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Toward a Fossil-free Future:

An Explorative Study on Value Proposition Development in an Emerging Ecosystem

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Abstract:

The ecosystem lens is becoming increasingly popular in strategy discussions. However, how value propositions (VPs), one of its central concepts, are developed within this context remains poorly understood. This thesis seeks to address this knowledge gap. Specifically, it aims to identify the dynamics that affect VP development in an emerging ecosystem and understand how these dynamics affect it. A qualitative research design was used to conduct a single case study on the fossil-free steel ecosystem surrounding SSAB, LKAB, and Vattenfall. With a focus on the orchestrators, semi-structured interviews were conducted with various actors within the ecosystem. The study identifies two dynamics that affect VP development: co-evolution and co-creation. It demonstrates how co-evolution establishes the ecosystem structure, providing the basis for developing a VP, and how co-creation influences VP development through various actors contributing to the design, quantification, and communication of value, as well as a circular VP enhancement. Through these findings, this thesis contributes to an understanding of VP development in an emerging ecosystem. A main contribution is the exploration of co-creation, a concept from the marketing literature, in an ecosystem context. Finally, the practical implications of this study are intended to assist practitioners in making better use of their surrounding ecosystem and taking the identified dynamics into account when developing VPs.

Key words: ecosystem emergence, value proposition, value proposition development, ecosystem orchestration, co-evolution, co-creation

Supervisor: Kaisa Koskela-Huotari

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List of Abbreviations

DRI	Direct reduced iron
HYBRIT	Hydrogen Breakthrough Ironmaking Technology
JV	Joint venture
VP	Value Proposition

Glossary

Co-creation	Refers to how value is collectively created by multiple actors, not only one (Vargo & Lusch, 2016).
Co-evolution	Refers to a process in which interdependent, interacting actors adapt and evolve with each other over time (Aarikka-Stenroos & Ritala, 2017; Breslin et al., 2021).
Direct reduced iron (DRI)	Refers to the output resulting from the direct reduction of iron ore by a reducing gas (hydrogen in the case of the HYBRIT technology) and is the main input for fossil-free steel production. DRI is also known as sponge iron.
Dynamics	Refers to mechanisms and actions that provide change within a system over time.
Ecosystem	Refers to "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017, p. 40)
Ecosystem actor	Refers to an organization that plays a role in value creation or value capture within an ecosystem.
Ecosystem orchestration	Refers to the actions of one or multiple leading companies to improve value creation and appropriation among ecosystem actors (Lingens et al., 2023; Shen et al., 2024).
Ecosystem orchestrator	Refers to the leading ecosystem actor(s) that is (are) responsible for improving value creation and appropriation among ecosystem actors (Lingens et al., 2023; Shen et al., 2024).
Ecosystem structure	Refers to "the alignment of activities, actors, positions, and links" (Adner, 2017, p. 40).
Joint Venture	Refers to a business agreement "whereby two or more owners create a separate entity." (Harrigan, 1988, p. 142)
Value Proposition (VP)	Refers to a proposition created by a firm (and potentially other actors) to explain why a customer should purchase from it (Payne et al., 2017).

1. Introduction

The current business environment presents complex challenges such as rapid technological development and sustainability requirements. This complexity requires intensified collaboration beyond firm, industry, and sector boundaries to create and capture value (Linde et al., 2021; Ritala & Jovanovic, 2024). The ecosystem lens illuminates an alignment structure that enables complex collaborations of hierarchically independent, yet interdependent actors resulting in a focal customer offering (Adner, 2017; Jacobides et al., 2018). It acknowledges multilateral relationships that cannot be broken down into dyadic interactions (Adner, 2017), which is a novel element compared to more traditional discussions in the management literature, for instance value chains (Porter, 1985, as cited in Adner, 2017). The ecosystem lens recognizes that resources necessary to achieve a system-level output often reside in different sectors and industries, broadening the scope of a firm beyond traditional boundaries (Autio & Thomas, 2022). Thereby, it presents strategies for aligning heterogeneous actors (Jacobides et al., 2018), rendering it powerful for when structures of value creation are changing (Adner, 2017). These advantages have led to the popularity of the ecosystem lens in theoretical and practical discussions on competitive and corporate strategy (Adner, 2017). This is also necessary because ecosystems can be found throughout the business world. Examples range from technology giants such as Apple's App Store (Jacobides et al., 2018) to tire manufacturers such as Michelin's PAX Run-Flat Tires (Adner, 2017). The specifics of ecosystems, thereby, have rendered traditional constructs inefficient (Foss et al., 2023), compelling firms to engage in collaborations within ecosystems (Jacobides et al., 2024). Hence, it is important for researchers and practitioners to fully understand this concept.

In general, ecosystems transition from nascent, unstructured to more organized states (Moore, 1993). The emergence of an ecosystem, also named birth stage (Moore, 1993), is crucial to its future development (Dattée et al., 2018; Jacobides et al., 2018). In this stage, scholars recognize the significance of dynamics (Breslin et al., 2021; Jacobides et al., 2018), which this thesis defines as mechanisms and actions that provide change within a system over time. Despite its importance, research on how ecosystems emerge remains limited (Pushpananthan & Elmquist, 2022). Within ecosystem emergence, the value proposition (VP) is developed (Moore, 1993). The VP represents the ecosystem structure and combines the efforts of heterogeneous actors into a customer offering, thereby significantly affecting the ecosystem's success (Adner, 2017; Linde et al., 2021). Surprisingly, research on VP development in an emerging ecosystem is scarce (Lingens et al., 2023). The primary discussions about VPs take place in the more traditional marketing literature, for instance, in Payne et al. (2020), where various scholars and institutes emphasize the importance of the concept. Webster (2002, p. 61), identifies the VP as "the firm's most important single organizing principle", and the Marketing Science Institute (2010, as cited in Payne et al., 2020), posit ways to develop VPs as a research priority. The ecosystem literature, however, differs from the traditional marketing literature, which for instance typically focuses on dyadic interactions in discussing VPs, such as in Payne et al. (2020). Given the increased importance and prevalence of ecosystems, researchers and practitioners alike need to understand how VP development might differ in an ecosystem context. The limited research is further problematic due to the VP's centrality in the ecosystem literature and its significance for the success of an ecosystem (Adner, 2017). Moreover, ecosystems typically do not simply appear, but are established through purposeful actions by a leading actor, commonly referred to as ecosystem orchestration (Jacobides et al., 2018). Consequently, an understanding of VP development is essential for practitioners, as it can inform them on how to align heterogeneous actors toward one customer offering, thus influencing the successful emergence of ecosystems.

An interesting example of heterogeneous actors developing a VP is the Hydrogen Breakthrough Ironmaking Technology (HYBRIT) initiative. Here, the Swedish steel producer SSAB, Swedish mining company LKAB, and Swedish energy company Vattenfall set out to collectively decarbonize steel production, a major source of carbon emissions (Ember, 2023). These efforts were accompanied by various other actors, including experts, customers, and public actors. The complex interactions among these actors transcend the boundaries of conventional dyadic relationships. Furthermore, the transformation of the traditional steel production value chain resulted in a situation where structures of value creation were changing. These characteristics indicate the necessity of adopting an ecosystem lens (Adner, 2017). Finally, the HYBRIT initiative was not in the commercialization phase yet, making it a suitable research case for addressing the problematic scarce research on VP development in an emerging ecosystem.

1.1. Purpose and Research Questions

By researching the emerging HYBRIT ecosystem, this thesis aims to shed light on VP development in an emerging ecosystem. More specifically, the purpose of this thesis is two-fold. Firstly, as dynamics play a pivotal role in emerging ecosystems (Breslin et al., 2021; Jacobides et al., 2018), suggesting that they might affect VP development, this thesis seeks to identify the dynamics that affect VP development in an emerging ecosystem. Hence, the first research question that this thesis seeks to answer is:

What are the dynamics that affect value proposition development in an emerging ecosystem?

Secondly, this thesis has the purpose to understand how these dynamics affect VP development in an emerging ecosystem. Thus, the second research question that this thesis aims to answer is:

How do these dynamics affect value proposition development in an emerging ecosystem?

1.2. Delimitations

To answer the research questions of this thesis, two delimitations have been implemented. Firstly, the research conducted in this thesis focused solely on the HYBRIT ecosystem. While this approach allows for a detailed understanding of the given situation, it may limit the applicability of the results to broader contexts, such as to different industries or environments. Secondly, interviews were conducted with the most relevant actors for ecosystems focusing on the flow of value (Autio & Thomas, 2022). Prior literature informed our selection of the most relevant actors within the HYBRIT ecosystem by emphasizing the role of leading actors (Dedehayir et al., 2018). A focus on other actors may have affected our findings.

1.3. Expected Contribution

The expected contributions of this thesis concern theory and practice. Firstly, it seeks to contribute to management literature on how VPs in emerging ecosystems are created, specifically, by identifying the dynamics that affect this VP development and understanding of how these dynamics affect it. In doing so, it aims to contribute to further understanding of VP development, a phenomenon rooted in the marketing literature, in an ecosystem context. Furthermore, as VP development in an emerging ecosystem is studied, the findings of this thesis are expected to provide a contribution to illuminating the phenomenon of ecosystem emergence.

Moreover, the success of the studied HYBRIT initiative has significant implications for reducing Sweden's CO_2 emissions and thus mitigating climate change. To address the complex challenges of humankind, such as climate change, more collaboration across sectors and the entire value chain is needed (Linde et al., 2021). This thesis aims to identify and understand the dynamics that affect VP development in an emerging ecosystem. It is therefore expected to provide guidance to future initiatives seeking to develop a VP in such an environment.

1.4. Thesis Outline

The remainder of the thesis has the following structure. First, the thesis reviews prior management literature on ecosystems and establishes a theoretical framework. It continues to elaborate on the methodology used to address the thesis' research questions. Then, the empirical findings are presented and analyzed before they are compared to prior literature. The thesis ends with concluding the findings and by answering the research questions.

2. Literature Review and Theoretical Framework

To lay the foundation for answering our research questions, this section reviews management literature concerning ecosystems. It is structured to introduce the ecosystem lens, shed light on the emergence of ecosystems, explore dynamics within emerging ecosystems and critically assess research on VPs in emerging ecosystems. This provides the basis for identifying the research gap and devising a theoretical framework aimed at bridging the identified research gap and answering the research questions.

2.1. The Ecosystem Lens

The term "ecosystem" was first presented to the field of business strategy by Moore (1993), who adopted it from ecology. This construct is based on the idea that companies should no longer act as isolated entities but as part of a larger ecosystem (Moore, 1993). After its introduction, this ecosystem lens was used rather metaphorically. To benefit from its application it is, however, important to delineate its specificities (Adner, 2017).

Adner (2017, p. 40) defines ecosystems as: "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize." One key aspect of ecosystems is an alignment structure that defines the positions of its members and activity flows among them. Moreover, there exist multilateral relationships between partners that cannot be broken down into bilateral interactions (Adner, 2017). The necessity of an alignment structure combined with multilateral relationships necessitates the need for unique coordination activities. Prior literature highlights the role of an ecosystem orchestrator to build the ecosystem structure and ensure alignment and collaboration (Dedehayir et al., 2018). Moreover, Jacobides et al. (2018) stress modularity and specific complementarities in production and consumption as foundations for building an alignment structure of multilateral sets of partners. Modularity refers to a value creation structure in which different parts are separated by thin touch points. Creating modularity within an ecosystem ensures hierarchical independence between interdependent organizations and limits the required coordination. Specific complementarities are either unique, where one element (A) cannot function without another element (B), or supermodular, where an increase in one element (A) enhances the value of another element (B). These complementarities provide the parties a "vested interest to align and act as a group" (Jacobides et al., 2018, p. 2264). A key feature of ecosystems is that interdependencies are standardized on the basis of complementarities between groups of actors instead of between individual actors.

Moreover, membership in an ecosystem is defined by that its actors have joint value creation as a goal. Jacobides et al. (2018) further exclude actors whose relationships are not based on specific complementarities, and Breslin et al. (2021) specify that ecosystem actors need to co-evolve, meaning that they adopt and evolve through each other's actions, a distinguishing feature of ecosystems. Thereby, the ecosystem lens recognizes a broad range of actors, spanning multiple industries and sectors, to realize a VP (Adner, 2017). Finally, the goal of an ecosystem is the realization of a VP, which describes the promised benefits the customer will receive. A VP shifts the focus of value creation to the customer and describes the desired system-level outcome (Adner, 2017).

Jacobides et al. (2018) categorize ecosystem research into three distinct strands: business ecosystems, platform ecosystems, and innovation ecosystems. Whereas the research focus and how the ecosystem is seen differs between each research stream, the goal of each ecosystem is the realization of a VP (Autio & Thomas, 2022). As this thesis aims to identify and understand the dynamics that influence VP development in an emerging ecosystem, our work theorizes on the ecosystem lens that focuses on the flow of value (Autio & Thomas, 2022) and not one singular literature stream.

2.2. The Emergence of an Ecosystem

Building upon the foundational understanding of the ecosystem lens, this section explores what is previously known about ecosystem emergence. The emergence of an ecosystem, also referred to as birth stage (Moore, 1993) or initiation phase (Autio, 2022), is crucial to the development of the ecosystem. This emergence phase influences the subsequent development and success of the ecosystem, as ecosystems develop in a path-dependent fashion (Dattée et al., 2018; Jacobides et al., 2018). Central to this phase is the development of a VP (Autio, 2022; Moore, 1993), hence a thorough understanding of this phase is essential for this thesis.

While scholars designate the phases within an ecosystem differently, e.g., Autio (2022) and Moore (1993), there is a consensus that the emergence of an ecosystem is marked by an establishment phase. The birth-stage (Moore, 1993) emphasizes the development of a VP, collaboration to prevent engagement with competing ecosystems, and the orchestration of initiatives to enhance the ecosystem (Dedehayir et al., 2018; Moore, 1993). It is also characterized by the simultaneous presence of cooperation and competition (Daymond et al., 2023), alongside the establishment of an ecosystem structure (Autio, 2022).

Despite its importance, research into ecosystem emergence remains limited. One exception is Pushpananthan & Elmquist (2022) that conducted a case study focusing on the emergence of an ecosystem. In their study, they identified three triggers that played a pivotal role in the ecosystem's emergence. First, the need for resources and competences motivated the orchestrator to engage in several alliances. This led to the establishment of a joint venture (JV) and the company's need to synchronize its activities with the JV, the second trigger in ecosystem emergence. Finally, more alliances were established around the orchestrator's platform which led to the third trigger, the need to orchestrate and maintain the balance of the network.

Another case study, Dattée et al. (2018), views ecosystem emergence as a systemic, feedback-driven process. This process is characterized by collective discovery and co-evolution, where the orchestrator envisions a broad future of the ecosystem and together with its partners collaboratively explores and refines potential VPs.

The examples illustrate the critical roles of co-evolution and ecosystem orchestration in ecosystem emergence. To facilitate the reading flow, this thesis groups these terms under the notion "dynamics". Dynamics refer to mechanisms and actions that provide change within a system over time, and are explored in the next section.

2.3. Dynamics in Emerging Ecosystems

2.3.1. Ecosystem Orchestration in Emerging Ecosystems

Although several actors are important for the emergence of an ecosystem (Dedehayir et al., 2018), it is commonly posited that one actor takes on a large responsibility for creating, establishing, and leading the ecosystem (Iansiti & Levien, 2004; Moore, 1993). These actions are described as ecosystem orchestration, a key dynamic in emerging ecosystems.

In discussing ecosystem orchestration, the academic discourse differentiates between consensus-based and dominating orchestration approaches. Whereas consensus-based orchestration emphasizes the use of bottom-up mechanisms between the partners, in the dominating style the orchestrator designs the ecosystem in a top-down way (Reypens et al., 2021). Reypens et al. (2021) propose a third, hybrid mode of orchestration, suggesting that orchestrators act as environmental scanners, switching between orchestration modes over time. Thereby, the dominating style allows for structural direction and visionary leadership while the consensus-based style allows for consensus building and trust development.

Expanding further, various scholars have sought to delineate the critical actions adopted by ecosystem orchestrators in the emergence of an ecosystem, for instance Autio (2022), Dedehayir et al. (2018), and Shen et al. (2024). Dedehayir et al. (2018) pinpoint essential areas of actions during ecosystem emergence. First, ecosystem orchestrators govern the ecosystem by designing roles for ecosystem participants, expediting coalescence, and managing the flow of resources among partners. Moreover, they attract new participants, form links among them to create an alliance, create collaboration to achieve a common objective, and stimulate complementary investments. These investments require that the orchestrator stimulates value appropriation for both itself and other participants, including end-users. Recently, in a qualitative meta-analysis about industrial firms, Shen et al. (2024) noted that orchestrators undertake ecosystem strategic design practices that are essential for forming a shared VP among partners, something that is "foundational for the ecosystem's existence" (Shen et al., 2024, p. 14). Thus, the actions of an orchestrator are essential for developing a joint VP.

2.3.2. Co-evolution in Emerging Ecosystems

Co-evolution is a fundamental and distinguishing feature of ecosystems and another key dynamic in the emerging ecosystems (Aarikka-Stenroos & Ritala, 2017). Originating from biology (Janzen, 1980), within the management literature the term co-evolution has often been used metaphorically to describe the complex, interdependent development of organizations, rendering it meaning somewhat ambiguous (Abatecola et al., 2020).

Breslin et al. (2021) contribute to clarifying the concept of co-evolution for ecosystems by conceptualizing them as complex adaptive systems. As with complex adaptive systems, actors in an ecosystem "adapt and evolve through an internal organization structure not featured by a centralized coordination mechanism" (Breslin et al., 2021, p. 60). For that to happen, interactions between actors must be specific as well as rule-based, and there must be an energizing force propelling the system toward self-organization.

A foundational condition for co-evolution within ecosystems is interdependence among its actors. This interdependence is characterized by specific interactions, whereby the actions of one actor cause a change in the resources and capabilities of another actor. Moreover, such interactions are reciprocal, meaning both actors cause changes in the other, and simultaneous (Breslin et al., 2021). Those prerequisites have been explored in prior literature. Iansiti & Levien (2004, p. 69) underscore the necessity of a "shared fate" among ecosystem actors, implying that their individual performance is intrinsically linked to the collective performance of the ecosystem. Jacobides et al. (2018) posit that ecosystem actors must exhibit specific complementarities in production and consumption that lead to some degree of mutual specialization, called co-specialization.

Next, co-evolution emerges through the interactions of actors governed by formal and informal rules (Breslin et al., 2021). Formal, contractual rules enhance the coordination of activities between parties, while informal rules shape the practice of daily interactions and thus expectations of daily exchanges (Ness & Haugland, 2005). That co-evolution emerges through the interactions of actors aligns with Autio & Thomas' (2022) observation that ecosystems predominantly leverage relational rather than contractual governance mechanisms, facilitated by the interdependence among actors. Over time, the amalgamation of these rules, objectives, and activities fosters alignment and emergent order within the ecosystem (Breslin et al., 2021).

Driving this co-evolution within ecosystems is an energizing force, for instance innovation. It is often anchored by a principal actor capable of ensuring alignment and stability (Breslin et al., 2021).

2.4. VP Development in Emerging Ecosystems

After having established an understanding of dynamics that operate in emerging ecosystems, the phase where the VP is created, this section reviews literature on VP development in emerging ecosystems. The VP is a central concept in the ecosystem literature, representing the ecosystem structure and aligning the activities of ecosystem actors toward a customer facing solution (Adner, 2017; Linde et al., 2021). Consequently, the development of VPs is a critical area of scholarly exploration (Adner, 2017; Jacobides et al., 2018). However, whereas prior literature predominantly focuses on the articulation of VPs among pre-existing partners, there is a notable lack of research that addresses the development of VPs in emerging ecosystems (Lingens et al., 2023).

Moreover, the peculiarities of ecosystems present distinctive challenges in developing VPs. The interdependence among ecosystem participants (Jacobides et al., 2018), thereby complicates defining a VP. Unlike in traditional market settings characterized by dyadic relationships, an orchestrator in an ecosystem context lacks absolute control, necessitating the alignment of partners toward the development of a shared VP. This alignment underscores the orchestrator's critical role in ensuring that the VP provides sufficient value to both partners and end-users (Lingens et al., 2023). Moreover, in an ecosystem context resources necessary for realizing a VP reside in actors that often span across various sectors and industries (Moore, 1993). This indicates that multiple actors are required to materialize a VP and might influence its development.

The existing research insufficiently addresses these complexities. It rather overlooks this developmental phase, either by simply noting that ecosystem orchestrators initially propose novel VPs, seek appropriate partners, and persuade them to engage with the ecosystem (Dattée et al., 2018; Lingens et al., 2021), or by recognizing the negotiation of value offerings with partners while disregarding the role of customers in this process (Thomas & Autio, 2020). An exception is Lingens et al. (2023) who conducted a multi-case study to explore how factors like market uncertainty and level of co-specialization affect the process of developing VPs in emerging ecosystems. They state that orchestrators reduce the market uncertainty as much as possible before involving partners. Furthermore, the higher the level of co-specialization is between partners, the stronger the partners' interests are favored compared to the customers'. This can lead to that with higher levels of co-specialization, key partners act like co-orchestrators. Finally, their research identifies a generic process for how firms in an ecosystem setting develop VPs. This process starts with the orchestrator presenting an initial idea for a VP, then developing a prototype while only onboarding partners if necessary, iteratively refining the VP and finally integrating more partners for scaling up. Whereas the study explores some ecosystem characteristics such as co-specialization, it falls short to adequately incorporate further ecosystem complexities. The research stays on a generic level and does not specifically discuss how dynamics in emerging ecosystems affect the VP development. Moreover, it falls short of specifically exploring the interactions between customer and firm and their effect on the VP development, and neglects interactions with other heterogeneous actors.

2.5. Research Gap

The literature review emphasizes a notable scarcity of research concerning the emergence of ecosystems and an even greater scarcity in studies focusing on the development of VPs within such contexts. In fact, numerous scholars call for further research in the domain of ecosystem emergence, e.g., Dattée et al. (2018), Dedehayir et al. (2018), Gawer and Cusumano (2014), Jacobides et al. (2018), Pushpananthan and Elmquist (2022). Lingens et al. (2023) even characterize their study on VP development in emerging ecosystems as pioneering work. This scarcity of research is surprising, given that the VP plays a central role in every ecosystem and the main purpose of an ecosystem is to realize a VP (Adner, 2017; Lingens et al., 2023). Furthermore, the development of a VP is deemed pivotal to the emergence phase of an ecosystem, a phase that profoundly shapes its future trajectory (Dattée et al., 2018; Jacobides et al., 2018).

Furthermore, the literature review finds that the sparse existing literature on VP development in emerging ecosystems inadequately addresses the complexities of ecosystems and neglects the engagement with critical actors like customers or other entities (Thomas & Autio, 2020). This oversight is notable as ecosystems are characterized by heterogeneous actors that have joint value creation as a goal (Adner, 2017). The distinctive attributes of emerging ecosystems, such as their inherent dynamics, and the importance of the VP in this context, underscore the necessity for further research in this area. The literature review highlights co-evolution and orchestration as dynamics in emerging ecosystems. Yet, to date, no study has explored the dynamics that guide actors within an ecosystem to collaboratively develop a shared VP, nor examined the impact of these dynamics on VP development. This is problematic given the increased prevalence and importance of ecosystems (Jacobides et al., 2024).

Beyond academic interest, a deeper understanding of this subject bears practical implications. The nature of ecosystems has rendered conventional markets inefficient (Foss et al., 2023), and thus necessitates that companies engage in collaborations within ecosystems (Jacobides et al., 2024). Considering that ecosystems are typically orchestrated and VP development influences the success of the ecosystem (Jacobides et al., 2018), it is imperative for organizations to grasp the dynamics through which VPs are developed within such settings.

2.6. Theoretical Framework

From the previous discussions in the literature review and the identification of the research gap, the need of a theoretical framework that allows for comprehensively investigating the development of a VP in an emerging ecosystem was deduced. However, due to the lack of focus on the VP development in ecosystem literature, it is necessary to look in other theoretical domains for suitable explanatory literature. This suggests the exploration of marketing literature, where the concept of VPs has been extensively discussed. Therefore, this section first reviews prior marketing literature regarding the VP concept, then examines VP development, and finally integrates ecosystem and marketing literature into an integrated theoretical framework.

2.6.1. The VP Concept in Marketing

Few concepts in business are as frequently used as “the customer value proposition” (Anderson et al., 2006), often thought of as being formulated by the firm to articulate the value that the customer will receive, framing the VP as a “company-formulated marketing offer” (Payne et al., 2017). Payne et al. (2017) discuss how the concept of the VP has shifted over time. Early definitions posit the firm as the sole creator of value, which is then delivered to the customer (Bower & Garda, 1985, as cited in Payne et al., 2017)

Over time, a new perspective appeared, viewing VPs as being mutually created with customers (Payne et al., 2017). This is in line with the shifting perspective on value in marketing literature. In the conventional thought on value, according to Vargo & Lusch (2004) and Vargo et al. (2008), value is perceived to be an attribute that is embedded in goods through the production and manufacturing processes of a supplier. This value is then transmitted to customers via exchange. Rather recently, Vargo & Lusch (2004) introduced a new perspective that reconsiders the genesis of value, arguing against the notion that value can be created by a single actor. Instead, they posit that a supplier's role is limited to offering VPs, with the actual determination of value resting in the hands of the beneficiary, typically the customer (Vargo & Lusch, 2008).

A key component to Vargo and Lusch's (2004) proposal around the concept of value is the notion of co-creation which asserts that "Value is co-created by multiple actors, always including the beneficiary" (Vargo & Lusch, 2016, p. 8). In this sense, value creation is a collective process, that unfolds through interactions between suppliers and customers (Vargo et al., 2008), but also with other actors. Furthermore, the actors in this co-creation process may not always be conscious of the mutual benefits being generated (Vargo & Lusch, 2016), underscoring that co-creation does not require an explicit agreement to jointly pursue value creation. Finally, co-creation can transpire even in the absence of direct interactions, exemplified by customers who advocate for a brand, thereby influencing others' perceptions of the supplier (Vargo & Lusch, 2010).

2.6.2. VP Development

To better understand how VPs are conceived their development needs to understood. It can be co-creative in nature and influence how the VP is created (Payne et al., 2020).

The initial design of a VP is a foundational step in the development of a VP and encompasses the firm doing various assessments, such as assessing internal capabilities or conducting customer research. A customer's involvement in this stage can impact the perception of value and build strong relationships between customer and supplier (Payne et al., 2020).

An important step when establishing a VP, especially in B2B-markets, is the process of quantifying value (Kotler, 2017). It refers to how a company provides ways to quantify the value offered by the VP, and make customers easily see the benefits available to them, especially in relation to the price (Hinterhuber, 2017). This value could take the form of quantitative benefits such as lowered costs, or qualitative benefits such as improved ease of working (Payne et al., 2020).

Another important aspect of VPs is communicating value, which refers to activities of communicating the VP to the market. Focus is put on making sure customers fully grasp the VP through, for example, providing aid in visualizing the proposition, and what it would mean for the customer to accept it (Payne et al., 2020).

Furthermore, Payne et al. (2020) discuss what they call the strategic context, which supports the development of VPs. Core to this context is the firm's business model, emphasizing the strategic choices made, the value creating system, value capture and the value network.

2.6.3. An Integrated Theoretical Framework

With a greater understanding of value, VPs and VP development, the theoretical framework can be finalized. Figure 1 presents the integrated theoretical framework. It integrates the identified dynamics in emerging ecosystems, ecosystem orchestration and co-evolution, with the concept of co-creation from the marketing literature. Through this integration, it aims to offer an understanding of VP development amidst the complexities of the ecosystem environment.

Moreover, in examining co-creation within an ecosystem context, it is imperative to recognize that an ecosystem encompasses a multitude of diverse actors from various sectors, and that the outcome of the ecosystem is a VP (Adner, 2017). Thus, our analysis of how co-creation affects VP development adopts a broader perspective that extends beyond the dyadic interaction between customer and supplier to include other actors constituting the ecosystem.

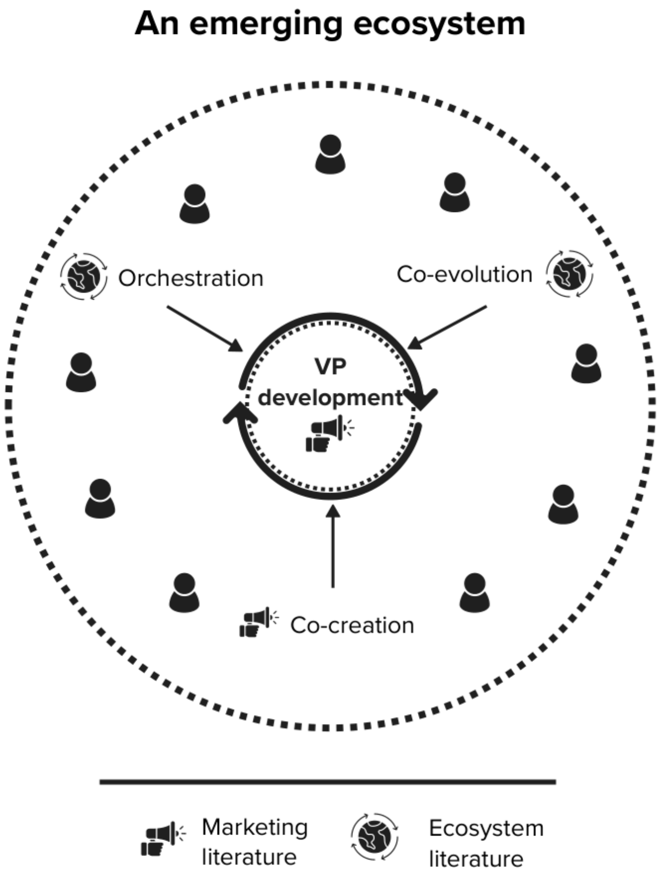

Figure 1 – Integrated theoretical framework

3. Methodology

After providing a theoretical understanding of our topic, this section explains how the research was conducted. Thereby, it elaborates on the scientific research approach, research process, research case selection, data collection, data analysis, quality of research, and ethical considerations.

3.1. Scientific Research Approach

This section first elaborates on the selected research strategy and philosophical considerations before discussing the research approach. Edmondson & McManus (2007) note that the developmental state of the theory should guide the choice of research strategy, organizing theory development into a continuum ranging from nascent to intermediate to mature states. Our literature review points out a notable research gap around emerging ecosystems, particularly concerning the development of VPs within these contexts. Moreover, to date no study has comprehensively investigated the dynamics that affect VP development in an emerging ecosystem. We therefore argue that our research area is in a nascent state and follow Edmondson and McManus' (2007) argumentation that this setting suggests a qualitative approach. Furthermore, we argue that our research is of an exploratory nature, as it aims to generate theory rather than test it, or in our case develop theory (Dubois & Gadde, 2002). Saunders et al. (2019) assert that qualitative research methodologies are particularly effective in exploratory settings. Hence, we posit that a qualitative research strategy is suited to our research area and questions.

The chosen research strategy is also underpinned by our philosophical considerations. We perceive reality as a construct shaped by social actors, thereby adopting a constructionist perspective. This view asserts that the phenomena we study are socially constructed, continuously shaped and reshaped by social actors. This ontological stance leads to our epistemological consideration. We seek to comprehend human behavior and generate knowledge by interpreting participants' descriptions and insights, aligning with interpretivist principles (Bell et al., 2019).

These philosophical considerations informed how we were to conduct our qualitative research. As individuals provide meaning to the phenomenon under study, our research will engage actively in their sense-making processes and interpret decisions from their perspectives (Lofland & Lofland, 1995, as cited in Bell et al., 2019). This approach necessitates posing numerous "how" and "why" questions to understand of how the individuals perceive their world (Bell et al., 2019).

When choosing our approach to studying our research area, we chose to align with an abductive method, or more specifically with what Dubois & Gadde (2002) describe as the systematic combining approach. This approach is closer to an inductive than a deductive approach but puts a greater focus on using theory to explain the data gathered in the research. Dubois & Gadde (2002) emphasize “theory development”, rather than “theory generation”. That is, systematic combining emphasizes adding or expanding on existing theory rather than generating entirely new theory. This is appropriate for us, as we seek to develop theory on VP development in emerging ecosystems, and will likely enrich existing ecosystem literature rather than establishing a new theoretical construct.

3.2. Research Process

We began our research in an initial phase, developing a preliminary theoretical framework based on ecosystem literature and simultaneously selecting our case. Following this, we began an initial sampling of interviewees through a hybrid process of theoretical and snowball sampling. We also created a preliminary interview guide. In the following phase, we continued the sampling process, conducted interviews from the initial sampling selection and begun coding the collected data. When coding and forming themes, we shifted back and forth between the data and our theoretical framework to evaluate if additional theory was required to explain certain findings, in line with Dubois & Gadde’s (2002) suggestion of an evolving theoretical framework. We also adapted our interview guide based on our findings and what additional data we needed. The sampling process was then repeated, guided by the type of interviewee we deemed important to interview. After conducting the interviews, we moved to a final phase where we analyzed our findings using the theoretical framework. The framework was further modified during the analysis process.

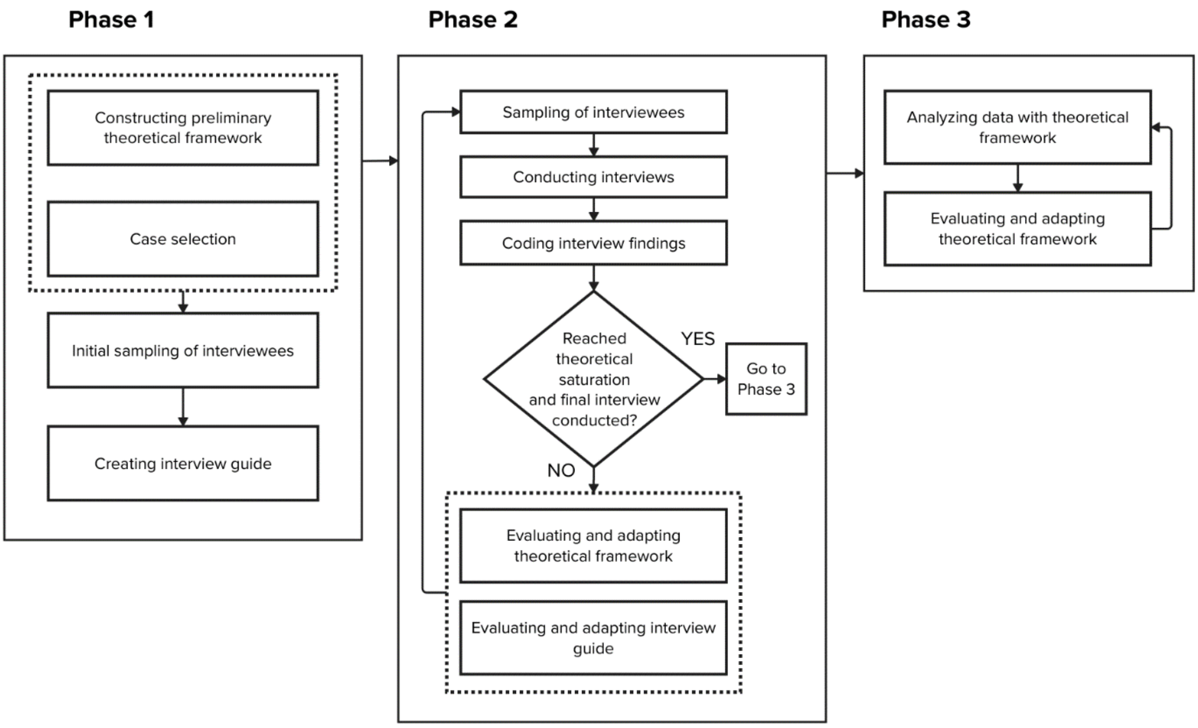

Figure 2 – Visualization of the research process

3.3. Research Case Selection

To study our research topic, we opted for a case study design. A case study has the focus on "a bounded situation or system, an entity with a purpose and functioning parts" (Bell et al., 2019). This makes a case study suitable for research into ecosystems, due the bounded nature of ecosystems and the ecosystem actors' focus on joint value creation (Adner, 2017). Case study research also proves valuable for inquiries aimed at a thorough understanding of social phenomena (Yin, 2018), aligning well with our objective to identify and understand the dynamics that influence VP development in an emerging ecosystem. Additionally, the case study approach is appropriate in fields where research is sparse, as noted by Benbasat et al. (1987), which aligns with the current state of research on VP development in emerging ecosystems, as detailed in Section 2.5. A single case study approach was chosen to enable an in-depth exploration of our topic, which a focus on multiple cases might have reduced (Dubois & Gadde, 2002). We are aware of the possible downsides of using a single-case design as opposed to a multiple-case design, such as the inability to compare or contrast multiple cases (Yin, 2018). However, we believe the in-depth learnings from a single case will better aid us in answering our research questions, in line with the beliefs of Dubois & Gadde (2002).

Our interest in collaborating with Vattenfall stemmed from our interest in ecosystems. In an early scan of potential corporate partners, we noted Vattenfall's increased involvement in external initiatives outside their core business. We also identified the HYBRIT initiative as a potential case for our research but had not decided on it at the time.

We employed a theoretical sampling approach to our selection of a suitable case, where our goal was to find a case that would allow for "the generation of a theoretical understanding" (Bell et al., 2019). Thus, we searched for a case that would allow us to further understand the concepts we sought to research, thereby helping us answer our research questions. Our criteria for this sampling process were: (1) the case needs to show indications of an ecosystem, as described in prior literature; and (2) the ecosystem needs to be in an emerging phase. After exploring a variety of projects, we decided that the HYBRIT initiative would be a suitable case. The initiative was deemed to have many actors involved with the joint focus on creating a novel VP, that of fossil-free steel, which aligns with the collective output of ecosystems. Additionally, the actors were involved in multilateral relationships, not only dyadic. Furthermore, the actors involved were not only the main contributors to the value chain, but also appeared to include public actors such as the Swedish government and European legislators, as well as research institutions. Furthermore, the initiative was recently formed, indicating an early stage of development, aligning with our interest in emerging ecosystems.

3.4. Data Collection

With a qualitative research method in mind, we set out to collect data by interviewing employees from the different actors in the ecosystem. This resulted in data in the form of interview transcripts. The data collection primarily took place over the course of one month. The following sections will delve deeper into this process.

3.4.1. Interview Sample

When starting the interviewee sampling, we proceeded with a purposive sampling method instead of random sampling. We did this to find interviewees that were relevant to our study and would have the best opportunity to contribute to the research, while also being diverse enough to get a variety of perspectives on the subject matter (Bell et al., 2019). More specifically, we employed theoretical sampling, as our goal was to generate a theoretical understanding, and probability sampling has been suggested to not be suited for qualitative research (Glaser & Strauss, 1967). Theoretical sampling was combined with snowball sampling (Bell et al., 2019), which formed a hybrid sampling approach. The snowball sampling method was relevant as we were recommended to not start reaching out to potential interviewees at the start and instead have a person in the strategic business development department contact a colleague, Vattenfall-1, who had been heavily involved in the HYBRIT initiative.

Furthermore, due to Vattenfall-1's seniority, knowledge of the project and industry contacts, we were able connect with relevant key senior employees in other organizations, which might not have been possible without snowball sampling (Bell et al., 2019).

The interview candidates resulting from snowball sampling were evaluated against criteria, in line with theoretical sampling. We sought to interview senior employees from various actors in the ecosystem that had been, or still are, involved in the HYBRIT initiative. We also desired interviewees that had been active in the initiative in different points of its lifetime. This was done to get multiple perspectives on the initiative. The full list of interviewees can be found in Appendix 1, and Table 1 provides a summary.

The sampling process ended when we acknowledged that we had reached theoretical saturation. The final interviews did not yield any relevant, new data, our themes were well-developed, and the relationships between them were clearly established. This is suggested by Strauss & Corbin (1998) to be the point at which theoretical saturation has been achieved.

Interviewed company	**Number of interviewees**
Vattenfall	6
LKAB	3
SSAB	3
HYBRIT	4
Volvo	2
External Researchers	2
Total	20

Table 1: Summary of conducted interviews

3.4.2. Interview Design and Documentation

When deciding on what type of interview to conduct, we had a clear focus of what to research and wanted to address specific areas of interest. Both authors would also be involved in conducting the interviews. For these research situations Bell et al. (2019) suggests that a semi-structured approach would be suitable, which was finally selected.

We created an interview guide (see Appendix 2) that covered our topic and research interests but also allowed us to go deeper in certain areas that were discovered during the interviews. The interview guide was modified over time to improve the wording of questions, remove questions that proved unnecessary, and to better fit the interviewee. However, no major changes were made to the main structure of the guide.

Before each interview, we conducted research on the interviewee and the organization they were employed by at the time of their involvement with the HYBRIT initiative. This was done to establish a good understanding of the interviewee's background, which enabled us to better comprehend their answers (Bell et al., 2019).

3.4.3. Interview Process

The prospective interviewees were contacted through emails or LinkedIn-messages, providing background information regarding our research, why we wanted to interview them, and requesting their participation. Interviews were conducted through video calls using the communication service Microsoft Teams. Video calls were deemed necessary for most interviews, as many had busy schedules, worked remote and/or had preferences for video calls. Video calls have been shown to be inferior to in-person interviews in some respects, but only by a negligible amount (Krouwel et al., 2019).

During the interviews, both thesis authors were present. One of the authors conducted the interview, asking the main questions outlined in the interview guide, follow-up questions and probing questions, as well as taking notes. The second author focused more intensely on listening and taking notes, and asked probing questions at points where interesting topics were brought up that the main interviewer had not considered. These roles were switched between different interviews.

Each interview followed a specific structure. When the interviewee entered the video call, a brief, informal discussion was held to make them feel comfortable with the situation and to establish rapport, thereby ensuring their willingness to proceed with the interview (Bell et al., 2019). We then refreshed the interviewee on the research topic, let them know that no private information would be used, and that their participation in the study was voluntary. We then asked for permission to record the interview and provided information about how the interviewee's data would be handled in accordance with General Data Protection Regulation. The interviewees were also asked if they wanted a transcript of the interview afterwards. Following that, we began the main interview.

After each of the interviews we compared our notes, examined interesting ideas and topics that we had identified, and discussed what information and data we would need from future interviews. All interviews except two lasted around 60 minutes, with the remaining ones lasting around 85 minutes and 40 minutes respectively.

Secondary sources were used to further research areas that some interviewees touched upon, or to confirm certain information. This was done mainly for data concerning important ecosystem events. Examples of secondary sources used were press releases from the companies and news articles regarding topics the interviewees mentioned.

3.5. Data Analysis

For analyzing our data, we drew upon the approach of thematic analysis as described by Braun & Clarke (2006), more specifically in line with what they refer to as theoretical thematic analysis. Theoretical thematic analysis is driven by the researchers' interest in specific areas, as opposed to a more inductive approach where data is not seen as needing to fit certain existing frames when coding. Since, we were interested in particular areas from the outset, the theoretical thematic approach of analysis appeared suitable. Consequently, coding and the forming of themes were often based in our interest areas, which also aligned with our approach of systematic combining. In Section 4 we present the data in a semantic approach, describing what interviewees have explicitly stated and what our secondary data describes (Braun & Clarke, 2006). We then provide an analysis on what Braun & Clarke (2006) describe as the latent level, going deeper than surface level observations of what participants say, seeking to find underlying concepts and assumptions. This aligns with our constructivist ontological position.

The analysis was separated by different phases, the first one concerning us getting familiarized with the data we had collected. This familiarizing process first occurred during the interviews where we took note of interesting answers and ideas, which were further discussed after each interview. The familiarizing process continued during the transcription process. Each interview was transcribed in real time through a transcription feature in Microsoft Teams, providing us with a first draft. We read through each transcript and fixed issues that had occurred during the transcription process. Following this, we started coding by using the qualitative analysis software program NVivo, finding interesting and illustrative parts of the data that could be grouped to form codes. These codes were then further grouped under themes. When themes were created or revised, we evaluated their relevance based on if they contributed to answering our research questions.

3.6. Quality of Research

To ensure the quality of our research, we evaluated it using specific criteria. There are different ways to evaluate the quality of qualitative studies. One of them is to use similar criteria to those used in quantitative studies, focusing on measuring validity and reliability (LeCompte & Goetz, 1982). Some qualitative researchers, such as Lincoln & Guba (1985) argue that qualitative research cannot be evaluated on the same criteria as quantitative research, because qualitative research entails researchers' interpretation of the world and allows for multiple views of a phenomena (Bell et al., 2019). Furthermore, Johnson et al. (2006) argue that evaluating the quality of research using criteria based on quantitative research represents a positivist research philosophy, which does not align with a constructionist and interpretivist stance. Lincoln & Guba (1985) suggest the four criteria of *credibility*, *transferability*, *dependability*, and *confirmability* as preferable criteria when conducting qualitative research. Based on the previous listed arguments, we have chosen to utilize these criteria.

Credibility is the equivalent of internal validity in quantitative research. To ensure it, a researcher needs to make sure that the research is carried out in such a way that credibility can be demonstrated, and that the subjects in the research are able to confirm that the researchers have properly grasped what has been studied. To ensure credibility, we enlisted two methods recommended by Lincoln & Guba (1985), member check and triangulation. For the member check, we made sure that our interviewees were able to review their contribution to the thesis. They were able to either read a complete transcript of the interview or the parts of their interview we quoted in the thesis. Triangulation is about using multiple data sources to confirm collected data. We asked many of the respondents the same, or similar questions. Thus, information about, for instance, certain events in the case could be deemed more credible if multiple interviewees held similar views. We also used secondary data public information to triangulate findings in our interviews, as described in Section 3.4.3.

Transferability is the equivalent of external validity in quantitative research and concerns how well the findings established in the research can be transferred or applied to another setting. To ensure transferability, we have made sure to provide what is known as *thick description*. This term is not completely well defined, but Lincoln & Guba (1985) suggests two important parts. Firstly, a thick description should contain "A thorough description of the context or setting within which the inquiry took place and with which the inquiry was concerned" (Lincoln & Guba, 1985, p. 362). We provide this through our in-depth description of the background of the case, our section on empirics (see Section 4), and the reasoning behind our research into our specific topic. Secondly, Lincoln & Guba (1985, p. 362) suggest that a thick description also should contain *"A thorough description of the transactions or processes observed in that context that are relevant to the problem, evaluand, or policy option"*. We provide this by constructing a timeline of the observed events and the processes within it, which can be found in Section 4.

Dependability is the equivalent of reliability in quantitative research. Reliability often is considered to rely on how replicable a study is, something that is hard to achieve in qualitative research. Thus, we instead consider dependability in our research. One of the methods to achieve dependability, suggested by Lincoln & Guba (1985) is to keep records similar to an audit trail of the research process. We have implemented this method by keeping various records such as notes from supervisor meetings, interview transcriptions, research plans and more to provide a potential inquiry auditor with material to evaluate the dependability of the research. We do note that since transcripts from interviews will be deleted at the end of the thesis period in accordance with SSE instructions, hence this extensive audit may not be possible thereafter. Our supervisor has been the closest to what could be considered an auditor for our research, since she had read various versions of our work.

Confirmability is the equivalent of objectivity in quantitative work and refers to if the findings of the research are developed based on the data gathered. To ensure confirmability we have strived to act professionally during our research and kept our own personal values and beliefs out of the process. However, we have still questioned and looked for underlying meanings in the data, in accordance with our constructionist position and interpretivist stance. Lincoln & Guba (1985) suggests that ensuring confirmability should be the main aspect of the auditor and the auditing process, mentioned previously in the section on dependability. For confirmability, it is the product of the research that is examined and audited, such as the findings and analysis, to see if they are supported by the data.

3.7. Ethical Considerations

To protect the identity of those involved in our study, all interviewees were anonymized. They were given a denotation based on the organization or group they are, or were part of that is involved in the HYBRIT initiative. Thus, an interviewee from Vattenfall was denoted Vattenfall-1, while an interviewee from SSAB was denoted as SSAB-1 (with consecutive interviewees receiving a higher number, such as Vattenfall-2 or Vattenfall-3). Interviewees were also briefed on the conditions of participating in the interviews, covered previously in Section 3.3.3.

4. Empirical Data

After providing an understanding about how the research was conducted, this section presents the empirical data gathered through our research. It commences by providing background to the HYBRIT initiative, and then describes the emergence of the HYBRIT ecosystem and the development of its VP. To present the empirical data in a structured manner, the emergence of the HYBRIT ecosystem is divided into three phases. In the preparation phase, the prerequisites for ecosystem emergence were established. In the subsequent formation phase, customers were engaged and roles were redefined. Finally, in the operation phase, the focus laid on scaling up.

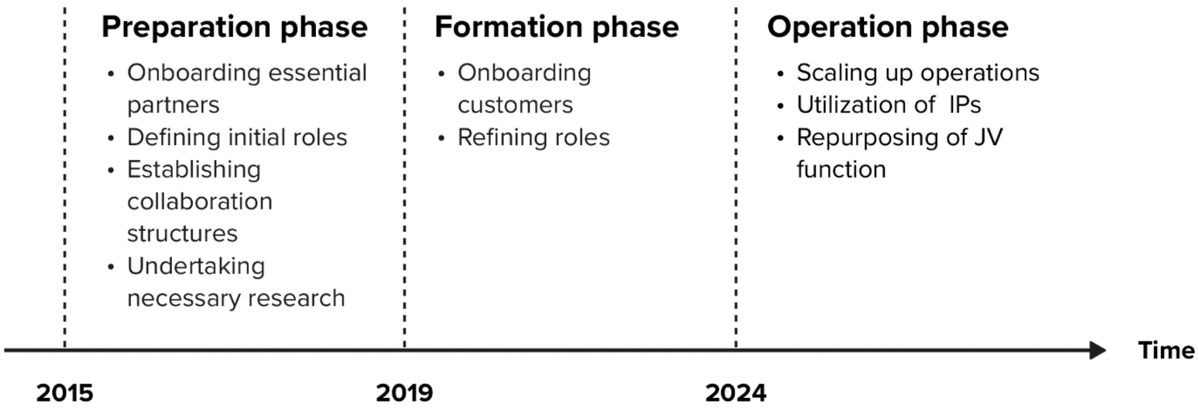

Figure 3 – Timeline of the Emergence of the HYBRIT ecosystem

4.1. Background to the HYBRIT Initiative

SSAB has consistently established itself as a frontrunner in sustainability within the steel sector. In partnership with its primary supplier and mining company, LKAB, it advanced blast furnace technology, leading to the production of high-strength steels that surpassed the lightness of its competitors' offerings. This breakthrough enhanced SSAB's steel production efficiency by 20 to 30 percent relative to its competitors. The longstanding partnership with LKAB fostered a deep connection between the two companies, extending beyond the supply chain to include LKAB's ownership of a 16% stake in SSAB.

> "I would say we consider ourselves not so much customer and buyer but more family. [...] They are one of our oldest customers, and we have had a very long-term relationship." – LKAB-3

Despite these advancements, SSAB remains one of Sweden's largest CO_2 emitters, contributing to 10% of the nation's CO_2 emissions. Most of their steel production, heavily reliant on fossil fuels across the entire value chain, follows a conventional methodology. LKAB extracts iron ore and processes it into iron ore pellets. These pellets are then transported to SSAB, where they are converted into hot metal in a blast furnace. This hot metal is subsequently processed in a basic oxygen furnace to manufacture steel, which is then distributed to SSAB's customers. Notably, it is the process of converting iron ore pellets into hot metal where most of the CO2 emissions occur. Therefore, SSAB conducted research on ways how to mitigate their CO2 emissions. A focus was laid on carbon capture and storage (CCS), where CO2 is captured after being emitted and either used in other applications or stored (International Energy Agency, 2023). However, after a years-long research program, SSAB came to the conclusion that CCS was not feasible for the amount of CO2 they were producing.

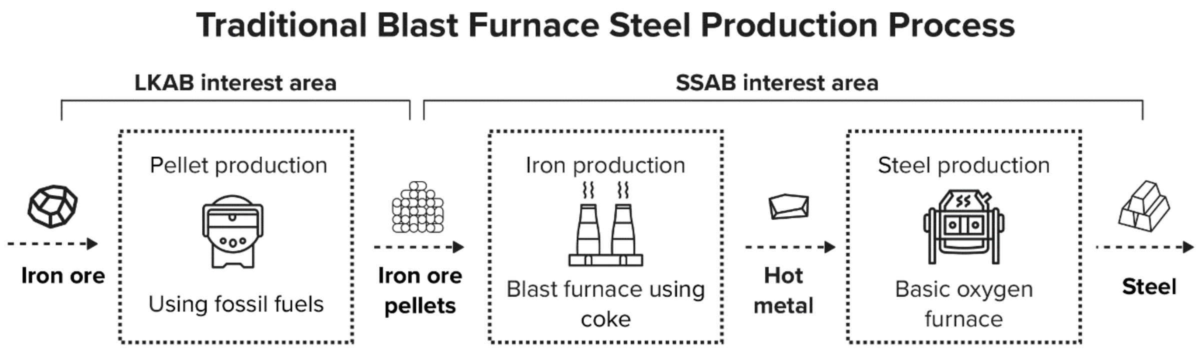

Figure 4 - Traditional steel production process using a blast furnace

At the same time, political pressure increased significantly. The signing of the Paris Agreement by Sweden in 2015 led to the establishment of national emission targets. Additionally, between 2013 and 2015, the Swedish steel industry's trade association, Jernkontoret, recognized the imperative for transformation. This period marked a shift toward proactive measures and efforts to reshape political perspectives.

Finally, during a period when major reinvestments were discussed, SSAB knew that they had to act now to align with Sweden's ambition of achieving net-zero emissions. At the end of 2015 they took the decision to pursue a more disruptive path and focus on making their steel production fossil-free. This entailed shifting iron production from blast furnace production to direct reduction, which uses hydrogen instead of coal to produce direct reduced iron (DRI) (also called sponge iron), and eliminating CO2-emissions across the entire value chain. However, SSAB quickly realized that they did not have the resources and capabilities to pursue this initiative on their own.

4.2. Emergence of the HYBRIT Ecosystem: Preparation Phase

In parallel to SSAB, Vattenfall independently arrived at conclusions regarding the potential substitution of coal with hydrogen in steel production, though there had been no prior interaction between the two entities. This situation evolved in 2015 when SSAB organized a conference focusing on the role of hydrogen within the industry and extended an invitation to a Vattenfall representative. During the conference, SSAB requested that Vattenfall explores the hydrogen production component of the initiative, given that transforming other parts of the value chain would already require SSAB's full focus.

At this point in time, the initiative was met with considerable optimism. This was attributable to several factors: a significant reduction in the cost of fossil-free electricity, essential for the initiative's success; SSAB's strategic shift away from fossil-fuel-based steel production; and Vattenfall's search for an important new project. Additionally, the technology under consideration was long-established, but was not yet economically viable for large-scale application.

> "Every star was aligned for this back in 2015 and then we stumbled into each other in this meeting." – Vattenfall-1

After the conference, Vattenfall's interest was driven primarily by the anticipated increase in demand for electricity and the potential benefits in terms of branding. SSAB then extended an invitation to LKAB for collaboration. For LKAB, participation in the initiative was aligned with their interests. They were extensively connected with SSAB, and consequently felt pressure to assist SSAB in transforming the value chain. Moreover, LKAB already had experience with the new direct reduction technology from halted projects.

Subsequently, the CEOs of the three companies came together to explore opportunities for collaboration. On April 4th of 2016, the trio hosted a joint press conference with the minister of enterprise, unveiling their ambition to establish a fossil-free steel production with a target set for achieving this by 2045.

Initially, Vattenfall was tasked by SSAB with managing electricity and hydrogen aspects, a role considered close to Vattenfall's core competencies. However, deliberations occurred within Vattenfall regarding whether this role was sufficient to justify active involvement and investments. Vattenfall-1 proposed the addition of hydrogen storage as a new component to Vattenfall's responsibilities—a part not previously understood by any of the collaborating entities. The addition of hydrogen storage presented a compelling incentive for Vattenfall's participation. It not only benefited the initiative by enabling the provision of hydrogen at lower prices but also presented potential synergies with other decarbonization efforts and the optimization of wind power facilities.

While the initiative commenced with distinct roles assigned by SSAB—Vattenfall managing electricity and hydrogen, LKAB overseeing mining and pelletizing, and itself focusing on direct reduction and steel production—areas of overlapping interests among the entities became evident shortly thereafter. Specifically, LKAB was interested in the hydrogen storage and direct reduction process. Thus, the partners were aware that a successful transformation of their activities would cause complications with regards to the traditional value chain structure. Figure 5 presents a comparison of the traditional and envisioned value chain to illustrate those complications.

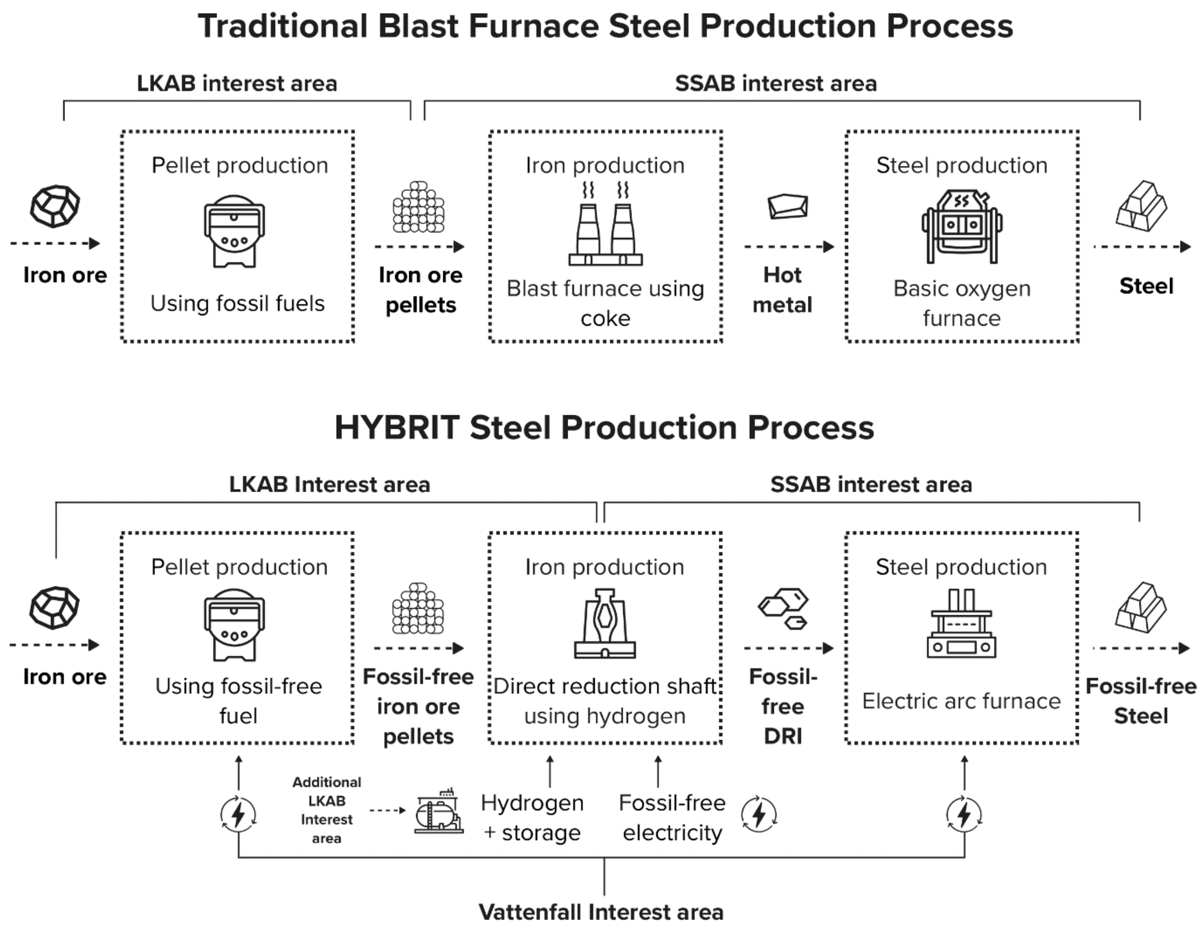

Figure 5 – Comparison of the traditional and the HYBRIT steel production process

In parallel, a feasibility study was conducted to assess the project's technical viability and the cost implications for the final steel product. The study concluded that the technology and business case might be feasible, prompting the continuation of the initiative.

After this initial success, SSAB, LKAB, and Vattenfall established the JV HYBRIT Development AB (henceforth referred to as "the JV"), based on a proposal from SSAB's CEO. The formation of the JV represented a pivotal development in the emergence of the HYBRIT ecosystem and was principally motivated by two objectives: firstly, to assemble a dedicated team with a focus on research and development (R&D) of the technology required to transform the value chain, and secondly, to consolidate the outcome of the R&D process: jointly-owned assets required for the next phases. Moreover, the JV oversaw the transformation of the entire value chain which proved valuable as the production processes were tailored to the unique chemical properties of the materials involved. For example, the characteristics of upstream iron ore directly influence the melting properties of downstream DRI.

Moreover, with the establishment of the JV, a shareholder agreement was created. This shareholder agreement includes a road map that guides the transformation of the value chain. Furthermore, it states required yearly investments from the owner companies into the JV and the owner companies' fields of interest in the new value chain. Finally, the shareholder agreement notes that future tangible and intangible assets established within the initiative will be jointly owned by the owner companies and its utilization would necessitate a usage fee paid to the JV.

Besides the cross-organizational team with a focus on R&D, the JV enabled other touchpoints between the organizations, such as the board of directors and the steering group which consisted of high level managers from each organization. The steering group met monthly to discusses the progress of the HYBRIT initiative.

In the beginning of the HYBRIT ecosystem, emphasis was placed on R&D concerning the fossil-free value chain. Consequently, several research projects were initiated, incorporating various research institutions, to cover the entire value chain. The JV's shareholder agreement facilitated the R&D process as it mandated annual financial contributions from each company to support technology development across the entire value chain. Furthermore, due to jointly owning the intellectual properties (IPs), this contract expedited the initiative's launch by prioritizing research over long negotiations on complex matters such as IP rights. Interestingly, at this stage, the VP was not a primary consideration.

> "I wasn't really thinking in terms of value proposition at that time [...]. It was more of an OK, we need to fix this for the industry and we should do it for our owners." – HYBRIT-1

Around the same time as the JV was established, Vattenfall announced a strategy shift to achieve fossil-free living within one generation. This further fostered Vattenfall's motivation to illustrate the significant role of electricity in fossil-free innovation, expecting to demonstrate tangible results through the initiative.

4.3. Emergence of the HYBRIT Ecosystem: Formation Phase

After the requirements for the ecosystem to emerge were established in the preparation phase, the formation phase started in 2019 with the aim to test the production of fossil-free steel on a larger scale. In 2020, a pilot plant was constructed in Luleå, Sweden. This facility, established by the JV, garnered significant media attention due to its pioneering role in producing fossil-free steel.

The HYBRIT ecosystem positioned SSAB as a frontrunner in Europe's transition toward fossil-free steel. However, this development led to the emergence of competitors, most notably H2 Green Steel in Sweden, which also focuses on producing steel with low or zero emissions. The rise of H2 Green Steel spurred SSAB to advance its timeline for largely decarbonizing its steel production to 2030, ahead of the initial 2045 objective. This strategic decision was only possible through close collaboration with the HYBRIT initiative, as it necessitated the availability of the required technology 15 years prior to the initial target.

Contrary to H2 Green Steel, which prioritized market engagement and secured commitments from customers through offtake agreements (agreements from customers to buy a certain amount of steel in the future) before commencing production, HYBRIT initially focused more on technical aspects without extensively securing market demand or customer engagement. This market-centric strategy of H2 Green Steel is perceived by some to have affected HYBRIT's shift toward enhancing customer engagement.

> "But of course I think it was good that H2 Green Steel pointed out the need to involve customers." – HYBRIT-1

In December 2020, Vattenfall, LKAB, and SSAB took the decision to engage potential customers for fossil-free steel.

> "We made a strategy in December 2020 that we want to onboard a couple of large customers in order to get traction. [...] It would be good to have an automotive company because the passenger car is the perfect example of an industry where the materials are important." – SSAB-2

The Volvo Group, with its commitment to becoming a fossil-free entity by 2040, emerged as the first and most important customer. While the direct emissions from Volvo's operations are relatively low, the usage of their trucks results in significant emissions for their customers. Volvo, alongside various other automobile manufacturers, has predominantly concentrated its decarbonization efforts on reducing these tailpipe emissions, primarily through electrifying conventional fossil fuel-based engines.

Subsequently, Volvo has shifted its focus toward mitigating Scope 3 emissions, a categorization that delineates emissions into three distinct areas. Scope 1 encompasses emissions directly resulting from a company's primary operations, which for Volvo includes emissions arising directly from the truck production processes. Scope 2 pertains to emissions indirectly associated with a company, such as those generated in the production of electricity used for powering factories. Scope 3 refers to further indirect emissions across a company's value chain (Deloitte, n.d.), which for Volvo, include emissions associated with the production of materials procured for product manufacturing, such as steel used in truck production.

Although steel constitutes a significant component of trucks, such as the chassis, it does not represent a major portion of the overall vehicle cost. Consequently, transitioning to fossil-free steel, despite potentially increasing costs, would not substantially increase costs for Volvo's customers.

> "Then the additional cost of having fossil-free steel in the whole car is very small compared to the cost of the end product." – HYBRIT-3

For Volvo, transitioning to fossil-free steel was not merely a cost consideration but a strategic move to position itself as an industry leader in sustainability. Furthermore, the ability to offer fossil-free products aligned with the growing demand from its customers to minimize their Scope 3 emissions. Moreover, Volvo sought to influence their steel suppliers toward adopting sustainable practices similar to those implemented by the HYBRIT ecosystem, aiming to spur similar transformations across the steel industry globally.

> "From the perspective of Volvo, numerous steel mills require transformation. We show that there is a customer who wants to buy this new material and aim to trigger similar transformations all over the world." – Volvo-2

Interaction between the Volvo Group and the HYBRIT initiative, with SSAB facilitating customer interactions, took place in late 2020. One notable conversation between the CEOs of SSAB and Volvo proposed a limited production run of fossil-free steel, with Volvo assisting in the selection of the most useful steel types for initial production. As SSAB produces hundreds of different steel grades, some of these would be more useful for Volvo's use cases.

> "So that is where our customers come in, to help us prioritize what we're using and where we go for something first." – SSAB-2

Further discussions between Volvo and SSAB revolved around the implications of production costs and the potential price premium for customers. Volvo also tested the quality of the steel and audited the value chain to make sure that the CO2 reductions were as promised. Similar tests were also conducted by SSAB that showed that the quality of fossil-free steel was as good, or even better, than that of traditional steel, which was communicated publicly. Additionally, connections between the companies' R&D departments were established. On August 18th of 2021, SSAB delivered the first batch of fossil-free steel to Volvo. Subsequently, on October 13th, Volvo unveiled the Tara-15, a driverless electric mine hauler produced entirely from fossil-free steel, showcasing the use of fossil-free steel in an end-product. Additional fossil-free steel vehicles, including the Volvo A30 dump truck, were globally demonstrated, illustrating the capabilities of the steel. These vehicles, exemplifying the collaboration between Volvo and SSAB, were branded with logos from both companies to highlight their partnership. Moreover, Volvo actively participated in numerous public engagements alongside SSAB, LKAB, and Vattenfall, promoting the ecosystem's achievements:

> "We have then been working with them also in the public arena. We've had joint presentations at the COP conferences, for example." – SSAB-2

Following initial engagement with Volvo, the ecosystem expanded its customer base within the automotive sector, with Mercedes emerging as another company to join. Mercedes' incorporation was based on their validation of the fossil-free steel's attributes through extensive tests and its capacity to showcase the material's demand to the European Union. The initiative also reached out to entities in other industries, such as manufacturing and construction.

> "Another sector that is interested in decarbonizing their supply chain is the construction industry. Nowadays, the environmental impact of using a building is not that high, but the carbon footprint comes from the materials that you're using when constructing the building." – SSAB-2

Beyond serving as a pivotal customer, Volvo also contributed to the HYBRIT ecosystem by supplying products, including trucks, to the owner companies. For instance, LKAB uses Volvo trucks in its mining operations, which are anticipated to transition to fossil-free models.

> "It [a shift to fossil-free trucks] will not happen overnight, but there are trucks produced from fossil-free steel." – LKAB-3

SSAB similarly uses Volvo's products, and is also expected to transition to fossil-free alternatives. Moreover, Vattenfall has expressed interest in incorporating fossil-free steel into its operations, for example in foundations for offshore wind power.

> "We are also keen to buy fossil-free steel because we need it for other stuff in our business. We need it to build wind towers." – Vattenfall-3

These interactions align with the overarching aim of the HYBRIT ecosystem to achieve net-zero emissions in steel production. While the technological framework supports this objective, ongoing discussions and improvements focus on ensuring that all equipment utilized within the production process is derived from fossil-free steel.

In December of 2023, a letter of intent was signed between Vattenfall and SSAB with the intention to supply fossil-free steel to Vattenfall (Vattenfall, 2023b). Additionally, Volvo has shown interest in utilizing hydrogen produced by Vattenfall for hydrogen-fueled trucks.

> "In the HYBRIT-case, my hope is that with hydrogen being produced, we will also have some hydrogen trucks operating in the future." – Volvo-1

Despite the depicted customer engagement, in the context of developing the VP for the HYBRIT ecosystem, SSAB, LKAB, and Vattenfall predominantly perceived themselves as the architects of this proposition, with minimal initial input from the customer base:

> "They [the customers] haven't been involved in designing the value. No, it's more like they raised their hand very quickly and said we want that steel." – Vattenfall-5

> "To put it very bluntly, we're doing this [producing fossil-free steel]. Do you want to be on board?" – SSAB-2

Moreover, during the formation phase the ecosystem's visibility and outreach to the broader public were significantly amplified. In 2019, SSAB, LKAB, and Vattenfall participated in the New York Climate Week, and in 2022, they, along with Volvo, engaged in discussions at Almedalen Week in Sweden to address policy frameworks necessary for the realization of fossil-free steel. In May 2022, the Swedish Prime Minister presented a candle holder made from fossil-free steel to the President of the United States. Furthermore, in 2023, the U.S. Secretary of State visited the HYBRIT pilot plant, accompanied by Swedish ministers and EU commissioners. During the visit, the Volvo A30 (constructed from fossil-free steel) was displayed outside of the plant and was captured in many of the pictures from the event.

> "When the state secretary Blinken visited Luleå, we brought it [the Volvo A30] up and placed it in front of the HYBRIT plant. There were a lot of photos taken with Blinken, all the EU commissioners and our Swedish ministers, and behind them was our A30." – Volvo-2

The actors also communicated their involvement in the ecosystem separately, through for example releasing digital content on their websites or on video platforms. For example, Vattenfall launched a limited series of a face mist made from water originating from the production of fossil-free hydrogen with an accompanying ad campaign (Vattenfall, 2023a; Sustainable Brands, 2023). Vattenfall also released a 6-episode long video series on HYBRIT, published on their YouTube-channel (Vattenfall, 2022a), and launched an ad campaign detailing their involvement in various decarbonization initiatives, such as fossil-free steel (Vattenfall, 2022b).

The formation phase also represented a pivotal moment to consider the location and responsibility allocation for scaling up operations in the subsequent phase. From the inception, LKAB and SSAB shared a common interest in the direct reduction step, which had been documented within the shareholder agreement. During the formation phase, a discussion emerged between the two partners, with each party expressing their interest in establishing the direct reduction plant and consequently exerting control over this step. The debate encompassed various arguments for building the demonstration plant on either LKAB's or SSAB's grounds. As SSAB traditionally managed the iron production, the proposition of LKAB assuming control marked a significant shift. However, given the lower weight of DRI relative to iron ore pellets, logistical efficiencies were identified in DRI transportation. Additionally, LKAB's strategic considerations for deeper mining operations, associated with increased risks and operational costs, underscored the necessity for higher profit margins that could be achieved through moving down the value chain.

> "The only thing we know is that we have to go very deep, probably down toward 1,800 and 2,000 meters. There is no large scale mine in the world today that is mining at those depths and what you do get is a lot of potential problems with stresses like rock stress and the rock mechanical issues." – LKAB-1

In November 2020, LKAB articulated a strategic pivot toward the production and marketing of fossil-free DRI over traditional iron ore pellets. This strategic decision resulted in the resolution within the HYBRIT ecosystem to establish the direct reduction facility on LKAB's premises.

4.4. Emergence of the HYBRIT Ecosystem: Operation Phase

The start of the operation phase was identified by the decision that all IPs that are established by the JV after 01.01.2024 will be individually owned by the financing company, rather than being a collective asset. This decision aligns with the objective of the operation phase which is scaling-up the explored technology. Scaling-up therefore will be done separately by each owner company and will lead to production capabilities vastly larger than those of the pilot plant.

During this phase, the utilization of the JV's IPs by the owner companies will begin. Certain technologies, identified as particularly beneficial to only a specific owner, can be acquired directly from the JV. The JV's role persists as the technological supplier, licensing the technology to the owner companies. For IPs not exclusively sold to a singular owner and thus remaining jointly owned, a licensing fee is imposed on the owner companies wishing to utilize the technology. This fee serves to reimburse the JV for its operational expenses and is subsequently redistributed among the owner companies, effectively compensating for investments made outside their immediate value chain segments. Despite general agreement, discussions regarding the precise commercial logic underpinning the licensing fee remain ongoing. Moreover, the owner companies are considering extending licensing rights to third-party companies interested in producing fossil-free steel, motivated by three primary considerations: recouping technology investments, facilitating larger corporations' decarbonization efforts, and complying with the stipulations set forth by the EU Innovation Fund and the Swedish Energy Agency for funding eligibility.

Beyond licensing technology, the JV can be tasked with further research by the owner companies. IPs resulting from this research will be owned by the client, aiding in the execution of necessary investments. The advantage of commissioning the JV lies in its deep integration with the owner companies, access to unique resources like the pilot plant, and the specialized knowledge cultivated over recent years.

> "The JV itself is not the IP owner anymore, they are more doing things for the owner companies now and that's because we are approaching industrialization and our field of interests are diverging more and more since we are sort of involved in different parts of this." – LKAB-3

5. Analysis

With the empirical data laid out, the aim of this section is to identify the dynamics that affect VP development in an emerging ecosystem and understand how they affect it. The integrated theoretical framework from Section 2.6.3. points to three dynamics that might affect VP development in an emerging ecosystem. These dynamics are ecosystem orchestration, co-evolution, and co-creation, and are analyzed below.

5.1. Ecosystem Orchestration

Ecosystem orchestration refers to the actions of one or multiple leading companies to improve value creation and appropriation among ecosystem participants (Lingens et al., 2023; Shen et al., 2024) and was identified by the literature review as an important dynamic in emerging ecosystems. In the HYBRIT ecosystem SSAB, LKAB, and Vattenfall were identified as the leading companies and thus henceforth referred to as "the orchestrators". Moreover, our research identified ***ecosystem governance*** and ***creating a collaboration platform*** as groups of orchestration actions. Ecosystem governance encompasses actions that steer the development of the ecosystem and creating a collaboration platform incorporates actions that facilitate alignment between the relevant partners. Both groups refer to actions of leading companies that seek to enhance value-creating interactions among participants of the HYBRIT ecosystem (Shen et al., 2024), and thus they may be grouped under ecosystem orchestration.

5.1.1. Ecosystem Governance

A first orchestration action was to *create and communicate a compelling vision*. SSAB envisioned decarbonizing its steel production by 2045, which facilitated attracting LKAB and Vattenfall. LKAB, deeply connected with SSAB, felt compelled to support this transformation, while Vattenfall saw an opportunity to increase electricity demand and achieve branding advantages. Prior to this strategic pivot, SSAB explored alternative CO2 mitigation measures, including CCS, which were deemed ineffective. Consequently, SSAB was able to provide a clear direction for the HYBRIT ecosystem, which was CO2 avoidance, and invited LKAB and Vattenfall to create a shared VP. Furthermore, the ambitious vision raised significant public awareness, placing pressure on the involved companies to demonstrate results rather than discussing details such as IP rights, thereby accelerating the emergence of the ecosystem.

Another orchestration activity to govern the HYBRIT ecosystem was to *define the roles of its key partners*, namely SSAB, Vattenfall, and LKAB. At first SSAB defined the roles of their partners according to their vision. This is exemplified in the first conference where SSAB clarified that they needed Vattenfall not only for the electricity but also for the hydrogen production. LKAB was asked to transform the mine and pelletizing step whereas SSAB would handle everything related to steel manufacturing and selling. This distinctive top-down role definition was an attempt to create a modular architecture. Within this top-down role definition, SSAB, however, provided flexibility for its partners. This enabled Vattenfall to recognize the value of hydrogen storage and LKAB to determine its role over time. From the outset, LKAB and SSAB shared a common interest in the production of DRI. While the initial role definition attempted to provide a modular architecture, the companies' overlapping interests were acknowledged through their inclusion in the shareholder agreement and making established IPs available to the orchestrators. While the ecosystem developed over time the roles became specific, suggesting the significance of co-evolution which will be discussed in Section 5.2. Finally, it was decided that LKAB takes responsibility for scaling up the DRI production. Hence, defining roles initially top-down and relying on bottom-up processes afterwards, facilitated the clarification of an ecosystem structure.

Finally, throughout the development of the ecosystem the *number of key partners was limited to the necessary ones for creating the VP*. The initiative started with SSAB, LKAB, and Vattenfall because those companies were needed to transform the value chain. Although other companies wanted to participate, the collaboration was deliberately limited to these three key companies. As the ecosystem developed, the orchestrators sought to engage a customer that was aligned with their vision and capable of showcasing demand, demonstrating the VP, and negotiating commercial matters. Volvo fulfilled this role and became akin to a fourth partner.

5.1.2. Creating a Collaboration Platform

The creation of the JV enabled the orchestrators to *establish value management structures*. It was agreed that the value chain would be jointly transformed. A significant section in the shareholder agreement, therefore, stated that all established assets will be jointly owned and managed by the JV. Furthermore, a company that wants to use any established technology had to pay a license fee to the JV. The rational underlying this was that those payments will ultimately be distributed to the owners, thereby repaying their investments in areas beyond their field of interest. This mechanism proved valuable because it facilitated joint investments and thus shifted the focus toward an ecosystem outcome. Moreover, it postponed complex discussions about who will be responsible for which step to the formation phase and led to the commencement of work on the technical challenges directly. The establishment of value management structures thus enabled and accelerated discussions on how value will be created within the ecosystem, thereby facilitating the development of a shared VP.

Finally, in founding the JV, the orchestrators *established structures for orchestrating resource flow and alignment*. The JV has been important in managing internal resources. Besides managing jointly owned assets, the JV also leveraged the responsibility of the owner companies by demanding expertise in the form of human resources from them. This resulted in the formation of cross-organizational teams, which increased the points of contact between the organizations and thus facilitated alignment. The cross-organizational board and steering group further increased the points of contact and facilitated alignment. Additionally, the JV's management team actively promoted this alignment by recognizing that their company was jointly owned and thus taking extra care not to favor any of the owners. Such alignment was significant shift focus to optimizing the ecosystem outcome of fossil-free steel, and ultimately establish an ecosystem structure.

5.2. Co-evolution

The second dynamic under observation was co-evolution which refers to a process in which interdependent, interacting actors adapt and evolve with each other over time (Aarikka-Stenroos & Ritala, 2017; Breslin et al., 2021). This section analyzes co-evolution in the HYBRIT ecosystem and identified ***co-evolution between the orchestrators*** and ***co-evolution between the orchestrators and other actors***. It follows Breslin et al. (2021) in analyzing the three requirements that enable co-evolution *dependency between the actors*, *rule-based interactions*, and an *energizing force* that drives the system toward self-organization.

5.2.1. Co-evolution between the Orchestrators

Co-evolution was apparent between the orchestrators in the ecosystem. One illustrative example of this is the role finding that has occurred amongst them. Whereas SSAB established a rough structure in the beginning, both SSAB and LKAB were eager to assume responsibility for DRI production. Historically, iron production (now conducted through direct reduction) was within SSAB's boundaries. However, over time, it became evident that LKAB would establish the direct reduction facility. Co-evolution played a significant role in finally defining the roles and thus also in establishing the ecosystem structure, which is why the following analysis will relate back to this illustrative example.

The initial prerequisite for co-evolution is that *actors are dependent on each other*. This is the case when one actor causes a change in the resources and capabilities of another actor. Furthermore, this interaction must be reciprocal, meaning it must cause changes in the initial actor, as well as simultaneous (Breslin et al., 2021). This was the case, as achieving the ecosystem outcome of fossil-free steel was underpinned by unique complementarities and established assets were jointly owned. This is analyzed in more detail below.

The production of fossil-free steel necessitated a transformation of the entire value chain from mining to manufacturing, something that was unachievable by any of the orchestrators independently. This dependency is underpinned by two-way unique complementarities (Jacobides et al., 2018). Specifically, LKAB's production of fossil-free DRI relied on Vattenfall's supply of fossil-free hydrogen, which was crucial for SSAB to manufacture fossil-free steel. Conversely, the demand for DRI and hydrogen depended on SSAB's initiative in pioneering fossil-free steel production. The complexity of this interdependence is compounded by that production processes were tailored to the unique chemical properties of the materials involved, reinforcing that interactions are specific, reciprocal, and simultaneous. This optimized interdependence implied that actions by one of the orchestrators could potentially deter another from making critical investments, potentially triggering a chain reaction in which the other entities also withhold their specific investments. Such a scenario could arise from a number of reasons, for example if one actor does not benefit sufficiently to justify the necessary investments. Hence, interdependency between the orchestrators ensured that no single entity could make decisions without considering the impact on the others. This is illustrated by the shift of DRI production from SSAB to LKAB due to LKAB's higher margin requirements from deeper mining operations.

Moreover, the existence of jointly owned assets intensified the interdependencies among the orchestrators. Since IPs were owned by the JV - itself jointly owned by the orchestrators - no single company could deploy the technology without coordination with the others. As the ecosystem evolved, the JV reinforced these dependencies by transforming into a resource with unique capabilities that the owner companies could use for their specific research during the operational phase. Utilization not only optimized value creation toward a shared VP, but also further enhanced the capabilities of the JV, further enhancing its value to the orchestrators.

The second requirement for co-evolution is that *interdependent actors interact with each other*, guided by both formal and informal rules (Breslin et al., 2021). The establishment of the JV introduced formal rules for interaction through the shareholder agreement. This agreement, for instance, identified the orchestrators' specific areas of interest and granted them significant influence in those areas. The agreement thus provided a framework for interaction among the owner companies. As discussed in Section 5.1.2, the shareholder agreement deferred more complex negotiations to future discussions. Hence, it facilitated collaboration and the development of informal rules.

Informal rules emerged from daily interactions, which, while guided by formal rules, allowed for the emergence of order. As discussed in Section 5.1.2., the JV enabled the formation of a cross-organizational board, steering group, and teams. They served as critical points of contact among the orchestrators, facilitating alignment over time as through these interactions, the actors gained insights into each other's interests, fostering trust. Consequently, while formal rules established the basis for interactions among the orchestrators, they were refined through daily interactions. The significance of these routine interactions is exemplified by how they facilitated the actors' comprehension of the necessity for LKAB to adapt its position in the ecosystem to achieve to a shared VP.

The interactions among the interdependent orchestrators were propelled by *innovation as an energizing force*. The objective of producing fossil-free steel necessitated the development of novel technologies throughout the traditional value chain, thereby binding the orchestrators together. This innovation prompted significant shifts in the importance of traditional production processes. Notably, major advancements occurred within the iron production (now using direct reduction), where the bulk of CO_2 emissions were mitigated, thereby elevating the significance of this step. This led to the emergence of new desires. Hence, innovation served as the catalyst for breaking up traditional structures, necessitating the emergence of a new order through co-evolution.

5.2.2. Co-evolution between the Orchestrators and Other Actors

As elaborated in Section 1.2., this thesis focuses on the orchestrators within the HYBRIT ecosystem. However, co-evolution between the orchestrators and other actors was also identified. The first instance of this was the co-evolutionary relationship between the orchestrators and their primary customer Volvo. They were dependent on each other as evidenced by unique complementarities (Jacobides et al., 2018). Unique complementarities are evident in the production of fossil-free steel, which was contingent upon demand from pioneering companies like Volvo. Moreover, Volvo also needed fossil-free steel to achieve its goal of becoming climate neutral by 2040. Moreover, these interdependent actors interacted based on formal and informal rules. They established an off-taking agreement and collaborated in joint R&D teams as well as in joint promotional events. This co-evolutionary relationship accelerated the development of the HYBRIT ecosystem as fossil-free steel could be produced and demonstrated in an end product by Volvo.

The orchestrators and public actors, such as the Swedish government and the legislators on the European level also co-evolved. They were dependent on each other, as evident by unique complementarities between them. Public actors needed fossil-free steel to reach climate targets, and the orchestrators needed the public actors to fund their R&D activities and provide legislation that enhanced the value of fossil-free steel. These interdependent actors interacted based on formal and informal rules. Formal funding agreements provided structure to their relationship, for instance, by specifying that the technology must be made available to third parties. Informal rules were established through various points of contact, such as lobbying.

Aspects of co-evolution were also identified between the orchestrators and experts, including research institutions, and competitors such as H2 Green Steel. Due to a focus on the orchestrators, these relationships were not explored fully explored. The study indicates that the orchestrators and research institutions were dependent on each other due to supermodular complementarities. The greater the success of the HYBRIT ecosystem, the more valuable it is for the research institutions to participate, as they would gain recognition. The research also indicates that H2 Green Steel and the orchestrators were dependent on each other as the rise of H2 Green Steel, with its focus on market engagement, influenced the orchestrators to onboard their initial customer, Volvo.

In line with Breslin et al.'s (2021) argument that only ecosystem actors that co-evolve should be included in an ecosystem, this thesis covers the members of the HYBRIT ecosystem as described in Figure 6.

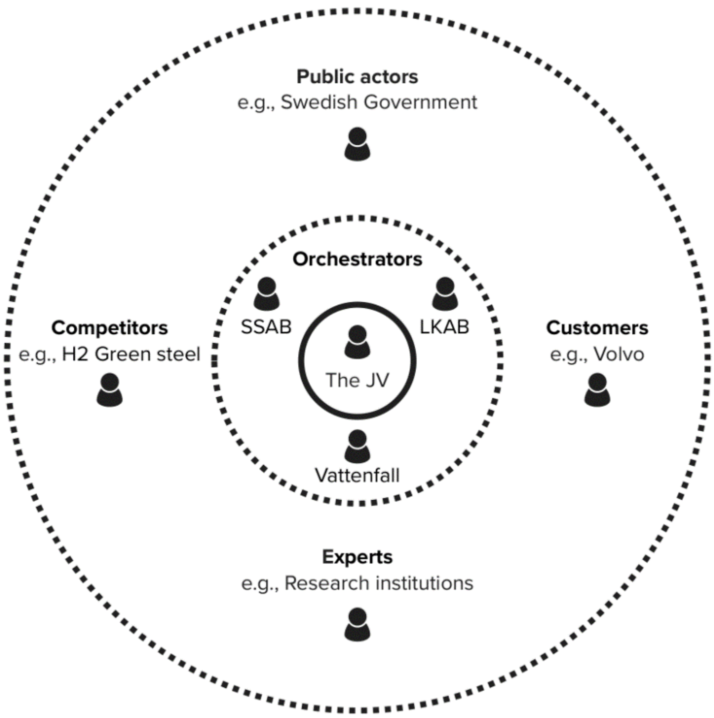

Figure 6 – The HYBRIT Ecosystem

5.3. Co-creation

The third dynamic under observation was co-creation. It refers to how value is collectively created by multiple actors, not only one (Vargo & Lusch, 2016). Regarding co-creation of the VP, the study identified various ways in which the ecosystem actors collaborated, or acted on their own, to affect VP development. These overarching activities are grouped under ***VP formulation, VP assessment***, ***VP outreach***, and the ***circular VP enhancement***. VP formulation encompasses activities that affected the specifics of the VP while VP assessment encompasses activities that affected its evaluation. The outreach activities encompass activities that served to convey the meaning of the VP to other actors and the market. Finally, the circular VP enhancement encompasses activities that further enhanced the key new benefit of fossil-free steel: reduced emissions.

5.3.1. VP formulation

The orchestrators perceived the VP to be developed by themselves, and especially by SSAB, and then presented to a customer for evaluation. However, the interviews illuminate instances of other ecosystem actors being involved in affecting the formulation of the VP.

The *VP discussions* between SSAB and Volvo regarding which types of fossil-free steel to first produce directly linked to the types of products that Volvo could create. Volvo steered SSAB toward certain steel grades that would enable Volvo to build their demonstration trucks, which became large promotional tools for the VP. This promotional aspect is discussed in Section 5.3.3. Other discussions between SSAB and Volvo were those regarding the first serial production of the fossil-free steel, where Volvo influenced the production to start earlier than planned. This helped Volvo construct the demonstration vehicles, accelerating the demonstration and communication of the VP.

Furthermore, customer involvement in formulating the VP can be seen in *price premium discussions*. These discussions related to the potential changes to cost of production, as well as what price premium the customer side would absorb and took place between Volvo and SSAB.

5.3.2. VP assessment

Assessment of the initial VP was conducted by different actors in the ecosystem. First, SSAB conducted *internal VP qualification*, by testing the fossil-free steel to see how its qualities compared to traditional steel, which was later shared publicly. Through this, they established that there was no compromise between reducing emissions and maintaining quality in fossil-free steel. Moreover, a similar testing process was done through *external VP qualification*, where customers such as Volvo and Mercedes tested the steel to ensure that it met their standards.

Finally, Volvo conducted an *emission auditing* of the production process of fossil-free steel to verify that the reduced emissions were realized. Thus, Volvo assessed and verified the proposed value of reduced emissions.

5.3.3. VP Outreach

The ecosystem actors conducted various *promotional activities* to promote the VP. The orchestrators did this both in joint and individual promotions. In joint promotional activities, such as the participation in the Swedish politician's week Almedalen or the New York Climate Week, the orchestrators collaboratively communicated the VP. Some of these activities were also conducted by other actors aside from the focal ones, such as Volvo, who joined many of these events. Public actors also conducted these activities, an example being the candleholder gift to the US president from the Swedish prime minister. In individual promotions the actors conveyed their participation on their own side, such as Vattenfall's ad campaign focused on their involvement in different decarbonization initiatives, their ad campaign regarding their face mist, and their YouTube-videos explaining HYBRIT.

Volvo further communicated and demonstrated the VP through the *construction of demonstration vehicles*, showcasing that fully functional end-products could be produced with fossil-free steel. These products were branded with both Volvo and SSAB logos. Volvo thus played an active role in demonstrating the VP to potential customers and substantiating the quality of the fossil-free steel.

Finally, SSAB signed *offtake agreements* with customers, mainly to secure financing for future production. Additionally, these agreements signaled to the market that a robust demand existed for the product, affirming the strength of the VP.

The motivation for so many different actors to promote the VP of the HYBRIT ecosystem in a co-creative way appears to stem from internal VPs derived from involvement in the ecosystem. In general, actors were motivated to promote the ecosystem VP to ensure the success of the ecosystem. For SSAB it further related to reducing their large internal emissions. For LKAB there was a necessity to mine at a deeper level, and for Vattenfall it was about achieving their goal of fossil-free living within one generation. Volvo was motivated by being seen as a frontrunner in sustainability and influencing their other steel suppliers to also decarbonize. For the Swedish government, the success of the HYBRIT ecosystem would vastly improve Sweden's chance of reaching its goals of reducing CO_2 emissions, thus motivating participation.

5.3.4. Circular VP Enhancement

A large co-creative aspect of the ecosystem is demonstrated through a circular VP enhancement. This refers to a continuous cycle of improvement, where the supply of fossil-free steel for various purposes throughout the production process further reduces the emissions from future steel-production.

Delving deeper into this circular enhancement, the essence of the VP of the HYBRIT-ecosystem lies in reducing emissions in steel production. Thus, there is a necessity to further enhance the steel production process to reduce emissions at every production stage, despite the reductions already achieved through the HYBRIT technology. The strategy thus extends to mitigating Scope 3 emissions, encompassing emissions from activities not directly controlled by the company, such as those associated with the purchasing of materials and equipment necessary for production. A truly fossil-free value chain requires all components in it, like equipment, vehicles, and facilities, to be produced with fossil-free materials. The enhancement process directly contributes to this.

More specifically, a *supplier based enhancement* was identified, exemplified by SSAB having signed letters of intent for supplying fossil-free to the other orchestrators. The use cases here include wind farms for hydrogen production on Vattenfall's side, and various facilities, such as the direct reduction demonstration plant on LKAB's side. Constructing these facilities with fossil-free steel would enhance the overall decarbonization of future production. The other part of the enhancement process relates to a *customer based enhancement*, exemplified by Volvo's supply of vehicles and equipment produced from fossil-free steel. This helps decarbonize parts of the production where vehicles and machinery are used, such as in LKAB's mining operations. Reducing emissions from both vehicles and other machinery might be partly solved through electrification, but since the overarching goal is to decarbonize the entire production process there is a necessity that all equipment, including trucks, are produced by fossil-free materials.

To summarize, SSAB will provide fossil-free steel to the other ecosystem actors who can lower their Scope 3 emissions when using steel in their operations. Furthermore, customers like Volvo can provide their subsequent fossil-free products, vehicles in Volvo's case, to the other ecosystem actors as well. Thus, customers like Volvo not only benefit from but actively contribute to enhancing the fossil-free nature of the steel they purchase. Through this collaborative engagement, there is an ongoing co-creation of the VP of fossil-free steel, where the value from reduced emissions in the steel increases with further decarbonization of the production process. Figure 7 illustrates the circular VP enhancement, and how the supply of fossil-free steel and fossil-free equipment flows back into the production process.

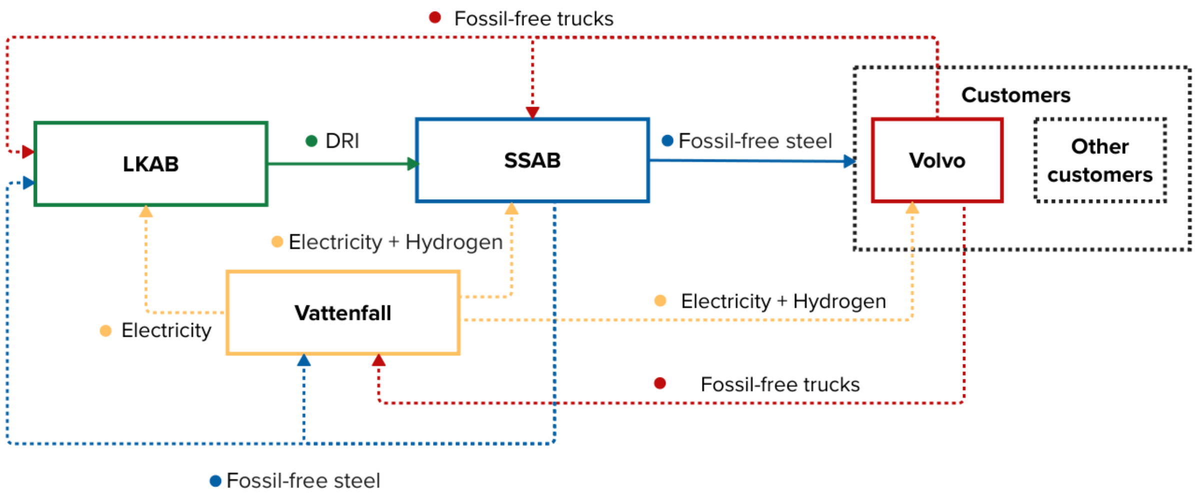

Figure 7 – Visualization of the circular VP enhancement

6. Discussion

After analyzing our empirical data, this section aims to compare them to prior literature and establish an understanding of what our research adds. Thereby, it aims to enhance the understanding about how the dynamics affect VP development in an emerging ecosystem and reflect on the findings.

6.1. Ecosystem Orchestration

Ecosystem orchestration was the first dynamic under observation. Here we identified ***ecosystem governance*** and ***creating a collaboration platform*** as groups of orchestration activities. Within ***ecosystem governance*** we identified *creating and communicating a compelling vision, defining the role of key partners, and limiting the number of key partners to the necessary ones* as key orchestration activities.

Creating and communicating a compelling vision is underscored by Shen et al.'s (2024, p. 9) Stirring Model which identifies "Sharing a common vision of shared value" as a pivotal orchestration action and foundational to developing a VP. Furthermore, the authors emphasized the necessity for orchestrators to make strategic decisions to develop an attractive VP. This is in line with our findings, which highlight SSAB's strategic decision to focus on CO2 avoidance rather than CCS. However, we interpret this decision as providing direction and inviting partners to collaborate in developing a VP rather than developing it independently. This emphasizes consensus-based orchestration which is effective in fostering alignment between partners (Reypens et al., 2021). Moreover, it shifts the mindset from a traditional value chain perspective toward a shared VP (Aagaard & Rezac, 2022).

Jacobides et al. (2018) emphasize the efficiency of modular architecture as an alignment structure in ecosystems and the role of an orchestrator in creating this modular architecture. Our findings indicate that SSAB played a significant role in this process through *defining the roles of the key actors*. The hybrid orchestration approach (Reypens et al., 2021) thereby seemed effective. SSAB initially defined the roles top-down, providing structure, but also kept flexibility through consensus-based orchestration that finally led to an alignment (Reypens et al., 2021). Dedehayir et al. (2018) posit that orchestrators design the roles of internal partners and coordinate interactions between them. We identified that the role forming process was rather initiated by the orchestrator, but subsequently specified in a co-evolutionary manner. Hence, our research highlights the importance of flexibility in role definitions to reach alignment over the ecosystem structure.

To create the VP, the *number of key partners was limited to the necessary ones*. This is in line with the findings of Lingens et al. (2023), who suggest that orchestrators attempt to reduce the market uncertainty as much as possible before involving partners. The involvement of partners from the outset, for instance, to be able to build a prototype, leads to that orchestrators have to respect both the interests of customers and partners. Thus, the authors posit that orchestrators should focus on customers from the beginning before attracting potential partners. This allows them to subsequently optimize the VP with partner interest in mind. Our research demonstrated a focus on partners from the outset to figure out technical foundations before involving customers to specify commercial aspects. This could be attributed to the orchestrators' intrinsic motivation to change, exemplified by the perceived necessity to reach national climate targets.

The second group of orchestration activities relate to **creating a collaboration platform**. With the creation of the JV, the orchestrators *established structures for orchestrating resource flow and alignment* as well as *structures for value management*. Reiter et al. (2024) posit that when an orchestrator is exposed to a high level of uncertainty and the partners' role is explorative, organizational forms like JVs that foster incentive alignment are established. The JV, thereby, serves as a vehicle for "maximum alignment of partners' future vision, supporting reaching alignment on the blueprint" (Reiter et al., 2024, p. 9). Here, "blueprint" refers to concrete vision of the ecosystem VP and ecosystem structure. Our case aligns with these described conditions. The JV created various contact points and dependencies between the organizations, two requisites for co-evolution (Breslin et al., 2021), and finally increased alignment.

To conclude, the findings indicate that ecosystem orchestration enabled co-evolution by establishing the necessary conditions (Breslin et al., 2021). This is exemplified by how the orchestrators provided flexibility in role definition and created a collaboration platform. This is in line with Reypens et al.'s (2021) understanding of consensus-based orchestration where orchestrators build flexible systems. Moreover, whereas orchestration initially occurred top-down, consistent with dominating orchestration, consensus-based orchestration established the necessary conditions for co-evolution to occur, emphasizing its importance.

6.2. Co-evolution

The second dynamic under observation was co-evolution. Co-evolution took place ***between the orchestrators*** and ***between orchestrators and other actors***. Co-evolution is a significant dynamic in emerging ecosystem and its requirements, *dependency between the actors*, *rule-based interactions*, and an *energizing force* (Breslin et al., 2021), were identified in the research.

The ecosystem participants were *dependent on each other*, as evidenced by specific complementarities. Specific complementarities are essential for the creation of an alignment structure within an ecosystem as they provide the actors a "vested interest to align and act as a group" (Jacobides et al., 2018, p. 2264). This is exemplified in the relationship between the orchestrators. In their efforts to transform the traditional value chain, they recognized the necessity of providing mutual benefits to ensure that each actor made the required investments. Furthermore, Lingens et al. (2023) note that partners that are interdependent through co-specializations act more like co-orchestrators. This aligns with the findings of this study and was exemplified by the orchestrating role of SSAB, LKAB, and Vattenfall.

Moreover, Jacobides et al. (2018) emphasize the importance of a modular architecture to facilitate coordination. The findings indicate that the JV served as a collaboration platform, providing *formal rules and touchpoints between the* orchestrators. This facilitated alignment and finally led to the creation of a modular architecture. Furthermore, while Autio & Thomas (2022) highlight the importance of relational governance in ecosystems, this study identified the significance of initial contractual rules. They provided the framework for co-evolution between the ecosystem members and for informal rules to arise.

Finally, innovation provided an *energizing force* to this ecosystem through breaking up traditional structures and requiring alignment of hierarchically independent, yet interdependent actors. This is in line with Adner (2017) who mention that the ecosystem logic is only required for when actors need to be aligned.

To conclude, also co-evolution played a crucial role in establishing the ecosystem structure, which is similar to the business model elements of a company that underlie VP development in the traditional marketing literature (Payne et al., 2020). Breslin et al. (2021) posit that co-evolution results in the emergence of order within an ecosystem through a self-organization process. This suggests that it aligns the actors toward an ecosystem structure. Hence, this finding of our study appears not to add to existing knowledge.

6.3. Co-creation

The final dynamic observed was co-creation, and four different aspects were identified: ***VP formulation, VP assessment, VP outreach,*** and ***circular VP enhancement***. Within VP formulation we identified *VP discussions* and *price premium discussions*.

Both the *VP discussions* and the *price premium discussions* relate to what Payne et al. (2020) discuss regarding the initial design of the VP. They argue customer involvement in the design of the VP helps influence perceptions of value and builds stronger relationships between the companies. The discussions between Volvo and SSAB about the first type of steel that Volvo needed for their demonstration vehicles relate to this value design involvement. A similar involvement can be seen when Volvo accelerated the first production batch of steel. The first steel types produced would only fit customers demanding those specific types of steel. Thus, the contents and the design of the VP was affected, as the starting selection of steel types could only be offered to certain customers. Finally, the price premium discussions also relate to value design. Price is an inherent aspect of VPs, as the customer benefits inherent in the VP are evaluated against the price of the offering (Hinterhuber, 2017).

Overall, there appears to be relatively low involvement in value design from actors other than the focal ones. This might be explained by Lingens et al.'s (2023) discussion around the effects of co-specialization in an ecosystem. They argue that a high level of co-specialization between key partners can lead to a VP that is less customer-focused, and more based on the vision of the key partners or co-orchestrators. Since the HYBRIT ecosystem is characterized by high levels co-specialization, this might explain the low direct impact on the specifics of the VP by other actors. However, this low involvement might also be due to the attributes of the steel. It appears that in their discussions with SSAB, Volvo did not affect or have influence on these attributes. The new property of fossil-free steel is reduced emissions. This aspect is more or less determined by the production process and leaves little room to for external influence, potentially explaining the relatively low design involvement from other actors.

Next, within ***VP assessment*** we identified *internal VP qualification*, *external VP qualification*, and *emission auditing*. These activities relate to value quantification activities from previous literature (Hinterhuber, 2017). Value quantification provides ways for the customer to quantify and understand the value offered by the VP (Payne et al., 2020). This can be seen in both the *internal* and *external VP qualification* activities, as the value derived from the steel was demonstrated through the tests conducted by SSAB and the customers. Furthermore, the *emission auditing* represents a value quantification activity where the customer could evaluate the amount of emissions reduced, and subsequently the value provided to them.

These activities also relate to what Payne et al. (2020) describe as value communication activities. Value communication focuses on how the supplier communicates the VP to the wider market. Aside from their value quantification aspect, the activities grouped under VP assessment communicated the VP and signaled that its promised benefits were genuine.

The actor's common goal of developing a VP (Jacobides et al., 2018) might have made VP assessment activities easier by simplifying how to conduct them, for instance enabling access to resources required for the assessment. Without this common goal, conducting the activities may have been more challenging.

Moving on, the activities grouped under **VP outreach** were *promotional activities*, the *construction of demonstration vehicles*, and the *signing of offtake agreements*.

Similar to the VP assessment activities, the VP outreach activities also relate to value communication (Payne et al., 2020), but to an even greater extent. In the HYBRIT ecosystem, these activities played a crucial role in reinforcing and showcasing the merits of fossil-free steel. They effectively communicated to the market that the VP is credible and capable of fulfilling its claims. This aligns with the views of Payne et al. (2020), who state that communicating the VP demonstrates a promise and should make sure that customers understand it. *Promotional activities* such as participating in events or branding, and the *construction of demonstration vehicles* made from fossil-free steel enable customers to grasp the product's functionality and performance. Moreover, Payne et al. (2020) emphasize that communication should aid customers in visualizing the VP, a goal notably achieved through the introduction of the demonstration vehicles. Finally, the *signing of offtake agreements* might not be considered communication activities on their own. However, they allowed for signaling that customers believed in the VP enough to purchase steel before it had been produced, showcasing a strong demand and affirming the strength of the VP.

From an ecosystem perspective, it becomes apparent that it was not just one actor who was conducting these activities in the HYBRIT ecosystem. The orchestrators conducted or joined many promotional activities, as did other actors such as the primary customer Volvo and the Swedish government. As Jacobides et al. (2018) discuss, an ecosystem focuses the attention of the actors on a novel VP. Volvo and the Swedish government are actors in the ecosystem who want the VP to become a reality, and as such took on additional responsibilities. Whereas the ecosystem literature limits the role of the customer to either accepting or rejecting the ecosystem outcome (Autio & Thomas, 2022), the observation of Volvo's co-creative promotional activities contrasts this view. Moreover, it appears that the motivation of many ecosystem actors to promote the VP stemmed from internal VPs that arose around the central VP, encouraging them to join the promotional activities.

Finally, the ***circular VP enhancement***, which grouped together *supplier enhancement processes* and *customer enhancement processes*, represented a large co-creative aspect of the VP. This is not as much of an involvement in value design, but more a general strengthening process of the VP. The process might not have been an intentional one, as some of these relationships already existed before the HYBRIT ecosystem. However, with the new value derived from reduced emissions, the co-creational aspects of the VP becomes clearer. For traditional steel, this circularity does not provide a direct improvement of the VP. With the introduction of fossil-free steel, the impact of the circularity increases as the core value aspect, reduced emissions, is directly improved by the circularity.

From an ecosystem perspective, the involvement of the actors in actively enhancing the VP in this way might, like many of the co-creational aspects, be explained by the focus of all actors in the ecosystem on a collective output, that of the VP (Jacobides et al., 2018). This is also consistent with Adner (2017) noting that ecosystem participants have joint value creation as a goal. As the ecosystem actors benefit from improving the VP, the motivation to join the circular VP enhancement thus aligns with this perspective. Additionally, the presence of the circular VP enhancement might also be explained by the of nature fossil-free steel. Steel is a relatively basic material that has a vast set of use-cases. Most companies require steel in some aspect of their operations, such as steel required for the products they build, the products they purchase or even the office their company is housed in. This makes it very likely that suppliers to the orchestrators will in some shape or form use steel. Thus, through using fossil-free steel the suppliers will reduce their indirect Scope 3 emissions, ultimately affecting the focal organization's Scope 3 emissions as well.

7. Conclusion

Our research set out to answer two questions. First, *what are the dynamics that affect value proposition development in an emerging ecosystem*? And subsequently, *how do these dynamics affect value proposition development in an emerging ecosystem?*

Section 2 indicates three dynamics that might affect VP development in emerging ecosystems: Ecosystem orchestration, co-evolution, and co-creation. The study indicates that co-evolution and co-creation affect VP development. Ecosystem orchestration appears to enable co-evolution by creating the necessary conditions for its appearance, for instance through providing flexibility in role definitions and creating a collaboration platform, rather than directly influencing VP development.

The study suggests that co-evolution influences VP development in an emerging ecosystem through facilitating the establishment of the ecosystem structure, which provides the basis for developing a VP. Co-evolution, thereby, led to an alignment of SSAB, LKAB, and Vattenfall which is needed to establish an ecosystem structure of hierarchically independent actors.

Furthermore, the study points to co-creation influencing VP development in an emerging ecosystem through the design, quantification, and communication of value, as well as the circular VP enhancement by various actors. Moreover, the study indicates that the ecosystem context intensifies certain co-creational activities through the common focus on creating the VP. This can be exemplified by the extensive participation in value communication activities by many actors of the ecosystem and the circular VP enhancement. This motivation of actors to participate in the ecosystem might be explained by the emergence of strong internal VPs that arose around the central VP of fossil-free steel.

These findings are summarized in Figure 8. It presents a framework answering the research questions of the thesis.

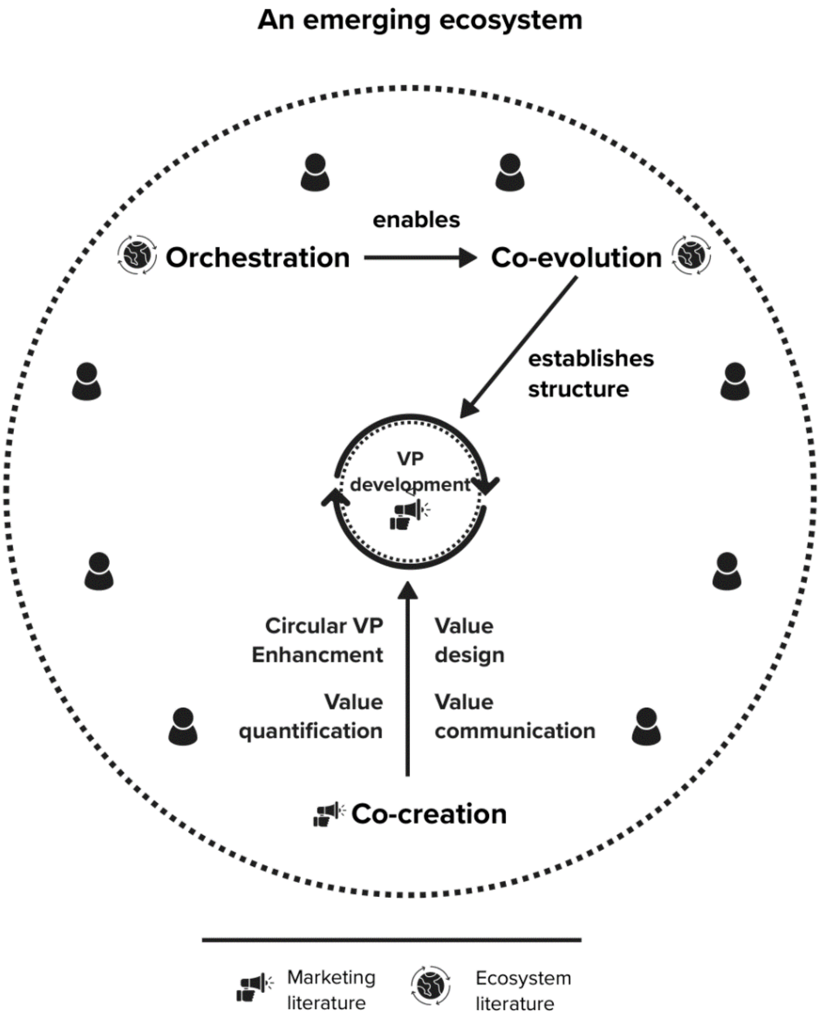

Figure 8 – Framework of our findings

7.1. Limitations

While this study contributes to the research on ecosystems in several ways, a set of limitations are acknowledged. Firstly, the research conducted in this thesis focused on the HYBRIT ecosystem through a single case study. While this focus allows for a detailed understanding of the given situation, the unique research environment may limit the applicability of the findings to broader contexts. First, the HYBRIT ecosystem is characterized by high levels of co-specialization. Moreover, the constellation of the orchestrators of the HYBRIT ecosystem may be relatively unique, as LKAB and Vattenfall are owned by the Swedish state and SSAB is partly owned by LKAB. The product, fossil-free steel, might also render the ecosystem more unique. As discussed, certain properties of the steel may influence co-creative mechanisms, which might not be observed in ecosystems with other products. The fossil-free steel is also viewed as important for meeting Sweden's climate targets, creating a large societal drive for the ecosystem. This might not be observed in ecosystems where VPs lack this societal importance.

Finally, the ecosystem observed in the study is mostly located in Sweden. The general business culture may have affected the way in which the ecosystem was formed, potentially limiting the study's applicability to ecosystems in other countries.

Furthermore, the findings of this study are limited to the types of ecosystems that focus on the flow of value (Autio & Thomas, 2022), as emphasized in Section 1.2. and Section 2.1.

Thirdly, the data collection method used might limit our findings. The VP of the HYBRIT ecosystem developed over several years. Thus, some of our interviewees had to reflect on events that happened long ago which may have increased the probability of misrepresentation in their answers. For research that focuses on a specific issue over time, a longitudinal case study might have been more suitable (Bell et al., 2019). However, this was not feasible due to the limited time frame of the thesis writing period.

7.2. Theoretical contributions

The theoretical contributions of this study span two areas. Firstly, it contributes to the limited body of literature on VP development in emerging ecosystems. Despite the importance of this topic, it has been largely overlooked by previous researchers (Lingens et al., 2023). This thesis identifies two dynamics that affect VP development in an emerging ecosystem: co-evolution and co-creation. Furthermore, it establishes an understanding of how these dynamics affect this development process. A primary contribution of the thesis is the exploration of how co-creational activities of VPs from marketing literature are manifested in an ecosystem context, and the identification of a co-creative circular VP enhancement. Moreover, the ecosystem literature reduces a customer's role to merely accepting or rejecting the ecosystem outcome (Autio & Thomas, 2022). However, this study contradicts this by acknowledging their role in co-creation.

Secondly, while the focus of the thesis is VP development in an emerging ecosystem, it additionally contributes to the literature on the emergence of ecosystems. Thereby, it responds to calls for further research into emerging ecosystems from various scholars, for instance from Dattée et al. (2018), Dedehayir et al. (2018), Gawer and Cusumano (2014), Jacobides et al. (2018) and Pushpananthan and Elmquist (2022). This study adds to Jacobides et al. (2018) who posit that ecosystem orchestration is necessary for ecosystems to emerge. It indicates that ecosystem orchestration creates the conditions for co-evolution, which is necessary to align the actors toward an ecosystem structure. Moreover, whereas initial orchestration occurred in a dominant way, this thesis emphasizes the importance of consensus-based orchestration in establishing the conditions that enable co-evolution, which creates alignment. Therefore, it adds to Reypens et al.'s (2021) discussion about the relative importance of dominant and consensus-based orchestration in hybrid orchestration.

7.3. Practical Implications

Aside from theoretical contributions, our study also provides implications for practitioners. This is significant as collaboration needs to be intensified to address the complex challenges of humankind (Linde et al., 2021). Moreover, the ecosystem lens is becoming increasingly important in strategy discussions (Adner, 2017), and as the VP is central to ecosystems and ecosystems usually do not just emerge but are orchestrated (Jacobides et al., 2018), VP development needs to be understood.

Our research can help practitioners to make better use of their surrounding ecosystem and take the identified dynamics into account when developing VPs. We emphasize that organizations claiming a focal role in their ecosystem need to acknowledge their responsibility for creating the ecosystem structure. In doing so, the significant role of co-evolution needs to be recognized, and its foundations established. Finally, co-evolving actors should be considered for purposeful involvement in co-creational activities when developing the VP.

7.4. Future Research

The findings of this thesis present various opportunities for future research. In general, we hope future researchers continue to study the emergence of ecosystems, as the area is still underexplored. Conducting similar studies to this one in other industries or countries would further enhance the understanding of the effects of ecosystem dynamics on VP development. Additionally, longitudinal studies on similar emerging ecosystem to the studied one could offer extensive insight into ecosystem emergence. A longitudinal study would allow for data to be gathered close to when decisions and events in the emergence occur, ensuring a greater understanding of this process. Finally, the circular VP enhancement would be an interesting topic of study for future researchers. More specifically, it would be beneficial to explore in what other areas it exists, how it affects ecosystems, and what the preconditions for its emergence are.

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9. Appendix

Appendix 1: Interviewee List

Number	Organization	Position	Abbreviation	Date	Location	Recording length	Transcript length
1	Vattenfall	Senior strategy manager	Vattenfall-1	22.02.2024	Online	55:56 min.	31 pages
2	HYBRIT	Former C-level executive	HYBRIT-1	26.02.2024	Online	55:14 min.	35 pages
3	SSAB	C-level executive	SSAB-1	27.02.2024	Online	59:42 min.	28 pages
4	Lund university	Associate professor	Lund university-1	28.02.2024	Online	61:11 min.	49 pages
5	LKAB	Former senior strategy manager	LKAB-1	29.02.2024	Online	85:53 min.	49 pages
6	HYBRIT	Former senior strategy manager	HYBRIT-2	01.03.2024	Online	66:36 min.	56 pages
7	Vattenfall	Senior communications manager	Vattenfall-2	04.03.2024	Online	53:12 min.	31 pages
8	SEI	Researcher	SEI-1	04.03.2024	Online	55:27 min.	32 pages
9	Volvo	Senior R&D manager	Volvo-1	05.03.2024	Online	57:07 min.	29 pages
10	SSAB	Senior strategy manager	SSAB-2	06.03.2024	Online	58:27 min.	29 pages
11	Vattenfall	Communications manager	Vattenfall-3	06.03.2024	Online	52:45 min.	29 pages
12	SSAB	Communications manager	SSAB-3	07.03.2024	Online	58:29 min.	29 pages
13	Vattenfall	Technical consultant	Vattenfall-4	07.03.2024	Online	59:03 min.	29 pages
14	LKAB	Former C-level executive	LKAB-2	08.03.2024	Online	39:57 min.	19 pages
15	HYBRIT	C-level executive	HYBRIT-3	08.03.2024	Online	60:23 min.	35 pages
16	Vattenfall	Senior strategy manager	Vattenfall-5	12.03.2024	Online	68:10 min.	36 pages
17	Volvo	Senior strategy manager	Volvo-2	12.03.2024	Online	58:50 min.	27 pages
18	Vattenfall	Former communications manager	Vattenfall-6	13.03.2024	Online	57:27 min.	26 pages
19	LKAB	Senior R&D manager	LKAB-3	15.03.2024	Online	55:21 min.	28 pages
20	HYBRIT	Senior R&D manager	HYBRIT-3	08.04.2024	Online	66:52 min.	44 pages

Appendix 2: Interview Guide

There were two types of interview guides during the interview process one for interviewees from SSAB, LKAB, Vattenfall, and research institutions, and one for interviewees from Volvo. The following presents an example interview guide for interviewees from SSAB, LKAB, Vattenfall, and research institutions.

Preliminary information:

- Introduction to interviewers and research project
- General Data Protection Regulation information
- Ask for consent to record
- Start recording

Introduction:

1. What is your position and your responsibilities?
2. For how long did you work on this initiative?

Main part:

3. Can you tell us about how the conversation around fossil-free steel for your organization started?
4. Who do you consider to be the leading actor in this initiative?
5. How would you describe your organization’s role in this initiative?
6. How would you describe the process of arriving at your organization’s role?
7. What do you think were the motivations for creating the HYBRIT JV?
8. How would you say did the JV influence the initiative?
9. To what extent would you say the actors in this initiative were dependent on each other?
10. To what extent would you say that formal contracts played a role in this initiative?
11. Would you say the HYBRIT initiative is a success so far?
    a. (If yes) Why?
12. How would you describe the VP of fossil-free steel?
13. How would you describe the process of developing the VP for fossil-free steel?
14. How would describe your organization's involvement in developing the VP of fossil-free steel?
15. Which other actor do you consider having affected the development of the VP?
    a. How do you think they did so?

b. (If other actors affected) To what extent would you say VP development in this initiative differed compared to if your organization would have done it on its own?

16. Who was the intended target audience for the initial VP?
    a. How did you define this target audience?
17. To what extent do you consider your organization to have been in contact with the final customer?
18. To what extent do you think your organization benefited from being part in the HYBRIT initiative?

Ending:

19. Do you want to add something that we did not touch upon?
20. Could you provide us with three more contacts within your organizations that were deeply involved in the HYBRIT initiative?

The other type of interview guide was used for interviewees from Volvo and is presented in the following.

Preliminary information:

- Introduction to interviewers and research project
- General Data Protection Regulation information
- Ask for consent to record
- Start recording

Introduction:

1. What is your position and your responsibilities?
2. For how long did you work on this initiative?

Main part:

3. Can you tell us about how the conversation around fossil-free steel for your organization started?
4. Which company would you say your organization was mostly in contact with in the HYBRIT initiative?
5. Who do you consider to be the leading actor in this initiative?
6. How would you describe your organization's role in this initiative?
7. How would you describe the process of arriving at your organization's role?
8. Would you say the HYBRIT initiative is a success so far?

a. (If yes) Why?

9. How would you describe the VP of fossil-free steel?
10. How would you describe your organization's involvement in the HYBRIT initiative?
11. How would describe your organization's involvement in developing the VP of fossil-free steel?
12. Which other actor do you consider having affected the development of the VP?
    a. How do you think they did so?
13. To what extent do you think your organization benefited from being part in the HYBRIT initiative?

Ending:

14. Do you want to add something that we did not touch upon?
15. Could you provide us with three more contacts within your organizations that were deeply involved in the HYBRIT initiative?

Appendix 3: Statement about the Use of Generative AI

Generative AI was utilized throughout the thesis to enhance its language. Therefore, the authors utilized the tool ChatGPT. The prompt consisted of a combination of the text "Please enhance the readability of the following text:" and our initial text. The result of this request was subsequently used as an inspiration to enhance the initial text. For this, sentence structures and words were changed if it enhanced the readability in the eyes of the authors, paying particular attention to retain the arguments and meaning of the initial text. This served as a basis for further rewriting by the authors. Risks of accidentally inputting sensitive information such as personal data into the AI was mitigated through removing it from the text beforehand. This was a small issue, as generative AI was only utilized for guidance on enhancing readability. Moreover, the feature that would allow ChatGPT to train itself on the data was disabled. Generative AI was not utilized anywhere else in the creation of this thesis. Finally, the authors found AI tools such as ChatGPT to be well suited for ensuring a well written and easy to understand thesis.