and analysis. Second, truck drivers, maintenance, and fueling infrastructure were identified to be other core resources in the resource integration process, as they were necessary for

the focal resource to operate. Third, brand image, route planning, legislation, and business model were identified to be part of the broader resource integration processes, as they were not as central as the focal resource or other core resources, but still relevant for the resource integration process. As interviewees discussed the benefits and problems of adopting the new technology, the insights from the coding process eventually informed the increasingly theoretical three main themes; enablers to resource integration, hindrances to resource integration, and both enablers and hindrances to resource integration.

3.5 Trustworthiness of Study

This study's quality and rigor is important as the study seeks to pave the way for academic research in the theoretical field of S-D logic and resource integration. To ensure this study's trustworthiness, the accepted set of criteria proposed by Lincoln and Guba (1985) were followed. The criteria include credibility, transferability, dependability and confirmability and is specifically adapted for qualitative research as quantitative research criteria, such as generalizability or replicability, are not compatible with qualitative research.

3.5.1 Credibility

Credibility, otherwise referred to as internal validity (Bell et al., 2019), relates to the practice of ensuring that the analysis correctly depicts a tenable interpretation of data and interviewees perspectives, otherwise referred to as the confidence in the truth of the findings (Lincoln & Guba, 1985). Credibility was ensured by means of triangulation as conclusions were drawn independently by the authors, eliminating bias from the process. Additionally, member checks were conducted where conclusions were shared with the interviewees, assuring that the authors' interpretation reflected interviewees' thoughts.

3.5.2 Transferability

Transferability describes the external validity of research (Bell et al., 2019), in other words the research viability in other areas or use cases (Lincoln & Guba, 1985). As qualitative research is concerned with generating deep knowledge in a narrow topic (Bell et al., 2019), the research becomes rather unique. Lincoln and Guba (1985) explain that to merit transferability, researchers

should go into deep detail and description of the depictions relayed, also helping future researchers adopt findings into new empirical contexts, something that this study strives to follow.

3.5.3 Dependability

Dependability is similar to credibility but more concerned about whether the research can remain relevant in the future and whether other researchers can test it to be dependable and repeatable (Bell et al., 2019; Lincoln & Guba, 1985). In order to achieve confidence in the rigidity of this study against time, an external audit was employed as recommended by Lincoln and Guba (1985). The external audit was done by presenting the findings of this study to industry experts who were not participating interviewees, and triangulating the findings among them to stress test the results and ensure robustness.

3.5.4 Confirmability

Confirmability is concerned with limiting personal opinions and biases from affecting the integrity of a study and limiting the possibility of any vested interest from compromising the truth (Bell et al., 2019). Establishing confirmability is important to ensure that the findings are consistent with the intended insights detailed by the interviewees. In this study, confirmability was established by maintaining an audit trail of the research process encompassing internal and external communications along with a record of the analysis, readings and thoughts. Moreover, findings were triangulated among the authors and external experts to narrow down the corroborating findings, as detailed by Lincoln and Guba (1985). Finally, following the recommendations of Lincoln and Guba, reflexivity was established as the authors relied on their diverse experiences to avoid viewing issues from the same lens and fall into similar pitfalls.

4. Empirical Findings

In this section, the main empirical findings from the conducted interviews are presented. First, the findings related to the focal resource are presented (4.1). Second, the findings related to other core resources are presented (4.2). Last, the findings related to the broader resource integration processes are presented (4.3).

4.1 Focal Resource in the Resource Integration Process

Interviewee discussions revealed that the hydrogen truck was the main resource in focus, thus motivating the classification of the hydrogen truck as the focal resource. Hydrogen trucks showed similarities in fueling and range to diesel trucks. This became especially evident as interviewees compared it to BEV trucks, a technology that posed its own set of differences. However, interviewees shared that FCEV trucks posed both benefits and problems, which will be further illustrated in the following sections.

4.1.1 Truck

Several interviewees raised the technical constraints of hydrogen trucks as being a question of "size, dimension and weight", explaining that most hydrogen trucks were heavier than diesel trucks as an effect of the fuel cell system. This created payload issues, and even though the hydrogen trucks were still lighter than BEVs. Generally, the importance of payload was related to the type of operations that the company pursued, as it could pose a problem for weight restricted transports but not for volume restricted transports. It should be noted that some companies found the payload restriction to be a deal breaker while others did not, but it nonetheless appeared to be important to most. One company described that due to the limited payload, they have had to take other routes. Countries such as the USA have tried to counteract this issue by raising their payload limit for fossil free trucks on public roads, but it was still insufficient at matching diesel trucks' payload in certain cases.

> *"In comparison to diesel, it is roughly 10,000 pounds less of cargo that you can move with your truck. That is a seriously limiting factor, not critical in some operations, /.../ [but] if you are going to a warehouse 76 miles away, you cannot make the trip." (Interviewee 13)*

Other issues for companies adopting and using hydrogen trucks were the reliability of the fuel cell system and the involvement of several actors in supplying the truck. Although coordination efforts had been made in advance to get the truck functioning properly, there were problems with integrating the fuel cell system and tanks with the trucks. Some companies also experienced problems with software failures. Companies acknowledged that FCEVs were a new technology, that actors were learning, and that trucks were produced in limited amounts, but still, the problems made several companies want to purchase a fully ready vehicle instead. One interviewee explained that the reliability of hydrogen trucks had been quite good, even though customers wanted to see at least the same level of performance as for diesel trucks. However, downtime was still worse for hydrogen trucks than it was for diesel trucks, directly influencing operations and profits.

> *"I think the main issue is the fact that the technology of fuel cell trucks is not ready yet. There is just no development. We had a lot of downtime due to software issues, the fuel cell not communicating with the electric drivetrain, starting the truck up - it took like half an hour to get the truck running." (Interviewee 9)*

4.2 Other Core Resources in the Resource Integration Process

In order for companies to successfully operate their hydrogen trucks, other core resources than the focal resource were needed. This section aims to highlight the findings of several other core resources that have been identified and present the complexities associated with these resources. Along with hydrogen trucks comes a complex ecosystem, as companies were required to engage in partnerships to gain access to resources such as fueling, repair and maintenance.

> *"We had to build a partnership of people who could deliver the whole ecosystem. From the manufacture of hydrogen to the storage of hydrogen, the hydrogen fueling stations, the repair and maintenance, the interim supply of hydrogen. There is a big ecosystem." (Interviewee 11)*

4.2.1 Truck Drivers

Many companies emphasized the importance of truck drivers' willingness to cooperate on operating hydrogen trucks for a successful project. One interviewee describes the importance of truck drivers by the following quote:

> *"The driver makes or breaks your project. If you have a driver that wants to do this, you are going to have a good project. If you have a driver that does not want to do this, it is going to be a bad project." (Interviewee 12)*

Companies had different backgrounds of introducing new technologies and reducing emissions. Employees and truck drivers in experienced companies showed curiosity towards new technologies, although they wanted to learn how to use the hydrogen trucks first in order to feel comfortable. Many companies explained that their truck drivers loved the new trucks, as they were proud and never wished to switch back to diesel trucks. The truck drivers enjoyed the improved and more sustainable working environment with "quick acceleration, very low noise and easy to drive", resulting in increased employee satisfaction. Several truck drivers shared that the trucks were more responsive, making altitude climbing in topographic conditions more enjoyable. Generally, truck drivers shared that it felt "clean" to drive hydrogen trucks.

> *"Benefits are obviously non-emitting, better driving experience. Literally, every driver I spoke to, and I think I spoke to all of them, told me that he is very proud, and he would never want to switch back to a diesel truck and he is very happy. So, the employee satisfaction is extremely high." (Interviewee 8)*

Furthermore, junior and senior truck drivers differed in their attitudes towards using hydrogen trucks. While companies believed that a new generation of truck drivers were more attracted to sustainability and driving hydrogen trucks, older truck drivers appeared to show more of a general resistance to new technology. One company explained that for its truck drivers, the most important thing was that they could do their job properly and at least to the same level as with diesel trucks, otherwise, the truck drivers would show resistance. The truck drivers' interest in sustainability was secondary, as they were more interested in reducing problems directly affecting themselves, such

as noise levels. Some truck drivers who tried early hydrogen truck models had negative experiences, which were hard to reshape.

> *"We had a driver that said, after all, I do not want to drive it. So, it is resistance towards new technology, which is still a little bit too early. But that has nothing to do with hydrogen or with electric. It is something new where you might have issues, I see the resistance to change." (Interviewee 12)*

Many truck drivers were trained on how to operate the trucks as effectively as possible. Training included topics on the truck, safety, driving and fueling. Several interviewees described that they were surprised by how easy it was to learn about these trucks. Training was mainly provided by OEMs, frequently ranging from two to eight hours on a single day, which proved to be sufficient.

> *"[The training] was done by the OEM. They just told [the truck driver] about the engine, about the car, they made a test fueling. They were simply at the fuel stations to see how this works, it was also very easy." (Interviewee 6)*

Another interviewee raised awareness of the increased importance of training hydrogen truck drivers to drive fuel consciously, since there could otherwise be more critical problems than purely financial ones as with diesel. For example, the risk of running out of fuel increased due to the sometimes limited hydrogen fueling infrastructure, a problem which is highlighted by the following quote:

> *"You need to explain what will impact the fuel consumption of the vehicle. Because with a diesel vehicle, it matters if you want to reduce your fuel consumption. Everything you do matters, but you have enough diesel with you, so you are never going to have problems with that. And it is so much more difficult with zero emission vehicles such as fuel cell electric vehicles, you do not have as much fuel with you." (Interviewee 12)*

4.2.2 Fueling Infrastructure

The topic of fueling infrastructure was prominent in the interviews, being central to the use of the focal resource, and was oftentimes raised to illustrate issues. Access to infrastructure was widely varying. For example, in Switzerland, there have been hydrogen projects ensuring access to a network of fueling stations with one single fuel card as part of a pay-per-use business model. Although some have still wished for more fuel stations in the country, companies explain that the beneficial access to fueling infrastructure has been a key reason in choosing to deploy FCEVs in Switzerland. On the contrary, many countries lacked hydrogen infrastructure. For example, one interviewee explained that there were only six or seven hydrogen truck fueling stations in Germany. The situation favored operations in smaller distances, such as waste management where one station would be enough to sustain operations, opposed to long haulage distributions that would require a change of business model to access a network of infrastructure all across the country.

> *"Waste management is probably the biggest buyer of hydrogen trucks in Germany right now. And this is also because they work locally: if they have one source of hydrogen, that is enough. But if you are a company which drives all over Germany, you will have to have a kind of network. An actual logistics company will have problems transforming their business model to hydrogen because well, there are not enough fuel stations." (Interviewee 1)*

However, some did not have access to any fueling stations at all, arguing that there was a "chicken-and-egg" problem where fuel providers wanted to ensure that there would be more hydrogen trucks, and hydrogen truck providers wanted to ensure that there would be satisfactory access to fuel stations. One solution for some companies was to use mobile refueling until the demand would become sufficient. However, one interviewee stepped out of his role to solve this problem by signing a letter of intent to exclusively fuel at the provider's station, something that the interviewee had never done previously for diesel trucks.

"[The fuel providers] say that we must have a certain number of vehicles so that they can have some economy in the stations, so, we are signing a letter of intent to promise that we have 10 vehicles refueling at this station." (Interviewee 3)

With the introduction of new vehicle technology, several interviewees cited that they needed to rethink how they cooperated with OEMs and other market actors. For example, companies expressed that especially for fuel stations, OEMs should cooperate more with actors in order to make the ecosystem function. Companies showcased that they were interested in how the market was shaped and how the product was distributed, but considered themselves to be too small to have any influence, prompting them to seek partnerships.

"We kind of need to have partnerships because without partnerships we would be way too weak as an economic branch or as a company itself to have a say in where the technology is supposed to go or where availability needs to go or need to come so that we can have a feasible model of business." (Interviewee 1)

Furthermore, interviewees raised the issue of fuel station pressure as it was sometimes adapted for passenger cars rather than trucks, implying that trucks could only be filled to half of the maximum capacity. Several interviewees also explained that hydrogen stations had a limited amount of hydrogen, only enough for a few trucks each day. In fact, some stations had run out of hydrogen, and several stations had also been closed for maintenance or accidents, whereby their reliability has been questioned. One interviewee also explained that the hydrogen fueling infrastructure had not linearly scaled up with the increase of hydrogen trucks.

"The challenges when you introduce such a new technology, the infrastructure also needs to scale up at the right pace. And that is where we were. We were having some challenges in Switzerland, sometimes some filling stations ran out of hydrogen. And then it was difficult to refuel the trucks. /…/ The hydrogen infrastructure structure was not able to cope and scale up as quickly as the hydrogen consumption." (Interviewee 17)

Reliability problems were also raised by interviewees who experienced unforeseen delays at the hydrogen fueling station, for example caused by unannounced inspections or even frozen fuel station pipes. These problems could have troubling consequences for companies, as illustrated by the following quote:

> *"When you fill up hydrogen in wintertime and when there is a huge humidity in the air, the pipe is combined with the car and it is frozen. To separate it costs the driver 10 minutes. All these issues are very difficult. Also, these hydrogen stations have inspections there and they do not inform you about the inspection. Then the drivers go there and there is inspection time. So it is a hard way, and you can really get in trouble when you do not take this into account." (Interviewee 5)*

Several companies explained that they considered, decided, or already finished building their own fueling stations, integrating fuel production into their business, as a result of the limited infrastructure. Interviewees said that this was a new approach compared to previous diesel operations. Another reason why companies integrated fuel production was independence, as fuel prices had been fluctuating and severely impacting operations, while it was also said to be a way of securing access to green hydrogen. Some companies explained that they would produce fuel fully on their own, while other companies would involve other market actors in the process.

> *"No one could provide us with hydrogen. So if we wanted to move on before providers were ready with their infrastructure we had to build our own. So that is the only reason why we are dealing with the production." (Interviewee 2)*

To make up for the lacking hydrogen infrastructure, some companies with smaller operations sought quick fix solutions. These solutions were suboptimal as the supply of hydrogen was unpredictable and problematic. The situation was described by one interviewee:

> *"We had to work with one of the scientific facilities here that produced some hydrogen that they could give us on some days, but at a different pressure type that was required for the trucks, so we could only fuel our trucks about half of what we actually needed. /…/ And*

that was complicated, because at the same time, hydrogen was not always available at their small gas station." (Interviewee 1)

4.2.3 Maintenance

Hydrogen truck maintenance was raised by interviewees to be central to successful focal resource operation. Although some companies experienced problems with fuel cell integration, some did not experience any problems at all. Many companies expected a reduced need for hydrogen truck maintenance compared to diesel trucks, as hydrogen trucks had fewer moving parts and removed the need to replace parts that would be abundant in diesel trucks.

"[Benefits have been] maintenance, less oil, less hydraulic components, much easier to handle. /…/ You have less vibration, less emissions, better noise level and when it comes to the trucks, you do not have the combustion engine where you need to change oil spark plugs, set the valves. All that does not exist anymore." (Interviewee 7)

Interviewees explained that few mechanics with appropriate knowledge to service hydrogen trucks and hydrogen fuel stations existed on the market. While one company reached out to the OEM supplying the hydrogen trucks, requesting training and a certification for its mechanics, several other companies have struggled with mechanics training since they needed to be able to operate on high voltage or the consequences could be fatal. The required education could stretch for at least half a year. Although efforts to train more maintenance experts were increasing, the progress overall remained slow and companies would not be able to service their hydrogen trucks as conveniently as diesel trucks in the near future. One interviewee discussed companies' interests for mechanics to learn to operate on FCEVs:

"There is a keen effort from the vehicle manufacturers in our area, and the training colleges that are working on mechanics in our zone to build these programs, because there is a lot of pressure in our zone to move in this direction that everyone is recognizing." (Interviewee 13)

Mechanics' limited expertise related to the availability of workshops capable of servicing hydrogen trucks, as interviewees shared that the number of workshops available for servicing hydrogen trucks were limited compared to those servicing diesel trucks. In fact, many companies described that solely the OEM was able to service the truck in its specific workshops. Therefore, some customers who experienced breakdowns and problems with their hydrogen trucks had to wait long for maintenance, criticizing the high dependency on the vehicle supplier. For example, problematic trucks were sent to other countries and spare parts had to either be shipped by air cargo or slower transport alternatives when the parts were too large. Another interviewee explained that for light services and maintenance, local help existed, otherwise mechanics had to travel from another country.

> *"There are not a lot of places where you can do repairs, there is basically only your supplier. If you have a problem with the fuel cell, which we did, the vehicle was gone for about two months. Because there was a problem with that, they had to replace it and to replace it, they had to [receive] it and it is not something you can do as easily as with a diesel motor. /.../ That kind of dependency is not good and that is a problem. We would really appreciate it if there would be a lot more diversity in supply."* (Interviewee 1)

As a result of the above-mentioned problems with accessing maintenance and in order to reduce downtime, some companies instead decided to take on a more active role and build their own workshops.

> *"When you have a problem with a truck and you call your partner company, it needs two days before they are there and can repair the trucks and the other truck stands there four days perhaps with a small issue that you can solve by yourself, often in half an hour." (Interviewee 5)*

4.3 Broader Resource Integration Processes

Continuing from the focal resource and the other core resources in the resource integration process, interviewees described additional resources affecting operations either directly or indirectly. These resources were categorized as belonging to the broader resource integration processes. In this

section, the findings regarding the most relevant resources in the broader resource integration processes are presented.

4.3.1 Brand Image

Interviewees described both expected and unexpected marketing benefits incurred by the adoption of hydrogen trucks. Some found that they were garnering great support and attention from their direct customers, and one interviewee even noticed an "extreme marketing impact" which created more meaning for the company. One company experienced that its customers wished to use the hydrogen truck for their own marketing campaigns:

> *"[The hydrogen truck] had a huge marketing boost. A lot of our customers in Switzerland have invited us just to take the truck and park it in front of their headquarters, so that anyone can say 'yes, we drive this truck with hydrogen', I am sure." (Interviewee 6)*

Marketing benefits were not only related to customers, as one interviewee explained that it became easier to recruit new, good truck drivers that were attracted by the premise of sustainability. Truck drivers also wanted to work for a company with a good reputation, which stemmed from the adoption of hydrogen trucks.

> *"We can see that the way our customers are talking about us and people look at us when we are looking for new employees, it is very easy for us to get new and good employees and they are very stable. And the rumors about us as a company, I think that may be priceless." (Interviewee 2)*

One interviewee described that in Switzerland, the bar had been raised as it could even be seen as a competitive disadvantage not to have a hydrogen truck rather than a competitive advantage to have one. Moreover, some customers had taken an active role in shaping the actions of truck operators by questioning not only their price but also their carbon footprint, demanding change towards more sustainable solutions when negotiating for deals.

"Today when we sign contracts with customers we get two questions: 'what is your price?' and 'what are your efforts on sustainability, what is your carbon footprint?'" (Interviewee 4)

4.3.2 Route Planning

Range had a significant impact on operations and was therefore raised by interviewees as being central to route planning. One company described that with BEVs, it would have needed twice the amount of trucks to replace diesel trucks, thus also twice the number of truck drivers, acknowledging that hiring truck drivers already is an issue today. This was not the case for hydrogen trucks, as it allowed companies to more conveniently switch to these trucks without worrying about adjusting their route planning process.

"Especially for this hydrogen project, we see that it works. We use these trucks today equal to all of the other day trucks. We do not have to adapt route planning or something like that, we use it like any diesel truck." (Interviewee 5)

Although offering better range properties than BEVs, hydrogen trucks still offered shorter range than diesel trucks. With hydrogen trucks, however, some argued that range was not a problem since truck drivers need to rest anyways. Most companies had a positive attitude towards the range of hydrogen trucks and believed the technology to be well suited for long haul distribution, especially for the ones needing to return in a single trip.

"For the trucks that usually are running around our greater region, but do have some pretty long runs and then sometimes need to get all the way out to a city 300 something miles away, it is going to be much, much, much more effective to be on a hydrogen vehicle than on a battery electric for that type of load one. You can get there in one run, you do not need to stop for fuel on the way." (Interviewee 13)

4.3.3 Legislation

Several interviewees cited the influence of environmental goals and targets set by the government as a driver towards the shift for using renewable fueled vehicles. Such goals sought to limit the

amount of CO2 produced by companies by setting a cap to how much CO2 they can emit, pressuring companies to adopt, for example, hydrogen vehicles. Interviewees in some countries have cited high taxes imposed on polluting vehicles as a prohibiting factor for using fossil fuel trucks, indirectly favoring the use of fossil-free vehicles.

> *"The reason why the trucks were rolled out in Switzerland was because of the Swiss heavy duty tax. Switzerland had an initiative in the early '90s where they said 'we want to preserve our alps, and if you pollute them, we want you to pay for it.'" (Interviewee 8)*

Other interviewees highlighted stricter laws outright forbidding the use of certain emission standards, and thus certain diesel trucks, in specific city zones. This benefited operations of companies using fossil-free trucks. Another opportunity for hydrogen trucks was that they were allowed to do business during previously forbidden hours, because of the reduced noise pollution compared to diesel engines. This resulted in one company being able to extend operations and gain new business opportunities.

> *"When it comes down to emission standards, there are certain areas in the city where certain diesel engines are not allowed anymore. At certain places, you cannot go due to the Euro 5 emission standard. You do not have that issue with the hydrogen vehicle. /.../ We used to not be allowed to work before six, or to clean certain areas at night, but with electric vehicles, we are allowed to do that." (Interviewee 7)*

Some interviewees mentioned problems with limited legislation regarding hydrogen trucks, resulting in confusion and lack of guidance. These interviewees demanded more legislation in the areas of safety, operations, amongst others. One interviewee explained that the limited legislation had made it difficult to navigate the transition from diesel trucks to hydrogen trucks, as illustrated by the following quote:

> *"There are no rules in Sweden, so we are waiting for that. What safety must we have, where can we park it, and so on? /.../ We must have the rules: what should the drivers think of, what should we do if something happens, etc." (Interviewee 3)*

On the other hand, legislation regarding hydrogen trucks did not appear to be lacking in all countries. Therefore, legislation was country-specific. According to one interviewee in the USA, safety training for first responders had taken place and guidelines regarding handling of hydrogen existed, why legislation was said to be sufficient.

> *"There are also a series of strong requirements in our local fire codes, or local building codes and stuff like that about how hydrogen gets handled, and safety training for first responders. Our local zone has started getting training, in that there are a couple of manuals that have been put together." (Interviewee 13)*

4.3.4 Business Model

Several interviewees described that OEMs' business models for hydrogen trucks sometimes differed from previously conventional ones regarding diesel trucks and related to the operation of the focal resource. One example was the pay-per-use model which appeared to be particularly prominent in Switzerland. The model entailed that the cost was incurred per kilometer driven, and included repair, maintenance, fuel, amongst others. With this complete solution that included everything but truck drivers, obstacles for the fleet operator to engage in hydrogen logistics and deliveries were removed. When coordinated by a concentrated number of stakeholders, a complete solution had the potential to optimize costs and reduce customer risk, because if the customer was not able to drive the hydrogen truck, payment was not required. This proved to be beneficial for adopting and using the hydrogen technology in its early phase, according to interviewees who looked positively towards OEMs offering a complete solution.

> *"This means it was extremely easy for us and also for me to bring this decision to the board, because we could say if the truck will not work, we cannot drive and we will not pay. So, it was the absolutely perfect situation for it and what we see now when we look at the total cost of ownership. We signed a contract for eight years with full service: the truck is included, the hydrogen fuel is also included in the cost per kilometer. The costs, on top of our total cost of ownership, is just our driver." (Interviewee 4)*

However, the pay-per-use solution was not an option for all companies. For example, one government organization explained that it was required to own the vehicles and was therefore not able to subscribe to the pay-per-use business model. Even for those who were not restricted by regulation, some considered themselves to be more conservative and wished to buy hydrogen trucks as they previously had done with diesel trucks. For example, one interviewee was skeptical towards truck suppliers going out of their core business area to focus on energy provision.

> *"I am not sure that the same supplier should supply trucks and hydrogen, because that is related, yes, but they are very different technologies and they are two very different value chains." (Interviewee 2)*

5. Analysis

In this chapter, the empirical findings are analyzed with a S-D logic theoretical perspective, particularly focusing on resource integration. First, aspects that were deemed to mainly be enablers of resource integration are presented (5.1). Second, aspects that were deemed to mainly be hindrances of resource integration are presented (5.2). Third, aspects that were deemed to be both enabling and hindering resource integration are presented (5.3).

5.1 Enablers to Resource Integration

5.1.1 Brand Image

Having adopted hydrogen trucks, companies' brand images improved in several ways which in turn facilitated their resource integration processes. Operating sustainably was in some cases essential to doing business and demanded by customers, thus being not only an enabler but a requirement for integrating resources. This is strengthened by the need to use new technologies, not because it became a competitive advantage to do so but because it became a competitive disadvantage to not do so. Furthermore, companies' customer attention and marketing impact increased, which could reasonably be argued to convert to an increase in business and therefore enable resource integration.

The improved brand image also facilitated resource integration as employer attractiveness increased by the adoption of hydrogen trucks. This was especially true for attracting good and stable truck drivers, as it changed from being hard to becoming very easy. As truck drivers are core resources to the resource integration process and can make or break a project, having good truck drivers is highly enabling for the resource integration process.

5.1.2 Route Planning

The maximum range of a truck was central to route planning. Although hydrogen trucks offered a slightly more limited range compared to traditional diesel trucks, their maximum range still outperformed BEV trucks. Given the goal of companies to maintain transport operations, one company described that the changing from diesel trucks to BEV trucks would require double the amount of trucks and truck drivers. It goes without saying that route planning and resource integration practices would be severely affected and hindered by a decision to adopt BEV trucks.

While one might think that the more limited range of hydrogen trucks compared to diesel trucks would hinder the use of the focal resource for its intended purposes, the resource integration lens shows that this is actually not the case. Hydrogen trucks would be able to replace diesel trucks, as truck drivers were required by law to take rests routinely before the maximum range of hydrogen trucks was ever reached. Therefore, companies did not have to adapt route planning for their hydrogen trucks, but could continue to integrate resources in the same way as before and use hydrogen trucks equally to diesel trucks.

5.1.3 Business Model

Although traditionally, companies have bought or leased their trucks from OEMs, new business models were offered as part of hydrogen truck introductions and were shown to facilitate resource integration. For example, the pay-per-use business model not only included all costs except the truck driver, but also included access to energy and workshop infrastructure that was otherwise problematic in the hydrogen truck ecosystem. While problems such as infrastructure access and supplier coordination did not exist to the same degree with the previous technology, resource integration routines have changed. With the offering of new business models, actors have been trying to solve resource integration issues related to the new technology. As new business models facilitate the use of the focal resource by reducing hinders to accessing other necessary resources, these can be seen as enablers to resource integration.

The new business models also introduced new actors, changed roles of actors and as a result, reconfigured the ecosystem constellation. For example, the supplier of the pay-per-use business model took on a pure coordinating role, partnering with other actors such as energy or maintenance companies, in order to be able to offer a more complete solution. The role of solely coordinating without manufacturing was deemed to be a result of adopting the new technology, as it had not previously been prominent in the diesel truck ecosystem.

Furthermore, relational ties were also affected by the new business models. For example, the pay-per-use business model allowed beneficiaries to more easily contact their supplier without having to coordinate contact with several different suppliers of trucks, energy, maintenance, amongst

others. The coordination of communication appeared to be especially important when adopting and using the new technology as companies experienced problems with contacting different suppliers that did not want to take responsibility.

On a more practical note, suppliers wishing to offer a complete solution business models need to change customer attitudes in certain cases as sometimes, they showed criticism of OEMs taking a complete solution role.

5.2 Hindrances to Resource Integration

5.2.1 Truck

The new hydrogen truck resource constellation hindered companies from integrating resources the way they used to and forced the companies to change their practices. As a result of the new resource constellation of hydrogen trucks, the weight of hydrogen trucks exceeded the weight of diesel trucks. Interviewees explained that even though hydrogen trucks weighed less than BEV trucks, there could still be payload issues in certain business cases as weight is frequently important in the transportation industry. This forced some companies to take other routes and most likely, some operations could not be pursued. Although efforts were made in the USA to raise public road payload limits for fossil free trucks, it was still not sufficient for properly operating hydrogen trucks to the same extent as diesel trucks. The efforts made by governments to raise payload limits however show how companies are affected by, and integrate, public resources such as roads and legislation.

As part of the new resource constellation of hydrogen trucks, the fuel cell system had to be properly integrated. To ensure successful integration, interviewees engaged in extensive coordination efforts with suppliers, something that had previously not been necessary for diesel trucks, therefore affecting relational ties and changing the ecosystem constellation. Nonetheless, many interviewees experienced problems relating to the fuel cell systems integration. This caused an increase in downtime, meaning the time that the truck is not being able to operate on the road. Downtime directly hinders resource integration and beneficiaries' profit as it is crucial for the use of the focal resource.

5.2.2 Fueling Infrastructure

Beneficiaries' access to hydrogen fueling infrastructure showed to be highly country specific. With the pay-per-use business model that was prominent in Switzerland, the access to fueling infrastructure was relatively good as the business model included access to fuel stations. However, the access to fueling infrastructure in most other countries was limited compared to diesel infrastructure, restricting and negatively affecting certain operations, thus acting as a hindrance to resource integration. For example, hydrogen fueling stations were few, had reliability problems and were at certain times running out of hydrogen. Fueling stations sometimes offered the wrong hydrogen pressure, thus, truck drivers were only able to refuel up to half of the truck's maximum capacity.

The roles of partnerships and supplier coordination appeared to be critical for making the hydrogen truck ecosystem function as companies were sometimes too small to have an impact on their own. The need to engage in new types of partnerships that were not previously necessary to integrate resources can be seen to hinder the resource integration process. For example, several interviewees raised the chicken-and-egg problem, where fuel providers were unwilling to build hydrogen fueling infrastructure due to the limited number of hydrogen trucks, and truck suppliers were unwilling to scale up hydrogen truck production due to the lacking hydrogen fueling infrastructure. New partnerships also illustrate how ecosystem constellations and relational ties have changed because of hydrogen technology.

Roles of actors have been redefined in the hydrogen truck ecosystem compared to the diesel trucks ecosystem, significantly changing the ecosystem constellation and affecting relational ties. For example, due to the limited hydrogen fueling infrastructure, some beneficiaries have had to take a more active role by producing their own energy and building their own refueling stations, something that had not previously been necessary in the diesel trucks ecosystem. In some cases, this has resulted in the removal of the traditional fuel provider's role in the hydrogen truck ecosystem.

5.3 Enablers and Hindrances to Resource Integration

5.3.1 Truck Drivers

Truck drivers had a central, dual role in resource integration as they displayed qualities of both operand and operant resources. On the one hand, truck drivers can be categorized as operant resources since they have a defined set of knowledge and skills that enables them to act upon the focal resource and be a resource integrating agent. On the other hand, truck drivers can also be categorized as operand resources as they are acted upon by route planners by providing them with route plans and supporting guidance in order to create value and would not be able to do so without, for example, route information.

Truck drivers were identified to be enablers to resource integration as evidenced by their positive and willful participation in training. Truck drivers described how surprisingly quick and easy hydrogen truck training was as the new technology showed similarities to the previous technology, which resulted in an attitude conducive to resource integration. Since interviewees repeatedly expressed that truck drivers did not enjoy change and emphasized the need for hydrogen trucks to replicate the diesel experiences, the benefit of FCEVs became clear when interviewees recalled their experiences with truck drivers. Therefore, the familiar nature of the technology allowed truck drivers to integrate resources in a similar way as before. However, it should be noted that the requirement of having new knowledge and skills for carrying out the resource integration process can be somewhat hindering on its own, as explained later in the analysis' maintenance section.

Furthermore, truck drivers played a crucial role in the hydrogen truck ecosystem, as they also did in the diesel truck ecosystem. Operations essentially fall upon truck drivers as their ability to integrate resources brings the entire resource integration process together. Truck drivers are able to put the company's resource integration processes to a standstill at will, thus hindering operations and affecting overall business. This was evidenced by interviewees who explained that truck drivers sometimes refused to drive the hydrogen trucks, therefore causing problems for the resource integration processes. When truck drivers act on the focal resource, they also have a direct impact on the fuel consumption and thus resource integration. One interviewee described that truck drivers' impact on fuel consumption was even more important for the new technology than the

previous technology. Sometimes, truck drivers displayed a resistance to change, however, this was often overcome as truck drivers who tried the new trucks enjoyed the new working environment.

The rules of resource integration can be difficult to change as truck drivers stick to their routines and can decide not to integrate resources. The problem of truck drivers deciding not to integrate resources did not appear to be a problem in the diesel truck ecosystem. However, it is important to remember that the previous ecosystem had been relatively unchanged for a long period of time. In order for companies to successfully integrate resources using the new technology and motivate truck drivers, the routines and driver culture need to follow the change. A shift might be occurring, as it was noted that a younger generation of truck drivers was said to be more positive towards integrating resources with the new technology.

5.3.2 Maintenance

On the one hand, the resource constellation of hydrogen trucks differed compared to diesel trucks. As several interviewees noted, FCEVs were built with less mechanical and moving parts. Although some companies have had their hydrogen trucks too briefly to be certain of the trucks' durability, other companies experienced a decrease in problems that would typically appear in their diesel truck counterparts. As a result, companies have reduced their needs for maintenance, repair, and time spent in the workshop for changing oil spark plugs, setting the valves, amongst others. The reduction of downtime enables use of the focal resource, and thus enables resource integration.

On the other hand, the resource constellation of hydrogen trucks has raised new problems, demanding new expertise for mechanics to perform maintenance. Given the nature of hydrogen trucks being powered by fuel cells and electrical engines, mechanics were required to be knowledgeable about electricity. As mechanics act on other resources to create value, and have knowledge and skills, they are considered to be operant resources. However, mechanics' knowledge and skills were quickly discovered to be lacking for performing maintenance on the new technology. The mismatch of knowledge and skills acted as a hindrance to resource integration. For example, mechanics have had to engage in extensive education stretching for at least half a year, in order to be able to service the new trucks.

Furthermore, mechanics' lack of expertise translates into the scarcity of workshops available for servicing hydrogen trucks. Workshops can be defined as operand resources, as they are tangible and acted upon by mechanics during the maintenance process in order to create value. Sometimes, only the OEM workshops were able to service the hydrogen trucks. The high dependability of the mechanics and vehicle suppliers increased downtime and hindered resource integration. As a result, some beneficiaries were seen to take on a more active role, affecting relational ties and therefore the ecosystem constellation. For example, beneficiaries educated their own mechanics and built their own workshops, something that had not previously been done to the same extent.

5.3.3 Legislation

On the one hand, legislation in some countries promoted the use of renewably fueled vehicles, therefore facilitating the adoption and use of hydrogen trucks by increasing the operational possibilities of the focal resource. For example, legislation enabled resource integration in certain cases by removing the need for hydrogen truck drivers to pay significant road taxes that diesel truck drivers had to pay. Furthermore, legislation also allowed for operation in more areas and during more hours of the day, increasing business opportunities. As a result, the more the companies drove hydrogen trucks, the more financially viable it became compared to driving diesel trucks. These aspects also show how legislation has quickly adapted to promote the adoption of the new technology.

On the other hand, legislation did not always seem to follow the development of the new technology, as it in some cases created uncertainty and negatively impacted resource integration. For example, regulations regarding the handling of hydrogen truck problems and adapting workshops to safety criteria were lacking in Sweden. As a result, companies have had to look into these problems and risks on their own.

5.4 Summary of Analysis

When analyzing the findings from a traditional resource perspective, the new hydrogen technology showed similarities to the previous technology. However, when taking on a resource integration perspective, significant changes were revealed. The analysis shows that the adoption of a new

technology does not only impact the focal resource but other core resources and the broader resource integration processes as well, affecting the ecosystem in its entirety.

As part of adopting the new technology, actors took on new roles that they had previously not been associated with. These new roles included both becoming more independent by incorporating the production of certain resources, or taking on a coordinating role. When one actor incorporated the production of a core resource, the traditional roles of actors were redefined and some roles were no longer important in the new ecosystem. Furthermore, as the former supplier of that core resource no longer played a role in the ecosystem, relational ties were also affected. With the new technology, actors emphasized the importance of partnerships to make the ecosystem function. Because of the new roles and relational ties, the ecosystem constellation was changed.

Findings also show that the focal resource, an operand resource, can be influenced by surrounding operant resources. For example, routines are operant resources that can hinder resource integration as they can be sticky and hard to change. However, the routines have to be adapted to the new technology to enable resource integration. This relates to the truck drivers which sometimes showed resistance to change being used to their routines, hindering resource integration. Another example is knowledge and skills, or competencies, which also is an example of operant resources and was shown to be a hindrance to resource integration.

Truck drivers were identified to be both operand and operant resources, not being the actual change in technology or focal resource but rather part of the other core resources. As truck drivers could make or break a focal resource project, they illustrate that other core resources than the focal resource itself can be crucial for the resource integration process.

Furthermore, broader resource integration processes play a significant role too. Thus, companies must not only focus on focal resources individually but their integration and their consequences. For example, the maximum range of hydrogen trucks compared to diesel trucks illustrates this, as the aforementioned can be seen as limiting from a traditional resource perspective, but when looking at it from a resource integration perspective, it is in fact not problematic. Therefore, the findings show that companies need to understand that it is not just the focal resource or truck that

needs to be focused on, since it has shown to be solely a small part of the resource integration puzzle. Rather, this study has identified other critical resources that companies must focus on, emphasizing the need to see the bigger picture and understand the beneficiaries' resource integration processes.

6. Discussion and Conclusion

This chapter first relates the findings to previous research and discusses these (6.1). Then, this study is concluded by answering the research questions (6.2), presenting its theoretical contributions (6.3) and practical implications for companies (6.4). Finally, the study's limitations are discussed (6.5) and future research paths are suggested (6.6).

6.1 Discussion

This study was sparked by the recommendation of Schulz et al. (2021) on the need for more studies exploring nascent service ecosystems. The need for these studies was brought up by the interviewees, who have repeatedly highlighted the need to understand such ecosystems due to the difficulty of navigating them previously.

Earlier research by Osieczko et al. (2021) had already highlighted the inadequate energy infrastructure that this study has further confirmed in the analysis section. This study's interviewees have repeatedly highlighted not only the lack of infrastructure that was needed to carry out their operations, but also made mention of the chicken-and-egg situation where fuel providers would not build more hydrogen fueling stations before there were more hydrogen trucks, and hydrogen truck suppliers would not scale up production before ensuring access to more hydrogen fueling stations. Some companies spoke of the need for a market maker that would shape the market, noting that they were far too small to influence. Companies using letters of intent in this situation made for an interesting example of how actors cooperated to ensure both capacity and viable investments. Other companies operating hydrogen trucks have applied what had been mentioned by Alp et al. (2019) who suggested that early adopters must take an increasingly active role as they buy electric vehicles. Again, this has been supported by the findings and analysis of this study, where several interviewees had been quoted to have needed to build their own stations to support their small hydrogen truck fleet or collaborate closely with local scientific facilities to be able to secure the hydrogen that they needed.

Koskela-Huotari et al. (2016) also suggest that in a reconfigured ecosystem, new and existing actors' roles can be redefined, something that was also supported by this study. For example, actors took on new roles to offer a complete service and ecosystem to their customers. This study's

analysis shows that beneficiaries themselves have also adopted new roles such as being responsible for their own energy procurement.

However, it remains that in the light of new technology, resource integration is difficult and that many change initiatives therefore fail (Tohidi & Jabbari, 2012; Beer & Nohria, 2000). This fear had been spoken about by some interviewees who discussed the high costs incurred by the hydrogen trucks in addition to the variety of maintenance problems that would in course affect their resource integration practices. Another important point that was highlighted by Vargo and Lusch (2008) in previous research was that the beneficiary of a service always determines the value. This was illustrated by beneficiaries who determined that more value had been co-created with the new complete solution business models that were introduced for hydrogen trucks. It was also apparent that adopting hydrogen trucks was increasingly less of a choice for the interviewed companies, as tangible action for a decreased carbon footprint was being demanded from their business partners.

6.2 Answering the Research Questions

The main purpose of this study was to extend the understanding of S-D logic and resource integration by answering the two research questions.

Research question 1: "How does the adoption of a new technology influence beneficiaries' resource integration processes in a B2B context?"

The adoption of a new technology has shown to influence beneficiaries' resource integration processes in several ways. Although, at a first glance, the new technology showed many similarities to the previous one from a traditional resource perspective, the resource integration lens reveals significant consequences. This study shows that the new technology is just a piece of the resource integration puzzle, as changes not only occurred to the focal resource on its own, but to the ecosystem as a whole. Therefore, there is a need to look at the bigger picture and understand the resource integration processes in their entirety. As the new technology was adopted, other core resources and broader resource integration processes were identified to play a role in the ecosystem

constellation. The findings show that other operand resources need to be integrated, and that operant resources also affect the resource integration processes of the focal resource.

Having adopted the new technology, actors' roles were redefined as some took on new roles and beneficiaries became more active, sometimes taking on a coordinating role or incorporating production of other resources, thus eliminating the traditional roles of some other actors. As a result of the redefined roles and that resources are connected and need to be integrated, effects were seen on relational ties and the ecosystem constellation as well. Findings show that partnerships and the cooperation of actors became more important when adopting a new technology.

Research question 2: "What enables or hinders beneficiaries from changing their resource integration processes in a B2B context?"

The theoretical resource integration perspective shows that resources in an ecosystem can enable or hinder beneficiaries from changing their resource integration processes. It is not solely the focal resource, or the newly adopted technology, that changes, but the ecosystem as a whole. As these other core resources and broader resource integration processes can enable or hinder the resource integration processes of beneficiaries, this study shows that there is a need to understand the bigger picture of the ecosystem and not only the changes of the new technology. This study provides several examples of these types of enablers and hindrances to resource integration.

First, routines were shown to be sticky on several levels and sometimes acted as a hindrance to beneficiaries' resource integration processes. These had to be taken into account and adapted for the new technology. Second, operant resources were shown to have a make or break impact on the resource integration processes of the focal resource, and some showed a general resistance to change. Third, a mismatch between knowledge and skills was identified, hindering the resource integration processes of beneficiaries as it reduced the operational possibilities of the focal resource. Finally, some aspects, such as particular inferior technical properties of the new technology, appeared to be hindrances to resource integration from a traditional resource

perspective. However, the resource integration perspective reveals that this was rather an enabler due to processes of how other resources were integrated.

6.3 Theoretical Contribution

The theoretical understanding of S-D logic and resource integration has been strengthened by this study as it has generated knowledge on how the adoption of a new technology can influence, enable and hinder companies' resource integration processes in a B2B context. While there has been a need for evidence-based research to take a more prominent role in the research field of resource integration (Vargo & Lusch, 2017), this study served as a piece to the puzzle of making the research less abstract and adding more evidence-based research. Furthermore, this is accomplished as this study examines the empirical context of hydrogen trucks and analyzes it from a theoretical standpoint, thus bridging theory with practice by providing empirical resource integration research, something that has been encouraged by academics in the field (Akaka et al., 2012; Findsrud et al., 2018). As the hydrogen truck ecosystem is still in an early phase and much development is taking place, studying this empirical context helps fill in the gap of exploring nascent ecosystems as recommended by Schulz et al. (2021). The insights generated by this study makes the understanding of resource integration more nuanced. For example, insights show that the adoption of a new technology and the changed focal resource is only a small part of its ecosystem, demonstrating the importance of understanding the bigger picture.

6.4 Practical Implications

As most companies' change initiatives fail (Tohidi & Jabbari, 2012; Beer & Nohria, 2000), and B2B situations are particularly complex (Lievens & Blazevic, 2021), this study has helped reveal the implications of adopting a new technology from the perspective of a beneficiary. Thus, the insights provided by this study are valuable to many companies, providing information about stakeholder processes. The generated knowledge can help companies improve value co-creation as this is done by facilitating their customers' access to other resources, potential to integrate and use these resources (Vargo & Lusch, 2011; Simeoni & Cassia, 2019), going in line with the suggested implications by Akaka et al. (2012) of studying service ecosystems and their reconfiguration.

As OEMs bet on new technologies to meet sustainable transport demands, they now have access to empirical customer insights to rely on when shaping the market. This study allows for a better understanding of the hydrogen ecosystem, implying that OEMs can better understand which areas in their current offerings are successful and which ones are not. For example, truck drivers were described as "make it or break it" resources for adopting and using hydrogen trucks. As internal resistance can exist, managers need to motivate and ensure that truck drivers are onboard the change processes for a successful transformation. However, findings show that companies adopting and using hydrogen trucks have had an easier time to attract good truck drivers.

Interviewees referred to the chicken-and-egg problem as the hydrogen fuel providers did not want to build fueling infrastructure because of the limited number of hydrogen trucks, and hydrogen truck OEMs did not want to increase supply of hydrogen trucks due to the limited fueling infrastructure. Many beneficiaries wished for increased collaboration between hydrogen truck OEMs and fueling infrastructure suppliers, as it would be a part of solving the chicken-and-egg problem. For OEMs and fuel providers, the insights show that partnerships could be beneficial.

Furthermore, hydrogen truck OEMs should consider offering more complete solutions, as many beneficiaries expressed interest in this type of business model. Demand for more complete solutions was driven by a variety of factors, including the recently significantly higher prices of hydrogen trucks and the lack of operational experience and partnerships needed to support the trucks daily with other core resources.

Companies should not only focus on the truck itself and its specifications, as this study's analysis showed that the ecosystem in its entirety is affected by the new technology, thus, the bigger picture is crucial for companies to understand. For example, the maximum range of hydrogen trucks could be seen as a limitation compared to the maximum range of diesel trucks. However, the resource integration perspective shows that OEMs do not need to improve the maximum range specification as it is sufficient for using the truck for beneficiaries' purposes.

This study provides regulatory organizations with insights as companies using hydrogen trucks raised issues and benefits with current legislation. These aspects are important to understand in

order to encourage the sustainable development of the transport industry. For example, beneficiaries appreciated the benefits of being allowed to drive in previously restricted city zones and nightly hours, as it allowed them to increase the use potential of the new trucks. On the contrary, companies in most countries wished for more clear regulation regarding safety.

6.5 Limitations

Throughout the process of this study, a variety of difficulties were encountered. First, the target of interviewing several employees at each company in order to get a thorough account of each case was impeded by the nature of the relevant departments in these companies being relatively underdeveloped and nascent. This meant that there were a limited number of knowledgeable persons on the topic, and knowledge was therefore concentrated at the hierarchical top. Furthermore, few companies had already adopted and used hydrogen trucks due to the technology being nascent. Additionally, in the cases where more employees were willing to be interviewed, communication was oftentimes difficult as no common language was shared between the interviewees and interviewers. Difficulties therefore existed in finding sufficient relevant companies and experts. This issue was counteracted by allowing the interviewee more time to answer the question or the use of online translation services for specific words.

Second, interviewed companies were diverse and located in multiple countries. As a result, aspects such as subsidies and regulations regarding the new technology differed from company to company. While this can be argued to reduce this study's generalizability to population, this kind of generalizability in itself is not a goal for qualitative research as has been discussed in the methodology chapter. Therefore, diverse interviewees rather made it possible to gain deep insights of the research topic. The diversity also allowed for a discovery of country-specific differences, such as legislation.

Finally, obtaining absolute truths from interviewees is not possible as their experiences are subjective. Secondary research is an option that could have been used to support interviewees' claims, but it was rather limited in the field and was also one of the main reasons that prompted the need for this study. The sentiment that no one possessed certainty regarding the matter was strengthened by learnings from attending conferences and engaging in conversations with experts

in the field. Furthermore, the incentives for interviewees to tweak their interview answers were deemed to be limited. Therefore, the empirical findings were deemed to be credible even though they should not be considered as absolute facts.

6.6 Future Research

First, it would be interesting for future research to explore the BEV truck ecosystem and the resource integration practices relating to it. As the BEV technology appears to be a bit more developed compared to FCEV technology, it would be valuable to compare those insights with the ones presented in this study to see how resource integration changes over time. Interviewees seemed to believe that more knowledge on the topic of BEVs would be useful as many believe that both FCEVs and BEVs will have a prominent role in the future of the transport industry. Such research would also complement the practical implications for OEMs presented in this study.

Second, relating to the previous suggestion to conduct similar research with BEVs, it would be interesting to understand how the resource integration processes change as a new technology becomes more mature. Therefore, a similar study could be conducted in the future. This would be insightful as companies' hydrogen fleets will have likely scaled up by that point, resulting in new challenges related to scaling up. Such a study would also help develop greater understanding of the enablers and hindrances discussed in this study.

Third, in this study, truck drivers were identified to have a dual role, being both operand resources and operant resources. Although the dual role of resources was not a central topic on its own in the analysis in this study, it could be an interesting area of research for S-D logic to explore in order to better understand what impact that dual role resources could have on resource integration processes, and if they differ from traditional resources that are either operand or operant.

Finally, the analysis chapter in this study raises a variety of topics, such as relational ties, routines, amongst others. The generated insights and the changes in resource integration relate to other theoretical perspectives. For example, the changes in relational ties could be further examined using network theory, and the idea of rules and routines could be further examined using

institutional theory. Using these perspectives to uncover new insights would add greater depth to the understanding of changing resource integration processes and its implications.

7. References

Adams, W. C. (2015). Conducting semi-structured interviews. *Handbook of practical program evaluation, 4*, 492-505. doi:10.1002/9781119171386.ch19

Agee, J. (2009). Developing qualitative research questions: A reflective process. *International Journal of Qualitative Studies in Education, 22*(4), 431-447.

Akaka, M. A., Vargo, S. L., & Lusch, R. F. (2012). An exploration of networks in value cocreation: A service-ecosystems view. *Review of Marketing Research,* (9), 13-50. doi:10.1108/S1548-6435(2012)0000009006

Alp, O., Tan, T., & Udenio, M. (2019). Adoption of electric trucks in freight transportation., 1-39.

Beer, M., & Nohria, N. (2000). Cracking the code of change. *Harvard Business Review, 78*(3), 133-141.

Bell, E., Bryman, A., & Harley, B. (2019). *Business research methods*. Oxford University Press.

Colruyt Group. (2020, Dec 8th). *Colruyt Group is the first in Europe to test a 44-tonne hydrogen truck.* Retrieved from https://www.colruytgroup.com/wps/portal/cg/en/home/press/press-releases/colruyt-group-first-in-europe-44-tonne-hydrogen-truck

Denzin, N., & Lincoln, Y. (2005). *The sage handbook of qualitative research*. SAGE.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25-32. doi:10.5465/AMJ.2007.24160888

Findsrud, R., Tronvoll, B., & Edvardsson, B. (2018). Motivation: The missing driver for theorizing about resource integration. *Marketing Theory, 18*(4), 493-519. doi:10.1177/1470593118764590

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal, 204*(6), 291-295. doi:10.1038/bdj.2008.192

Grand View Research. (2020). *Electric truck market size, share & trends analysis report by vehicle type (battery electric trucks, hybrid trucks), by region, and segment forecasts, 2020 - 2027*. Retrieved from https://www.grandviewresearch.com/industry-analysis/electric-trucks-market

Kleinaltenkamp, M., Brodie, R. J., Frow, P., Hughes, T., Peters, L. D., & Woratschek, H. (2012). Resource integration. *Marketing Theory, 12*(2), 201-205. doi:10.1177/1470593111429512

Koskela-Huotari, K., Edvardsson, B., Jonas, J.M., Sörhammar, D., & Witell, L. (2016). Innovation in service ecosystems-Breaking, making, and maintaining institutionalized rules of resource integration. *Journal of Business Research 69(8),* 2964-2971. doi: 10.1016/j.jbusres.2016.02.029

Lievens, A., & Blazevic, V. (2021). A service design perspective on the stakeholder engagement journey during B2B innovation: Challenges and future research agenda. *Industrial Marketing Management* (95), 128-141. doi: 10.1016/j.indmarman.2021.04.007.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE.

Madhavaram, S., & Hunt, S. D. (2008). The service-dominant logic and a hierarchy of operant resources: Developing masterful operant resources and implications for marketing strategy. *Journal of the Academy of Marketing Science, 36*(1), 67-82. doi:10.1007/s11747-007-0063-z

Nosi, C., Pucci, T., Silvestri, C., & Aquilani, B. (2017). Does value co-creation really matter? an investigation of Italian millennials' intention to buy electric cars. *Sustainability (Switzerland), 9*(12) doi:10.3390/su9122159

Osieczko, K., Zimon, D., Płaczek, E., & Prokopiuk, I. (2021). Factors that influence the expansion of electric delivery vehicles and trucks in EU countries. *Journal of Environmental Management, 296.* doi:10.1016/j.jenvman.2021.113177

Peters, L. D., Löbler, H., Brodie, R. J., Breidbach, C. F., Hollebeek, L. D., Smith, S. D., … Varey, R. J. (2014). Theorizing about resource integration through service-dominant logic. *Marketing Theory, 14*(3), 249-268. doi:10.1177/1470593114534341

Polit, D., & Hungler, B. (1991). *Nursing research: Principles and methods*. New York: JB Lippincott.

Scania. (2021). *Annual and sustainability report 2020*. Retrieved from https://www.scania.com/content/dam/group/investor-relations/annual-review/download-full-report/scania-annual-and-sustainability-report-2020.pdf

Schulz, T., Zimmermann, S., Böhm, M., Gewald, H., & Krcmar, H. (2021). Value co-creation and co-destruction in service ecosystems: The case of the reach now app. *Technological Forecasting and Social Change,* 170 doi:10.1016/j.techfore.2021.120926

Simeoni, F., & Cassia, F. (2019). From vehicle suppliers to value co-creators: The evolving role of Italian motorhome manufacturers. *Current Issues in Tourism, 22*(2), 218-236. doi:10.1080/13683500.2017.1293619

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., & Nenonen, S. (2016). Actor engagement as a microfoundation for value co-creation. *Journal of Business Research, 69*(8), 3008-3017. doi:10.1016/j.jbusres.2016.02.034

Tohidi, H., & Jabbari, M. M. (2012). Innovation as a success key for organizations. *Procedia Technology, 1*, 560-564. doi:https://doi.org/10.1016/j.protcy.2012.02.122

Trafikverket. (2018). *Trender i transportsystemet.* (No. 2018:180). Retrieved from http://trafikverket.diva-portal.org/smash/get/diva2:1363874/FULLTEXT01.pdf

Transportnytt. (2020, Jan 23rd). *Norska asko först med scanias vätgasbil*. Retrieved from https://transportnytt.se/nyheter/norska-asko-forst-med-scanias-vatgasbil

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing, 68*(1), 1-17. doi:10.1509/jmkg.68.1.1.24036

Vargo, S. L., & Lusch, R. F. (2008). Service-dominant logic: Continuing the evolution. *Journal of the Academy of Marketing Science, 36*(1), 1-10. doi:10.1007/s11747-007-0069-6

Vargo, S. L., & Lusch, R. F. (2011). It's all B2B...and beyond: Toward a systems perspective of the market. *Industrial Marketing Management, 40*(2), 181-187. doi:10.1016/j.indmarman.2010.06.026

Vargo, S. L., & Lusch, R. F. (2016). Institutions and axioms: An extension and update of service-dominant logic. *Journal of the Academy of Marketing Science, 44*(1), 5-23. doi:10.1007/s11747-015-0456-3

Vargo, S. L., & Lusch, R. F. (2017). Service-dominant logic 2025. *International Journal of Research in Marketing, 34*(1), 46-67. doi:10.1016/j.ijresmar.2016.11.001

Vargo, S. L., & Lusch, R. F. (2018). *The SAGE Handbook of Service-Dominant Logic* (1st ed.). SAGE.

Volvo Group. (2021). *Annual and sustainability report 2020*. Retrieved from https://www.volvogroup.com/content/dam/volvo/volvo-group/markets/global/en-en/investors/reports-and-presentations/annual-reports/annual-and-sustainability-report-2020.pdf

Yin, R. K. (2003). *Case study research: Design and methods.* SAGE.

Yin, R. K. (2009). *Case study research: design and methods* (4th ed.). SAGE.

Appendices

Appendix A: Interview Guide

Introduction:

- Introducing the research topic
- What is your role in the company?
- How long have you been with the company?

Goods:

- To what purpose are hydrogen trucks used in your company?
- How many hydrogen trucks are you operating?
- Can you explain to us how you use this vehicle and how it is to work with? Has it changed?
- What kind of other resources were necessary for the previous trucks to do their job? Has this changed?
- Has something been beneficial with the hydrogen trucks?
- Has something been problematic with the hydrogen trucks?

Knowledge and skills:

- What kind of knowledge and skills do your employees working with hydrogen trucks need to carry out their tasks?
- Have these changed with the introduction of hydrogen trucks?
- If so, what kind of new knowledge and skills has been needed to acquire?
- Has it been problematic to acquire this new knowledge and skills?

Relationships:

- Have your partners changed when adopting hydrogen trucks?
- Why do you typically engage in partnerships?
- If so, what new needs came up that required you to search for new partners?
- What were you getting from them, and what are you getting from them now?
- Has something been problematic?

Outro:

- Would you like to add any other reflections that you have?