

Disruptive market-shaping processes: Exploring market formation for autonomous vehicle solutions

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ABSTRACT

In the race toward autonomous vehicle solutions, providers engage in disruptive market-shaping processes to overcome barriers to commercialization and trigger market formation. This study investigates how disruptive market-shaping processes unfold by employing a multiple case study of 10 AVS providers. Our findings reveal a disruptive market-shaping process comprising four dimensions: shaping the value logic, nurturing the demand side, forging ecosystem alliances, and catalyzing institutional changes. Furthermore, we analyze the temporal unfolding of these activities to illustrate a comprehensive market-shaping process comprising three phases: market exploration, market preparation, and market experimentation. We make significant contributions to the market-shaping and AVS literature. By showing empirically how disruptive market-shaping processes unfold, we refine existing knowledge on the broader market formation stage, anchoring it to the emergence of new markets. Our framework offers micro-level insights into the sequencing of activities and phases embedded in shaping new markets. We argue that successful disruptive market shaping is contingent on creating an attractive market value proposition. Finally, we identify the foundational activities required to overcome market barriers and advance the commercialization of autonomous solutions. We find that granular systems logic reveals AVS's true value, questioning traditional market logic and paving the way for a sustainable, autonomous future.

1. Introduction

Autonomous vehicles solutions (AVS) are set to disrupt a wide range of industrial transport markets (B2B), from heavy equipment to cars and shipping (Sjödin et al., 2023; Thomson et al., 2023; Tsvetkova & Hellström, 2022; Turienzo et al., 2023). Essentially the launch of AVS – “self-driving vehicles that sense their surroundings, location, and space, and that are operated without human intervention or control” (Leminen et al., 2022, p. 1) – holds the potential to unlock enhanced efficiency, safety, and sustainability in industrial transport markets. For example, Caterpillar, a leading supplier of mining equipment, has launched self-driving haulage trucks (i.e., AVS) that improve safety and productivity at mining sites by removing human operators from dangerous settings and enhancing the predictability of operations. Yet, large-scale adoption of AVS still remains elusive, and many providers of AVS are struggling to gain market acceptance for their solutions.

Indeed, disrupting existing transport markets with autonomous vehicle solutions presents a number of challenges. First, AVS confronts institutional barriers, such as lack of trust in autonomous technology,

unclear legislation, and conflicting interests from existing transport institutions (Schweitzer et al., 2022; Tsvetkova et al., 2021). Second, business models for AVS remain unclear in the absence of demonstrated value creation and delivery in industrial domains (Kohtamäki et al., 2022; Thomson et al., 2021; Thomson et al., 2023; Turienzo et al., 2023) creating uncertainty in industrial customer relationships (Sandvik et al., 2021; Tsvetkova et al., 2021; Turienzo et al., 2023). Third, the complexity of AVS as configurations of advanced product, software, and service modules means that no actor holds all the capabilities required to configure AVS on their own and, therefore, collaboration with an extended set of complementary ecosystem actors is imperative (Frandsen et al., 2022; Kohtamäki et al., 2022; Kolagar et al., 2022). What is clear is that overcoming these barriers requires a more comprehensive approach than merely focusing on individual elements (e.g., business models) to actively shape market conditions by instilling change within the institutions, actors, practices, and discourses in established markets.

The emerging literature on market shaping provides important perspectives on how firms may deal with such disruption challenges to induce market formation, which is the focus of this study. Market

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shaping refers to *purposive actions by a focal firm to change market characteristics* (Nenonen et al., 2019). Market shaping expands the traditional static view of markets by conceptualizing them as complex adaptive systems (Flaig et al., 2021a; Stathakopoulos et al., 2022) where market conditions are malleable under the influence of focal actors (market shapers). Market shaping can take different forms, such as widening (changing elements), disrupting (e.g., forming a new market) and protecting (e.g., creating entry barriers) (Flaig et al., 2021b). Thus, the market-shaping perspective suggests that AVS providers can proactively take action to shape market conditions (e.g., unclear legislation, customer demand) and steer market formation – configurations of market conditions that are sufficiently stabilized to allow the generation of exchange (Kjellberg et al., 2015). Thus, conceptually disruptive market shaping provides a fruitful perspective for unraveling actor-centric dynamics to form new markets from the outcomes of disruptive market-shaping activities (Nenonen & Storbacka, 2021; Schweitzer et al., 2022). However, our current understanding of how focal firms employ disruptive market-shaping processes to form new markets remains incomplete. Accordingly, we identify several research gaps in the literature on market shaping and autonomous vehicle solutions.

First, *there is a need for a deeper understanding of how disruptive market-shaping processes unfold*. Indeed, in reviewing the prior literature, there are no studies that describe disruptive market-shaping processes, such as shaping AVS markets. Despite the emphasis in the market-shaping literature on the continuously evolving nature of markets (Nenonen et al., 2019), knowledge is scarce on the disruptive market-shaping processes that underpin market formation. There are a few conceptual studies broadly outlining market formation as one of three stages in market shaping (Flaig et al., 2021a; Storbacka & Nenonen, 2011, 2015). However, given their overarching focus, they offer little insight into the micro-level dynamics of disruptive processes in market formation. In addition, these conceptual studies do not focus exclusively on the formation of new markets but also encompass incremental transformation. Arguably, given their nature, such transformative (i.e., change of a few market conditions) and disruptive (i.e., formation of a new market) shaping processes are substantially distinctive processes (Flaig et al., 2021b). Thus, while offering valuable initial insights into the overall stages of market shaping, the literature offers relatively few insights into disruptive market-shaping processes. Filling this gap would yield important insights into how disruptive market-shaping processes unfold and provide an important link between market-shaping processes and how new markets are formed.

Second, *there is a need to delineate how key activities are employed along the disruptive market-shaping process*. While the literature has identified a range of activities related to market-formation (Flaig et al., 2021a; Storbacka & Nenonen, 2015) and market-disruption strategies (Flaig et al., 2021b), little is known about their interplay. For example, prior studies have highlighted the influencing of institutions (e.g., legislation) as a key activity in market formation. However, engaging in institutional shaping may arguably unfold over time with varying intensities and in a complex interplay with other factors. In considering how best to shape legislation to implement the AVS, this would largely depend on the customer context in which the AVS is to be applied (e.g., what is the governing legislation) and how (e.g., where will the AVS be operational). Accordingly, there is need to untangle the synchronized unfolding of disruptive market-shaping activities and organize them into phases. Therefore, we argue for a dynamic process view to explain the relationship between activities within the phases and how companies advance through these phases.

Third, there is a need to understand *how companies shape markets to overcome barriers to commercializing autonomous vehicle solutions*. AVS holds immense, unrealized, potential to advance sustainability productivity and the safety of industrial operations. Previous studies have highlighted the need to overcome market barriers (Sandvik et al., 2021; Tsvetkova et al., 2021) and the simultaneous maturation of ecosystems, business models, and technology when creating markets for autonomous

vehicle solutions (Thomson et al., 2021). While certain studies have highlighted their disruptive potential (Leminen et al., 2022; Turienzo et al., 2023), research has only begun to investigate how AVS providers are shaping the commercial context to unleash that potential (Schweitzer et al., 2022). Certainly, examining disruptive market-shaping processes will provide insights into how best to overcome commercialization barriers to implementing autonomous vehicle solutions.

Accordingly, the purpose of this paper is to *investigate how disruptive market-shaping processes unfold for AVS providers in the course of establishing new autonomous vehicle solutions markets*. Thus, we seek to advance understanding of the micro-foundations of market-shaping processes, including the sequencing of phases and activities.

Our investigation builds on case studies from ten AVS providers and their affiliated market actors. Our findings reveal an empirically grounded market-shaping process consisting of four aggregate market-shaping dimensions: shaping the value logic, nurturing the demand side, forging ecosystem alliances, and catalyzing institutional changes. Furthermore, we analyze the temporal unfolding of these activities to illustrate a comprehensive market-shaping process consisting of three phases: market exploration, market preparation, and market experimentation.

Our study provides several significant contributions to the market-shaping and autonomous solutions literature, which carry valuable implications for business executives.

First, we contribute to the market-shaping literature by empirically examining disruptive market-shaping processes, thereby refining existing knowledge on the broader market formation stage and providing an important link between market-shaping processes and the evolution of markets. Second, our study provides further precision and refinement, which adds to our understanding of market-shaping processes. We address the ambiguous sequencing of disruptive market-shaping activities by explicating three phases in the market formation stage and linking them together by explaining the requirements for process progression. Specifically, we illustrate how AVS providers progressively turn their vision into a market value proposition (MVP) as change materializes. Third, concerning the autonomous vehicle solutions literature, our comprehensive process framework offers insights into how companies shape their business environment to advance the commercialization of autonomous vehicles. In particular, our finding of a granular system logic pinpoints how AVS providers shape industrial value logic to unlock the disruptive potential of autonomous vehicle solutions.

2. Theoretical background

2.1. Commercialization of autonomous vehicle solutions

Underpinning the commercialization of autonomous vehicle solutions – for example, self-driving trucks and unmanned vessels – is a technological shift that employs physical, software (AI), and connectivity components whose configurations progressively allow for monitoring, control, optimization, and autonomous functions (Porter & Heppelmann, 2014, 2015; Thomson et al., 2021). What differentiates autonomous capability from automation is that it does not rely on pre-programmed instructions to overcome unexpected events. Rather, autonomous vehicle solutions exhibit advanced AI functionalities, such as the ability to learn and adapt to changes in the environment (Sjödén et al., 2023). Autonomous vehicles are, therefore, able to carry out complex operations that, until recently, required the presence of human drivers (Thomson et al., 2021). Building on this technological capability, technology providers work to commercialize autonomous vehicle solutions for a wide range of industrial applications from shipping to mining, which can alleviate dangerous, repetitive, and complex operations (Thomson et al., 2023; Tsvetkova et al., 2021). A non-exhaustive list of the promised benefits illustrates its enormous scope in terms of value –

namely, labor cost savings, fuel reduction, fewer breakdowns, reduced accidents, increased earnings, improved fleet management, increased availability, geographical and social inclusion, and improved infrastructure utilization (Parida et al., 2019; Sjödin et al., 2023; Tsvetkova & Hellström, 2022; Turienzo et al., 2023). However, despite the potential, commercialization of AVS is challenging in traditional solutions markets and is faced with significant barriers to market formation.

First, the existing institutional environment around traditional transport solutions essentially acts as a barrier to autonomous vehicle solutions (Tsvetkova et al., 2021). For example, current law demands the presence of a person responsible for operating vehicles and ships, thereby effectively prohibiting the use of AVS in most industrial applications (Schweitzer et al., 2022; Tsvetkova et al., 2021). Accordingly, AVS providers need to persuade the authorities to introduce new institutional arrangements supporting unmanned usage. On the same note, safety concerns and liability issues lead to uncertainties regarding responsibility for accidents when no driver is present, and the lack of infrastructure supporting autonomous vehicle solutions creates hurdles that need to be overcome if AVS are to replace current transportation systems (Schweitzer et al., 2022; Tsvetkova et al., 2021; Turienzo et al., 2023). Additionally, fear of job replacements enflames tensions between employees and employers, creating further resistance to industrial customer adoption (Tsvetkova et al., 2021).

Second, unclear value logics make it difficult to convince incumbent customers. For example, many incumbent customers resist adopting autonomous vehicle solutions as first movers, which makes providers look to niche markets (Sandvik et al., 2021). Even though research links the value potential of AVS to the development of servitized business models (Leminen et al., 2022; Turienzo et al., 2023), many potential customers are reluctant to change their current business models as first movers (Tsvetkova et al., 2021). For instance, they are uncertain about whether AVS will yield sufficient value to offset the risk and uncertainty of changing their business logic. However, because the incumbent value logics of traditional markets are geared toward transactions of traditional products with after sale services, they effectively stifle AVS' value potential (Tsvetkova & Hellström, 2022). Thus, if new autonomous vehicle markets are to succeed, providers need to create a unifying value logic that demonstrates superior value to market actors.

Third, because markets are value creation systems (Vargo, 2011), AVS markets need ecosystems of suppliers and auxiliary companies to proliferate (Frandsen et al., 2022). For example, autonomous vehicle solutions extend beyond vehicle technology to include advanced sensor capabilities (e.g. LIDAR), autonomous driving software (e.g. AI algorithms), connectivity solutions (e.g., 5G), and fleet management systems. Given the diversity and complexity of the technologies required, no actor can develop AVS on its own (Kolagar et al., 2022; Thomson et al., 2023), and there is a need for collaboration in the ecosystems of complementary actors. For example, AVS providers need to identify and formalize appropriate collaboration with actors according to the specific conditions of the industrial domain and the particulars of the industrial site. Moreover, cooperation among ecosystem actors requires aligned business models (Parida et al., 2019; Storbacka & Nenonen, 2011). Thus, there is a need to develop collaborative and technological standards for autonomous vehicle solutions, which will facilitate efficient ecosystem cooperation (Schweitzer et al., 2022).

Maturing the technology is a challenging task in itself (Thomson et al., 2021). However, overcoming severe market barriers is a vital step that must follow if autonomous vehicle solutions are to be commercialized successfully. However, since market barriers occur on multiple levels (Brekke et al., 2023; Kohtamäki et al., 2022; Sandvik et al., 2021), developing AVS markets necessitates the co-evolution of actors, business models, stakeholders, and society (Makkonen et al., 2022). Thus, AVS providers must take the lead in the process of developing AVS markets by shaping the commercial context. In practice, creating AVS markets requires managerial actions aimed at aligning resource configurations, value logics, and institutional arrangements supporting the disruptive

process on both the firm level and the system level (Makkonen et al., 2022). In other words, successful commercialization requires companies to actively shape market conditions to facilitate autonomous vehicle solutions markets.

2.2. Market shaping as a theoretical framework

Arguably, the recent theoretical perspective on market shaping (Flaig et al., 2021b; Kohli & Jaworski, 2023; Sprong et al., 2021) may illuminate critical dimensions on how AVS providers can create the right market conditions to commercialize their offerings. The market-shaping literature draws on a broad range of theoretical perspectives, such as institutional theory (Baker et al., 2019), service dominant logic (Vargo, 2011), new product development (Harrison & Kjellberg, 2016), entrepreneurship (Santos & Eisenhardt, 2009), and innovation (Aarikka-Stenroos & Lehtimäki, 2014), to develop a comprehensive theoretical framework for analyzing how intentional actions of focal firms influence both the formation and transformation of markets (Hawa et al., 2020; Kleinaltenkamp et al., 2022). By viewing markets as “complex adaptive socio-technical-material systems consisting of institutions, actors, practices, and discourses that organize particular economized exchanges” (Nenonen et al., 2019, p. 252), the market-shaping literature provides an overarching link between streams such as market driving (Jaworski et al., 2000), market innovation (Kjellberg et al., 2015), and market scripting (Storbacka & Nenonen, 2011), and it supports a set of properties that serves as the theoretical framework to guide our analysis.

First, *the market-shaping literature views markets as complex adaptive systems where market conditions can be changed through the influence of market actors*. This provides a more dynamic view of markets as malleable entities compared to traditional static conceptualizations of markets, and it allows for the agency of focal actors in shaping market conditions (Flaig et al., 2021b; Mele et al., 2015; Pels et al., 2023). According to the literature, markets emerge from configurations of interdependent market elements. Thus, market shapers can develop AVS markets by improving the degree of configurational fit between market elements to support the new solution (Nenonen & Storbacka, 2020; Storbacka & Nenonen, 2011). A high configurational fit means that market elements mutually reinforce one another. In other words, providers can actively shape markets to create conditions that are favorable to their products and services (Flaig et al., 2021b; Storbacka et al., 2022). For example, by reducing the barriers to autonomous vehicles (e.g., regulation, standards, perception), thereby increasing configurational fit.

Second, *the market-shaping perspective includes a wider variety of market actors beyond the traditional buyer–seller dyad* (Nenonen & Storbacka, 2021). While the traditional dyad is still central, the market-shaping literature recognizes the importance of other actors to the overall value generation of the market system. Thus, when transforming or developing new markets, market shapers may influence institutional actors such as governmental organizations and industry associations, or ecosystem actors such as supplier networks and adjacent companies, in addition to customers and end-users (Flaig et al., 2021b; Kleinaltenkamp et al., 2021; Kullak et al., 2022; Storbacka, 2019; Storbacka et al., 2022). This core idea is important for the development of AVS markets because it requires the co-evolution of multiple ecosystem actors (Makkonen et al., 2022; Thomson et al., 2021; Tsvetkova et al., 2021).

Third, *the complex adaptive system view of the market implies that markets are held together by a shared value logic, which is subject to change*. In well-developed markets, business models fit together so that participating actors complement one another (Nenonen & Storbacka, 2020). Thus, as participants of value generating systems, market actors benefit from a shared understanding of how value is created, delivered, and captured in the market. As part of shaping the value logic, companies can actively work to change the values that drive competition in a market (e.g. price, environmental sustainability, social responsibility,

use value) (Nenonen & Kai., 2018; Nenonen & Storbacka, 2021). Indeed, autonomous vehicle solutions possess the potential to disrupt existing value logics (Leminen et al., 2022).

In sum, *market shaping explains the evolution and formation of markets as outcomes of market-shaping processes*. Markets are continuously evolving, shaped by both everyday activities such as trade and by explicit market-shaping processes to change or stabilize existing markets, or create new ones (Harrison & Kjellberg, 2016). Because market-shaping processes aim to alter market configurations (i.e., the state of the market) (Flaig et al., 2021b; Storbacka, 2019), markets evolve as aggregated successful outcomes of multiple, simultaneous, and/or sequential shaping processes (Flaig et al., 2021a). In effect, they may evolve continuously or abruptly, and they may merge with others or split into parallel markets. However, as complex adaptive systems, their trajectories are inherently hard to predict (Harrison & Kjellberg, 2016). Since market shapers have different intentions, markets can experience both stabilizing and transformative market-shaping efforts at the same time (Flaig et al., 2021b). This leads to competition among market shapers to develop the most attractive market visions, describing how new states of the market could be more beneficial than the status quo (Flaig & Ottosson, 2022; Kohli & Jaworski, 2023; Storbacka & Nenonen, 2011). Particularly, conflicts emerge as disruptive shaping efforts involve visions that propose market conditions so radically different from the current market state that simply widening it will be insufficient (Flaig et al., 2021b). Despite its centrality in the market-shaping literature, it remains uncertain exactly how the market vision emerges and how it is adapted through companies' market-shaping processes (Kindström et al., 2023; Kohli & Jaworski, 2023).

To further investigate this issue, our study builds on the market proposition concept of Storbacka and Nenonen (2011, p. 264), which is defined as “*resource-integration promises to enhance value creation for participating actors by creating a market configuration that makes increased density of resources and capabilities and value co-creation possible*”. To further increase precision, we refine this concept as *market value proposition (MVP)*, thereby placing the emphasis on value creation whilst positioning it as a distinct type of value proposition (other examples are supplier VP and customer VP) (Frow et al., 2014; Grimes-Rose et al., 2024; Payne et al., 2017). In essence, we view market value propositions as initial manifestations of market visions where companies offer their view on how markets should be configured, with the aim of displaying sufficient attractive configurational fit for potential market actors to support it.

2.3. Understanding market-shaping processes in the context of market formation

While market shaping is undoubtedly a relevant theoretical perspective to understand how companies can develop the right market conditions for disruptive offerings, such as autonomous vehicle solutions, we still lack insights into how market shaping for companies disrupting existing markets unfolds. Specifically, there is a need to fully grasp the underlying processes of market shaping for new market formation in the context of disruptive technologies.

To understand existing knowledge and identify prevalent gaps, we reviewed the literature on market shaping, with a focus on selecting articles that provide insights into the activities, phases, and processes integral to the formation of markets. Table 1 summarizes our analysis of the most relevant and influential market-shaping process frameworks. In the following section, we provide an overview of existing process frameworks in the literature and present the key insights and knowledge gaps that we derived from our review.

While market-shaping is inherently a process where actors change market conditions over time (Baker et al., 2019; Kjellberg et al., 2015), much of the market-shaping literature treats the process view implicit. It focuses on activities and capabilities (Nenonen et al., 2019) by building a market-shaping organization (Carrillat et al., 2004; Simone et al.,

2021) or unintentionally shaping a market as a consequence of other processes (Ekman et al., 2021; McDonald & Eisenhardt, 2020). Accordingly, there is a need for further in-depth studies to unravel the intentionality of market-shaping processes (Ekman et al., 2021; Flaig et al., 2021b; Hawa et al., 2020).

There is an emerging conceptual understanding of market-shaping processes that needs further refinement and in-depth study because frameworks linking market-shaping processes to the evolution of markets have largely been confined to conceptual papers (Flaig et al., 2021a, 2021b; Jaworski et al., 2020; Kindström et al., 2023; Storbacka & Nenonen, 2011, 2015). On the conceptual level, the literature has provided initial frameworks for understanding market-shaping processes by categorizing activities and practices from previous studies into three overarching stages with various labels, such as infusion, formation, and retention (Flaig et al., 2021a) or origination, mobilization, and stabilization (Storbacka & Nenonen, 2015). However, due perhaps to their conceptual underpinnings, these stages are overly broad and lacking clear illustration of the temporal unfolding within stages. We argue that these overall conceptualizations of stages in market shaping require greater in-depth analysis and empirical research into the underlying sub-processes within them. We exemplify this need below with special emphasis on the sub-processes inherent in the market formation stage, which is the focus of this paper. Fig. 1 illustrates the overall conceptualization of market-shaping processes and the need for further study of the underlying sub-processes, such as market disruption (the focus of this study).

The *market infusion* (origination) stage is conceptualized as an internal stage where the main activity is the development of a market vision describing the desired future states of the market. Similarly, Kindström et al. (2023) delineate a fuzzy front end stage of market shaping as an internal phase shrouded by uncertainty, where multiple temporary early visions (market images) compete for prevalence. However, how this front end (infusion/origination) stage actually unfolds is unclear (Kindström et al., 2023). For example, the structure of the fuzzy front end may be different depending on the markets envisioned (e.g., widening or disruption).

The next stage, *market formation* (mobilization), is conceptualized as the first phase where activities lead to observable outcomes in the market. In this phase, the goal is to instill a set of market conditions and create resource linkages that can support a stable market. While the literature lists several activities such as creating a market identity (Maciel & Fischer, 2020), developing networks (Baker & Nenonen, 2020), and influencing institutions (Fuenfschilling & Truffer, 2016; Kukk et al., 2016) as key in the formation stage, there is a need for further in-depth refinement of the temporal sequencing of these activities and their underlying intention. Arguably, the unfolding of market shaping in this stage is contingent on the extent of the intended change. Specifically, initial papers have distinguished between *market widening* intentions aimed at modifying an existing market (i.e. transformation) and *market disruption* intentions aimed at forming a completely new market (Flaig et al., 2021b). Indeed, prior studies suggest disruptive processes are triggered when a profoundly conflicting market vision is incompatible with the market conditions of an existing market (Ekman et al., 2021; Flaig et al., 2021b) as in the case of AVS. Yet, the literature lacks a comprehensive framework that clearly links market-shaping processes in the formation stage with the creation of new markets.

The final stage is conceptualized as *market consolidation* (retention, stabilization).¹ In this stage, we locate two market-shaping sub-processes aimed at solidifying established market conditions. First, *market maintenance* aims to stabilize market conditions so that the market becomes resilient to further change – for example, by institutionalizing

¹ Note: While previously labelled this stage as market retention or stabilization, we now conceptualize it as market consolidation to better capture the temporal dynamics in market shaping and market evolution.

Table 1
Market-shaping processes in relation to the present paper.

Article/ type	Key insights	Shaping process	Market context	Market outcome
Carrillat et al. (2004) /Conceptual	Introduces a market-driving culture to the company (adhocracy, external/informal).	Internal; culture	Generic	NA
Santos and Eisenhardt (2009) /Multiple case	Companies shape their own organizational boundaries to construct new market spaces. Steps: Claiming, demarcating, and controlling nascent market.	Cultural; new cognitive market spaces	Nascent	Transformation
Storbacka and Nenonen (2011) /Conceptual	Conceptualizes market propositions as resource-integration promises to script markets. Firms spread their view of the market by oscillating market practices. Phases: Origination, mobilization, stabilization	oscillations diffuse new market elements	Generic	Transformation
Storbacka and Nenonen (2015) /Conceptual	Focuses on interorganizational learning where learning outcomes are changes in market properties. Market-learning cycle framework: Trigger, origination, mobilization, stabilization.	learning process	Generic	Transformation
Fuensschilling and Truffer (2016) /Case study	Highly institutional regime structures limits actors' scope for action, yet actors can play a mediating role in the co-evolution of institutions and technologies.	Institutional work	Industrial	Transformation
Kukk et al. (2016) /Case study	Bridges the literature on system building and institutional entrepreneurship. Shows how innovation system-building activities can indirectly lead to institutional change.	Institutional change	Public	Transformation
Baker et al. (2019) /Case study	Links market-shaping to creation of new markets. Find both undermining and creative market-shaping activities led to a new circus market. Emphasize the vibrant interplay among stakeholders.	Institutional change through vibrant networks	Consumer	Formation of new consumer market
Maciel and Fischer (2020) / Case study	Framework explains the process of collective action through three phases: Dispersed action, mobilization, concerted action. Access to adequate resources is the central decision to collaborate. Ethos for collaborative market shaping: "A rising tide floats all boats."	Collective action	Consumer	Transformation
McDonald and Eisenhardt (2020) /Case study	Markets evolve as entrepreneurial firms adopt business models by learning from the market through "parallel play".	Internal business model adaptation	Nascent	Transformation
Baker and Nenonen (2020) /Case study	Shows how small market actors build power through collective action. Three phase model: Coalescing, legitimizing, using market clout.	Collective action	Consumer	Transformation
Jaworski et al. (2020) /Conceptual	Creates a 2 × 2 typology of market-shaping firms based on focus (cultural/ functional) and level of action (individualistic/ collaborative). Conceptualizes a 7-step activity-based market-shaping framework from previous case studies.	Cultural or functional; Cascading waves	Generic	Transformation
Flaig et al. (2021a) /Literature review	Broadly organizes market-shaping activities into market-shaping stages: Infusion, formation, retention. Circular phases and continuous process allows companies to enter at any phase depending on their intention.	Generic	Generic	Transformation / Formation (market formation as a stage is ambiguous)
Simone et al. (2021) /Conceptual	Firms need T-shape (in-depth competencies and dynamic capabilities) for brokerage and exaptation strategies to foster new market spaces (context of use).	Internal process to find new market spaces	Generic	Transformation
Ekman et al. (2021) /Case study	Distinguishes between intentional and unintentional market shaping. Both capability development and institutional conflict can trigger market-shaping.	Intentional and unintentional	Real Estate	Transformation
Schweitzer et al. (2022) /Case study	Process of shaping and adaptation: Create saliency, mitigate reservations, and institutionalize the desired change. Finds incumbents shy away from coercive use of power in shaping (market catalyzer role).	Shaping and adaptation	Industrial (AVS)	Transformation
Kindström et al. (2023) /Conceptual	Provides 9 propositions delineating a fuzzy front-end phase of market shaping occurring before actual market shaping materializes. The FFE phase centers on building a market image. Actors, agency, and activities are dispersed and uncoordinated.	Internal and dispersed	Generic	Transformation
Schaumann and Tarnovskaya (2023) /Case study	Embedded market-shaping process shows an actor change affects stakeholders through recursive cycles of market-shaping engagement affecting structural links, relationships, and stakeholder roles. Actors can be unaware of/uninterested in the market vision, yet still have profound influence over the process.	Embeddedness	Generic	Transformation
This study	Explores market formation for autonomous vehicle solutions. Provides a disruptive market-shaping processes with three phases: exploration, preparation, and experimentation. Companies disrupt markets by developing attractive market value propositions.	Disruptive process	Industrial (AVS)	Formation

practices or strengthening social ties (Humphreys & Carpenter, 2018; Kjellberg et al., 2015). Similarly, to hinder further change, incumbent actors may undertake *market restriction* processes by neutralizing threats and enforcing market norms (Cova et al., 2021).

In sum, conceptually developed process frameworks provide a birds-eye perspective linking focal actors' market-shaping processes to the evolution of generic markets. Yet, they lack the contextual anchoring required to understand how actors' market-shaping processes lead to the formation of new markets (Flaig et al., 2021a; Storbacka & Nenonen,

2011, 2015). However, empirical frameworks frequently provide contextual grounding but tend to investigate the transformation of markets (widening) rather than the formation of new markets (disruption). Consequently, there is a missing link in explaining the progression of the early market-shaping stages and how this leads to the emergence of new markets.

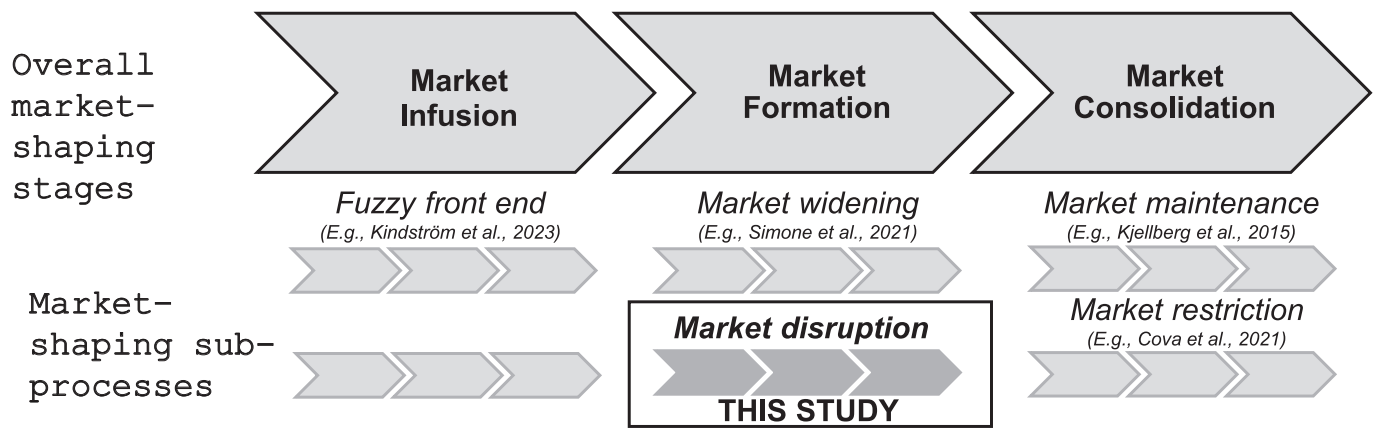


Fig. 1. Market-shaping stages and subprocesses.

3. Methods

3.1. Research approach and case selection

To understand how AVS providers shape markets for their autonomous vehicle solutions, we adopted an exploratory multiple case study approach. Case studies enable several observations of complex processes and are a good way to investigate contemporary events (Yin, 2014). Multiple cases are likely to provide fertile ground for theory building when the research question has no obvious answers and the researched phenomenon is emergent (Eisenhardt, 2021). This approach seems appropriate given our empirical context (autonomous vehicle solutions) and the focal phenomenon (market shaping).

Our sample centered on Scandinavian 10 market-shaping AVS providers and included 18 relevant market actors engaged in transitioning toward autonomous vehicle solutions. The Scandinavian context is particularly promising because these countries are rated among the top on KPMG's autonomous vehicles readiness index 2020. Contrary to most other studies addressing business relationships, we followed the example of Tuli et al. (2007) by collecting dyadic data (e.g. provider – customer, supplier, adjacent actor) that included other relevant market actors in addition to the AVS provider. The dyadic data enabled a deeper understanding of disruptive market-shaping processes. Seeking to increase the theoretical generalizability of our findings, we drew our cases from multiple industrial settings – shipping, logistics, mining, airside operations, and both land and maritime public transportation (Eisenhardt, 1989). This wide selection allowed us to contrast perspectives on the disruptive market-shaping process from different industrial settings and to look for common practices across the cases. We used theoretical sampling, selecting cases in which the AVS providers were actively engaged in shaping market conditions to accommodate the transition toward autonomous vehicle solutions (Eisenhardt, 2021; Glaser & Strauss, 1967). As the market-shaping literature portrays markets as complex systems, the inclusion of other market actors allowed us to develop a deeper understanding of the dynamic market-shaping process for autonomous vehicle solutions. We applied the following criteria in selecting cases. First, the cases centered on AVS providers engaged in commercializing autonomous vehicle solutions. Second, the providers were actively engaged in shaping market conditions to facilitate market formation for their autonomous vehicle solutions. Third, the AVS providers were working in a B2B context. This effectively narrowed the sample by excluding AVS providers purveying autonomous consumer products, such as grass mowers and vacuum cleaners. We selected cases

where we were able to establish good contact with top-level managers (who had a strategic overview) at both the AVS provider and relevant market actors. We employed a snowballing procedure guided by the AVS providers to identify the other relevant market actors in each case. These actors were customers, potential customers, suppliers, OEMs, and facilitators.

3.2. Data collection

The data were primarily collected through individual in-depth interviews with participants who had a strategic overview of the transition to autonomous vehicle solutions. We developed a semi-structured interview guide and interviewed managers from both the AVS provider organization and the relevant market actors' organizations. We conducted a total of 44 semi-structured interviews with top-level managers. Semi-structured interviews gave us the flexibility to probe deeper into specific aspects of the interviews we found particularly interesting. At the same time, we allowed the respondents to freely elaborate on topics that were of special importance to them or in which they possessed extensive knowledge. The initial interview guide was developed based on themes from the literature, and it was customized to accord with each specific company context. Following the iterative nature of data analysis, we modified the interview guide continuously as the study progressed to accommodate the emergence of new information and themes (Draucker et al., 2007). This allowed us to start the analysis process whilst collecting further data and to modify the interview guide to extract new information. The interview guide carried an evolving view with questions aiming to capture the context and temporal order of the market-shaping activities. Respondents were asked open-ended questions, inviting them to provide rich data and examples from their own perspectives and experience. When the respondents broached a particularly interesting topic, we asked probing questions to garner further reflection on the topic. The interviews were primarily conducted via video link and ranged from 40 to 120 min with an average duration of 63 min. The interviews were recorded and transcribed. Additional data were collected from company websites, newspaper articles, industry podcasts, and annual reports. The secondary data were used in the following way. First, they provided a contextual background when developing interview guides, and then they facilitated data triangulation – that is, verifying the accuracy of information captured in the interviews (Yin, 2014). Information on interview data is summarized in Table 2.

Table 2
Data collection.

Solution/ Company	Description	Role	Interview conducted	Respondent title	No / Min / Words
Autonomous Ferry AutoFerry	Small start-up BU within a large innovation house.	Provider	Apr-Nov 2022	COO	3 / 260 / 36,014
		Customer	April 2022	Department Manager	1 / 101 / 14,884
		Potential	May 2022	Board Director	1 / 44 / 7711
		Customer			
Autonomous Sweepers AutoSweep	Smaller start-up owned by a large power product manufacturer.	Provider	Mar-May 2022	CEO	2 / 117 / 15,854
		Provider	August 2022	Business Development Manager	1 / 56 / 7844
		OEM	June 2022	CTO	1 / 89 / 12,081
		Customer	June 2022	Department Manager	1 / 106 / 14,180
Autonomous Ships AutoMar	Joint venture by large maritime OEM and ship management company.	Provider	June 2021	CEO	1 / 59 / 7697
		Provider	Nov-Dec 2019	Business Development Manager	2 / 118 / 11,394
		Provider	Nov-Dec 19–20	Marketing Manager	2 / 135 / 17,816
		Provider	Dec 2019	Board Director	1 / 56 / 6470
		Ship Management	February 2020	General Manger	1 / 40 / 3803
		Customer	Feb-Mar 2021	CEO	2 / 140 / 18,226
		Port 1	June 2021	CEO	1 / 69 / 9857
		Port 2	June 2021	CEO	1 / 67 / 8024
		Supplier 1	June 2021	CEO	1 / 64 / 9099
		Supplier 2	June 2021	CEO	1 / 27 / 4072
Autonomous Trucks AutoTruck	Start-up business area of a large heavy vehicle manufacturer	Provider	September 2018	Business Development Manager	1 / 55 / 7105
		Provider	August 2020	Service Manager	1 / 55 / 5910
		Provider	September 2020	Business Development Manager	1 / 57 / 7100
		Provider	Oct 2020	Platform Manager	1 / 55 / 6358
		Provider	Nov 2020	Department Manager	1 / 60 / 9882
		Provider	Dec 2020	Project Manager	1 / 49 / 6087
		Customer	Oct 2020	Technology Manager	1 / 56 / 6017
		Logistics integrator	Oct 2020	Business Development Manger	1 / 59 / 7349
		Provider	April 2022	Logistics Manager	1 / 47 / 6486
		Provider	February 2023	Academic Manager	1 / 61 / 8394
Autonomous Quarry AutoMine	BU within a large vehicle manufacturer.	Provider	May 2022	Project Manager	1 / 53 / 6374
		Customer	June 2022	CEO	1 / 71 / 9006
MineCo	Start-up owned by a large construction corporation.	Provider	March 2022	CEO	1 / 68 / 7875
		Customer	April 2022	CEO	1 / 72 / 10,488
		Potential	April 2022	Department Manager	1 / 68 / 7374
Autonomous Buses AutoCoach	Medium-sized start-up owned by a large mobility group.	Provider	June 2022	Department Manager	1 / 45 / 6059
		Customer	June 2022	Project Manager	1 / 63 / 8365
		Supplier	February 2023	Strategy Manager	1 / 71 / 10,037
AutoDrive	Small start-up.	Provider	August 2022	CEO	1 / 40 / 5655
		Customer	June 2022	Project Manager	1 / 60 / 8482
AutoBus	Small start-up.	Provider	June 2022	CEO	1 / 74 / 9452
TOTAL					44 / 2787 / 364,881

3.3. Data analysis

Our data analysis followed a thematic analysis approach similar to that outlined by Braun and Clarke (2006). The analysis consists of six recursive phases – familiarization, initial coding, searching for themes, reviewing, looking for aggregate themes, refining, and reporting. We chose this approach because of its strength in identifying patterns across large data sets whilst preserving empirical grounding in the data, and its ability to produce thick descriptions in multiple case studies, and to generate unanticipated insights (Braun & Clarke, 2006). The data

analysis was aided by the MaxQDA software, which helped us keep track of the growing set of initial codes, memos, and interesting quotations and segments from the data items and across the data set. To enhance transparency, we developed a data structure (Fig. 2) showing graphically how our analysis progressed from first-order codes to themes and aggregate dimensions, and how it aided our search for patterns across the data corpus (Gioia et al., 2013). In support of the data structure, Table 3 enhances the transparency of the analysis by providing representative quotations for each first-order code.

The first step of the thematic analysis was to familiarize ourselves

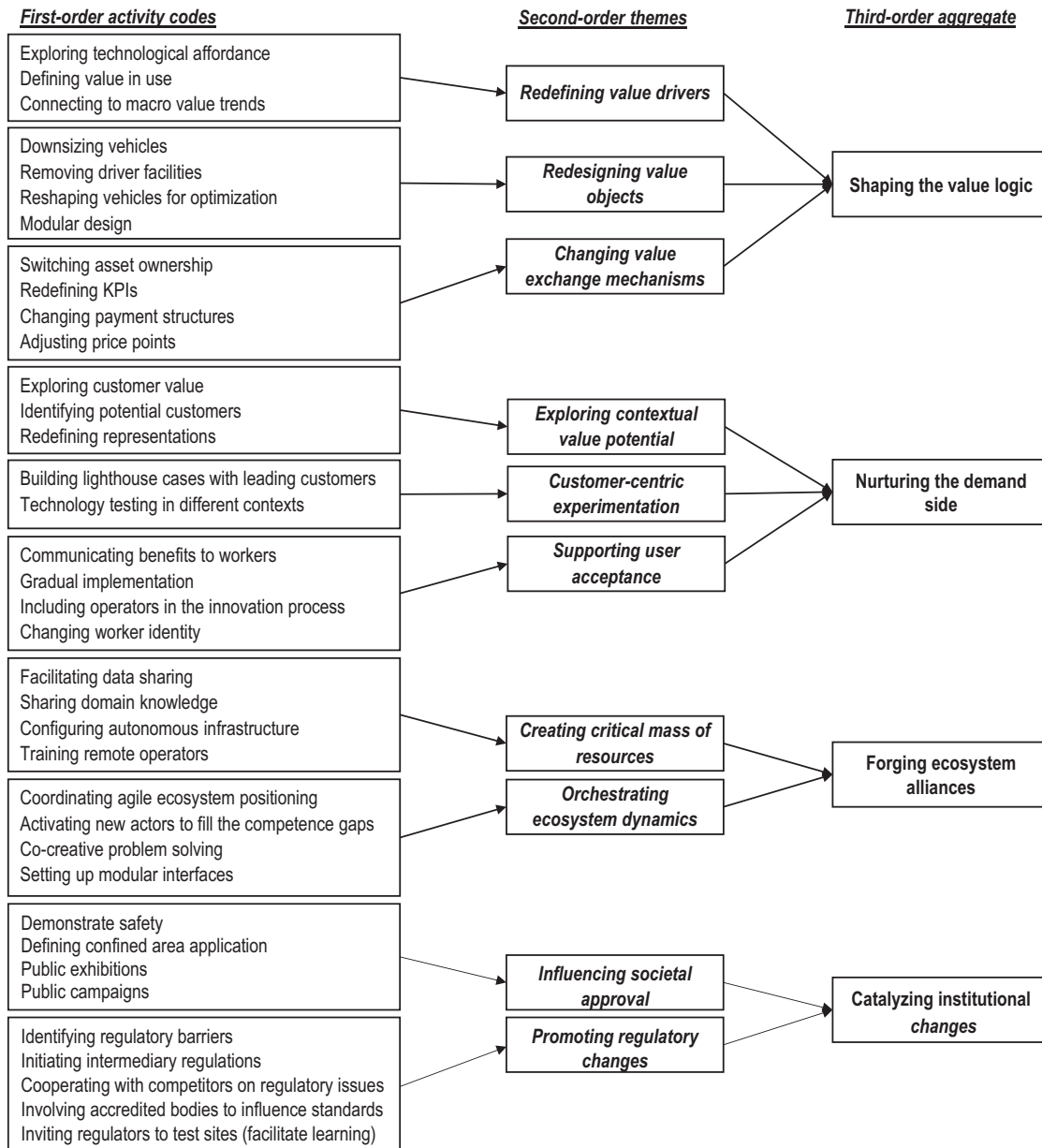


Fig. 2. Data structure.

with the data. This meant reading transcripts while listening to recordings. Interesting segments and emerging ideas were captured as we went through the transcripts. Next, we began the process of creating initial codes using open coding techniques. The initial codes were mostly descriptive, aiming to capture the essence of the raw data that could inform the research question. The initial coding process could be characterized as inclusive. We made sure to include some of the surrounding data to avoid losing context. Moreover, we made certain to code as many future themes as possible to avoid overlooking potentially important data. Next, we searched for patterns in the initial codes across the data set. Identified links and patterns in the initial codes were collated into second-order themes aimed at raising the level of abstraction whilst preserving the empirical grounding. The themes were reviewed in relation to the first-order codes and the other second-order themes from the data set. To achieve the correct level of abstraction to address our research question, second-order themes were collapsed into aggregate dimensions. As our research progressed, the analysis was conducted in parallel with the data collection, which was highly iterative. To increase reliability, analysis was conducted by multiple researchers, and disputes

were settled through iterative cycles of discussion (Miles et al., 2014). In consequence, codes, themes, and aggregates were revised, moved, removed, renamed, and redefined several times during the process. Our criteria for the prevalence of themes and codes were first based on their “keyness” (Braun & Clarke, 2006), – in other words, it captured something relevant in addressing how AVS providers shape markets for autonomous vehicle solutions. In a final, iterative step of the analysis, we theorized on the logic of relationships between the aggregate dimensions and themes, and the temporal order to which they were employed. The questions asked during data collection followed an unfolding view to capture the temporal order of the activity themes. While several themes were active throughout the process, their intensity varied. Three market-shaping phases were identified in an emergent way by organizing patterns of activity themes according to their intensity and shared objective, leading to the creation of the disruptive market-shaping process framework. The model was subsequently validated by respondents.

Table 3
Representative supportive data for first-order codes.

Dimensions and themes	First-order codes and representative quotations
Shaping the value logic Redefining value drivers	Exploring technological affordance: <i>There is an aspect when it comes to profitability, I would say. Making sure that the business models make sense. It doesn't make sense to have an autonomous solution running eight hours per day, five days per week in a traditional business. It makes more sense to have it running only around seven days a week, 24 h per day.</i> AutoTruck, business development manager Defining value in use: <i>User experience is that the driver, this computer, drives in a passenger-friendly way. ...So it's things like this that you work on to increase user friendliness for those sitting inside the vehicle.</i> AutoCoach, CEO Connecting to macro value trends: <i>The macro trend is that we have a rising generation that is perhaps to a much lesser extent car oriented, but perhaps to a greater extent than my generation, which is mobility oriented.</i> AutoFerry, COO
Redesigning value objects	Downsizing vehicles: <i>Smaller units mean a more frequent departure... ..And that is made possible by the fact that you do not have to think about the cost associated with those who will sit and drive.</i> AutoFerry, COO Removing driver facilities: <i>Because we see that, if you remove the driver's cabin from the truck, that is it, then you take away a very large part of the building cost, construction cost, maintenance cost, and that adds up, there is a lot of money in the driver's environment. Because that's where they [competitors] really compete.</i> AutoLorry, logistics Reshaping vehicles for optimization: <i>We have focused very hard on a very energy efficient hull and an energy efficient design. So, we have worked very hard not to waste a single kilowatt-hour of energy.</i> AutoFerry, COO Modular design: <i>...That's how we're working in the autonomous arena as well, trying to find a modular system, a way when we do a common solution that, with just some tweaks, can be applied at different customers. ...we need to develop a broad solution that could be used for other customers, in other countries, in other sites.</i> AutoTruck, project manager
Changing value exchange mechanisms	Switching asset ownership: <i>But all of this we basically want our customer not to have to worry about, we say we will take care of this. I simplify heavily but press the on-button and let it run and then press the off-button. And while it is on, this is the productivity you should expect from it.</i> AutoMine, project manager Redefining KPIs: <i>We run transport as a service. That is to say, we will not sell transport like most companies sell transport, lane by lane, we sell tonne-kilometers, you could say.</i> AutoLorry, logistics Changing payment structures: <i>...going from a one-on-one transaction, in terms of we sell you a truck and then we talk to you again in five- or ten-years' time when it's time to renew it, to having an ongoing relationship and transferring that value into a recurring payment that you can count on.</i> AutoTruck, service manager Adjusting price points: <i>This is an industry where there are margins where you are skilled at 3 %. We can lower the cost by perhaps 30 % then. Even more over time.</i> AutoLorry, logistics
Nurturing the demand side Exploring Contextual value potential	Exploring customer value: <i>We run through the customer's current operations through different algorithms and, based on that, we're able to say this is how a customer can optimize the logistics and then the [solution] has different packages or different sort of elements in it.</i> AutoLorry, academic manager Identifying potential customers: <i>So, there are a lot of people interested in it, and we have spent a lot of time educating future customers, trying to tell them about where we are and what to expect.</i> AutoCoach, department manager Redefining representations: <i>He who buys the apartment has already established a level of common housing expenses, has paid the ferry. So that, regardless of whether he is going to work, going on a trip, or going to leisure, or whatever, he is going to the city. Then he just waddles down and out onto the pier, then the ferry arrives, and he can just get on board, everything is paid for.</i> AutoFerry (potential customer), board director
Customer-centric experiment.	Building lighthouse cases: <i>We need to prove that this works, our concept. And we need to succeed; we need to get two, three, four, five ships on the water that work and actually prove that this is effective, so we can reduce the risk for our customers.</i> AutoMar, marketing manager Technology testing in different contexts: <i>What we've done is basically we have looked at different types of operations that they have, and basically done a calculation and risk mitigation of where we can do this best. How can we plan over the year different feasibility, different tests, basically.</i> AutoTruck, 2nd business development manager
Supporting user acceptance	Communicating benefits to workers: <i>...that the day is better when they can sit and monitor what's happening rather than having to be there all the time and be the last one to receive cargo. I believe it will result in a less stressful working day.</i> MineCo, CEO Gradual implementation: <i>...they have to do it gradually because of their own maturity, and their own staff. Start with something that is not a threat, but something people find is nice to get automated.</i> AutoMar, marketing manager Including operators in the innovation process: <i>It's important to take these seriously and not enter a silo where it's all about technology, but rather about the users. That's why we have knowledge about it, and we have empathy. So, in a way, we take these perspectives seriously and respond to them properly.</i> AutoDrive, CEO Changing worker identity: <i>And if we then can create new kinds of jobs, which do not require the same kind of uncomfortable environment, you can rather sit in a very comfortable chair and monitor the trucks. ...I mean the main aspect might not be the cost, it might also be the social aspects that might be more important.</i> AutoLorry, academic manager
Forging ecosystem alliances Creating critical mass of resources	Facilitating data sharing: <i>We receive a lot of data from the vehicles in various ways, and we also collect our own data in various ways. We then try to build tools, both for ourselves and our customers, to help optimize, plain and simple. ...We can add this data and provide it to the manufacturers and say, 'Here are the challenges.' These are the situations that can further develop their product. Conversely, for [a public transport operator], we can talk about where passengers board quite precisely. ...We can provide data to the public roads administration about their road network. We can provide map data to the mapping authority. We can provide data to the municipality about where there are potholes in the road.</i> AutoCoach, department manager Sharing domain knowledge: <i>While we have this knowledge, how to manage this automatically, right? What's crucial, incredibly crucial, is that the knowledge that exists needs to be integrated into the system so that the system gains the knowledge you as a person have.</i> AutoSweep, CEO Configuring autonomous infrastructure: <i>Furthermore, it's also about having a strong infrastructure, both in terms of telecommunications and physical infrastructure, which facilitates the development of a better traffic culture.</i> AutoDrive, CEO Training remote operators: <i>But then you train them and, if they are very well trained, they are attractive to other owners, and they will jump, so you need balance.</i> AutoMar, board director
Orchestrating ecosystem dynamics	Coordinating agile ecosystem positioning: <i>I believe that, at the very least, you need to be integratable and think like a partner in the ecosystem; customers will buy the best ecosystem.</i> Autosweep, CEO Activating new actors to fill competence gaps: <i>It is a cliché, but partnership is the new leadership. That is what everyone is talking about, right?</i> AutoMine, project manager Co-creative problem solving: <i>And then we had [provider 1] and [provider 2], who were asked to install an antenna and such. It was quite a hassle to get it done, and no matter what we asked, it cost a million, and so on. Eventually, [the customer] managed to talk to the right person at [provider 1], and it turned out that [the customer] was able to do what [provider 1] found difficult, and vice versa.</i> MineCo, CEO

(continued on next page)

Table 3 (continued)

Dimensions and themes	First-order codes and representative quotations
	<p>Modular interfaces: <i>The interface between the remote operation center and the vessel will become crucial. It may quickly become a separate module. Then, the smart city integration comes into play, which pertains to things like traffic optimization and such.</i> AutoFerry, COO</p>
<p>Catalyzing institutional changes Influencing societal approval</p>	<p>Demonstrating safety: <i>If you think about their safety protocol and how strict they talk about safety, they will probably not even allow you to go down there before you have proven yourself for quite a while, to have something where you cannot have a safety driver.</i> AutoTruck, platform manager Defining confined area application: <i>We call it industrial economy where there is a fence, it's not in the city center, it's an area where you have a set of rules to adhere to, and people in the area may have special training.</i> AutoSweep, CEO Public exhibitions: <i>It's like letting only a child be in a playpen and live their whole life in the playpen. Then you deprive that child of being among people, being in a social setting. So that's not the solution. But one must be both out in the public space and in the playpen.</i> AutoDrive, CEO Public campaigns: <i>I counted more than forty conferences and I have been pushing out. ...I try to repeat it at different fora and now I can feel like it's starting to, especially [nationally] that people have heard about it. You know, the people that we want to involve. Including politicians, universities and you know, a lot of non-buying customers.</i> AutoMar, marketing manager</p>
<p>Promoting regulatory changes</p>	<p>Identifying regulatory barriers: <i>...so what legal authority should actually take this on? ...so it is [the road authority] that we apply for our permits. ...And then we have a dialogue with the workplace authority. It is interesting as a by-note that their dialogue with [road authority] may not seem to be so good. So, we are sometimes going in-between and informing them.</i> AutoMine, project manager Initiating intermediary regulations: <i>It was that a legal framework was established for autonomous transport in 2017. I had worked extensively on it since 2017 through several trials, and also assisted the authorities with the legislation.</i> AutoDrive, CEO Cooperating with competitors on regulatory issues: <i>There is a lot of collaboration, both through EU projects, where stakeholders collaborate, which are often complementary to each other but can also be competitive.</i> AutoDrive, CEO Involving accredited bodies to influence standards: <i>We need to collaborate in things that will benefit us all like protocols, defining standard protocols for communication, for instance.</i> AutoTruck, project manager Inviting regulators to test sites: <i>We work with the authorities to obtain permission to increase the level of autonomous driving, for example. It's an ongoing process. The authorities don't know, they've never done this before, so they are also learning at the same time, as we are.</i> AutoLorry, logistics</p>

4. Findings

From our data analysis, we identified how AVS providers engage in disruptive market-shaping processes to form new markets for their autonomous vehicle solutions. The result of our thematic analysis is summarized in our data structure (Fig. 2). We identified four aggregate market-shaping dimensions that are essential to spur market formation: shaping the value logic, catalyzing institutional changes, forging ecosystem alliances, and nurturing the demand side. Further building on the analysis, we developed the disruptive market-shaping process framework by organizing the temporal unfolding of the themes. This led to identification of three phases with distinct objectives and the development of the market-shaping process framework. The following sections are structured as follows. First, we elaborate on the themes that constitute the aggregate dimensions, and their first-order market shaping activities. We then present the disruptive market-shaping process framework and elaborate on the phases, before presenting propositions on how companies proceed along the phases.

4.1.1. Shaping the value logic

Our analysis revealed that a critical component of the disruptive market-shaping process is *shaping the value logic*. Shaping the value logic means defining novel ways of creating and capturing value. Essentially, this is concerned with leveraging technological changes to create new opportunities by organizing value-producing activity. We identified three themes fundamental to shaping the value logic: *redefining value drivers, redesigning the value object, and changing value exchange mechanisms*.

By *redefining value drivers*, we mean establishing a coherent logic on how new solutions can provide value to a market. The activities to redefine value drivers are highly contextual, depending on technological affordances (e.g., driverless), the specific application (e.g., operation site), current value drivers in existing markets (e.g., efficiency), and macro trends and other cultural phenomena (e.g., sustainability transition). An initial way that companies work to redefine value drivers is to explore conceptually how technological innovations enable novel ways of organizing for value creation. AVS providers, therefore, map out different ways to leverage the affordance of driverlessness to increase

the value potential of their solutions. For example, we find that, for autonomous vehicle solutions, the driverless technology does not mean simply saving driving cost. By leveraging driverless technology, we find that AVS providers shape a completely new value driver – a granular systems logic. By introducing a granular system logic, AVS providers challenge the old across-industry standard of increased capacity per unit. We find that this is the truly disruptive potential of autonomous vehicle solutions because it implies scaling by numbers rather than by size, thereby upending the century old logic of “bigger machines, lower operating costs”. Because operator costs no longer increase according to the number of operating units, AVS providers work to reorganize operations so that fleets of autonomous units work collaboratively in a fine-meshed network to perform value-creating operations, thereby allowing value to be created through flexible on-demand routing, rush-hour scaling, continuous operations, and increased accuracy and safety. This way, the value of autonomous vehicle solutions is not confined to that of a single unit, but the autonomous system as a whole.

“Then you're not only coordinating one vehicle, but you can coordinate multiple vehicles, to interact or swarm through that operation to carry out the mission.”

AutoSweep, CEO

Creating an understanding of the technology affordances further allows firms to engage in defining value in use for various customer applications. By emphasizing value in use (e.g., outcomes) over product value (e.g., technological features), AVS providers can change the conversation from traditional criteria (e.g., machine costs) to system-level performance criteria (e.g., cost per ton moved). At the extreme end, shifting to autonomous service provision may enable complete operations to be outsourced to the provider. Another way AVS providers work to redefine value drivers is by connecting their new solutions to external value drivers inherent in macro trends, such as sustainability values. Indeed, informants described tapping into external momentum from sustainability trends, such as CO₂ reduction and safety, which may help to drive the market. In our data set, several AVS providers highlighted the importance of describing how their autonomous vehicle solutions could help toward sustainability issues whereas previous solutions could not. Building further on technological affordance, companies redefine value drivers to disrupt adjacent markets. For instance, AutoBus envisions creating a completely new transportation system – autonomous buses in narrow underground tunnels – allegedly enabling an estimated

90% cut in tunnel drilling costs compared with subway tunnels. A combination of different value drivers can be part of a complete value logic. The importance of redefining value drivers cannot be overstated. Simply applying new technology according to traditional value drivers could severely hamper its value potential. Put differently, new technologies may offer huge disruptive potential if executed correctly. The logistics manager for AutoLorry emphasized how autonomous technology enabled a disruptive granular systems logic in logistics:

“The easiest thing is, of course, to ask a driver to drive a car to Madrid and then back. That logic may not hold when you think more granularly and work more digitally (...) if you control digitally, it becomes an ‘ant hill logic’ [chain logic], which means that a trailer ends up in Madrid without there being any long break at all.”

AutoLorry, logistics manager

The next activity theme that AVS providers follow when shaping their value logic is *redesigning the value object*. This means leveraging opportunities granted by an enabling technology to change the object that is central to value creation in a market. The label “redesign” emphasizes that value objects need not be completely new to the world, although they can be. However, new technologies can allow significantly improved versions of traditional value objects. Therefore, we argue that, in order to truly unlock value potential, AVS providers need to identify how the enabling technology affords opportunities to redesign the value object in ways that add value. We identify at least three ways that redesigning the value object can add value to a market. First, a redesign may add value in its own right. This is classic product improvement. Retrofitting to add autonomous features falls into this category. Second, AVS providers can use the enabling technology to try and shift the value focus in the market. For example, autonomous truck providers seek to shift the traditional value focus of trucks away from being a competition about driver facilities to leveraging driverlessness and redesigning the value object by replacing driver facilities with alternative uses, such as increasing load capacity. AutoTruck described how removing driver facilities would cut 20% of production costs. Third, AVS providers can redesign value objects to complement their redefined value drivers, as when designing downsized autonomous vehicles to fully complement a granular system logic, thereby accelerating their disruptive potential.

“The moment you remove the driver, then the economics completely change. You have that economic drive, the thing. Then, our vehicles are easier to maintain, they're way more standard, we are much more flexible, so you could improve the flows. Eventually, it's going to have a lot of benefits. That's for the customer, and for us, it's a win-win.”

AutoTruck, project manager

The final activity theme needed to shape a comprehensive value logic is *changing value exchange mechanisms*. Value exchange mechanisms are the agreements that govern value transactions between parties. Changing value exchange mechanisms serves at least two important purposes in value creation. First, the value exchange mechanisms dictate how much value is captured by each exchange party. By aligning value exchange mechanisms with the redefined value drivers and redesigned value object, AVS providers seek to optimize their value creation potential because it provides incentives for both the supply and the demand side to follow the value driving logic. Thus, a failure to change value exchange mechanisms to mirror the underlying value driver and object limits the value-creation potential of the new solution. Second, the value exchange mechanisms can be set up to optimize value distribution between market actors, creating win-win agreements. Therefore, value exchange mechanisms can optimize total value creation in a market through incentivizing and distributive mechanisms. We identified several levers that AVS providers pull when designing value exchange mechanisms for autonomous vehicle solutions. These include changing price points, payment structures, KPIs, and ownership models.

MineCo intimated how lowering the price point opened the doors for smaller customers to use its solutions:

“And [MineCo's] philosophy is to have a much lower impact point than our competitors when it comes to adopting the technology. The others may need to have 20-30 vehicles and a substantial mine in Australia for it to be economical to start autonomous operations, while we sneak in under the radar and have a significantly lower start-up cost than what we have seen elsewhere.”

MineCo, CEO

The price point also depends on what is exchanged, whether it is the value object, a service, or a combined solution. Actors seeking to create market opportunities for autonomous vehicle solutions may switch from traditional customer asset ownership to other constellations that suit the redefined value drivers. Such ownership models enable the redistribution of value created by market actors. Similarly, connecting to the servitization value logic, payments may be drastically lower for “autonomy as a service” than the price of the autonomous unit or system itself. In this way, by connecting lowered price points with the redefined value drivers, market creators can lower the barriers for new customers.

“... a functional agreement, which means that we have full and complete responsibility for the machines running. The traditional agreement is that we are called in when they break down, or that we have an annual service.”

OEM (AutoSweep), CTO

4.1.2. Nurturing the demand side

Nurturing the demand side is perhaps the most salient dimension of the disruptive market-shaping process when commercializing autonomous vehicle solutions because demand is not necessarily latent. Nurturing the demand side refers to market-shaping activities aimed at creating the right conditions to attract customers to the coming AVS market. Our analysis uncovers three activity themes that constitute nurturing the demand side: *exploring contextual value potential*, *customer-centric experimentation*, and *supporting user acceptance*.

When AVS providers *explore contextual value potential*, they search for business contexts to test their solutions. We identified several activities that providers employed to explore the contextual value potential, such as identifying potential customers, exploring customer value, and redefining representations. For example, AutoDrive was involved in several projects to test its autonomous technology in different applications, such as buses and road sweepers. We found that AVS providers kept an open eye for potential customers. One deft tactic that we observed was how AVS providers were able to move the discussion on what their solution represented from being an object to a functional perspective, thereby exploring its value potential in new contexts with the hope of planting the seed of future demand with novel customer groups. For example, the COO of AutoFerry explained how talking about its autonomous ferry as a horizontal elevator had allowed it to explore the value potential for a completely different customer group – real estate developers – and help them generate a conversation about alternative funding:

“And for that money you can have your horizontal lift, it costs about the same to operate the ferry as it costs to operate the lift in the building you live in. Which means you can offer it as part of the whole package to live in a place. (...) You don't really need any additional funding beyond this. This pays completely by itself without a single public contribution. And that stands in quite stark contrast to the big sums [municipality] sponsors for every single bus ticket.”

AutoFerry, COO

Next, AVS providers nurture the demand side through *customer-centric experimentation*. By implementing commercial pilots with a few forward leaning customers, providers can explore customer value and

iterate the value logic in practice. Thus, AVS providers seek customers who are willing to change aspects of their operations to test the new value logic in a customer-specific context. AVS providers, in turn, learn from the practical implementation and update the value logic.

“It’s also the need for the customer to have an intention of actually orchestrating the logistical flow with their own system. That should be directed down to our self-driving systems.”

AutoTruck, value manager

AVS providers work to develop the commercial pilots into lighthouse cases showing the way for potential customers. In so doing, the provider tries to build momentum on the demand side, using the lighthouse cases as references to create positive feedback loops. For example, AutoMar transformed its first two commercial pilots into lighthouse cases for other customers to follow by alleviating risk in development costs and revealing actual economic gains. Thus, with the lighthouse cases, AVS providers signal solution maturity and plant the seed of customer demand.

However, potential customers often face resistance to adoption from user groups, such as workers. We find an important part of AVS providers’ nurturing of practice is *supporting user acceptance*. Customers and users are often different actor groups who may have conflicting interests. As autonomous vehicle solutions threaten to replace workers, we find that providers adopt different actions to support user acceptance. For example, AutoLorry and AutoMar communicated to drivers how they, as employees, would benefit from the solutions. Other firms, such as MineCo and AutoFerry, stressed the importance of including workers in the innovation process and AutoMar, AutoDrive, and AutoSweep assuaged skepticism through a process of gradual implementation. A job as a driver is often considered low status. AVS providers were keen to brief us that the new solutions would change worker identity from drivers to remote operators (desk job), thereby elevating the social status of these workers. For instance, AutoLorry contrasted operator identity with driver identity, advancing it as a solution to driver shortage rather than a threat to workers.

“...and the reason we have a driver shortage is that no one wants to work as a truck driver because the work sucks. Living out on the roads, low status, there are so many things that are wrong in that industry, and that there is a low profit margin doesn’t make it any easier either.... One has to look at why anyone would want to work in this industry at all! And our operators will sit in an office with colleagues, espresso machine, go home when they want, take time off when they need, and so on.”

AutoLorry, logistics manager

4.1.3. Forging ecosystem alliances

Our analysis revealed *forging ecosystem alliances* as one of the key elements in the disruptive market-shaping process. By forging ecosystem alliances, AVS providers seek to shape the right conditions for a solid supply side and to align adjacent ecosystem actors. Developing, improving, and operating complex product–service systems, such as autonomous vehicle solutions, require a high level of collaboration between ecosystem actors. AVS providers realize that their market-shaping efforts to create a market for autonomous vehicles have greater chances of success if they are backed by a solid ecosystem of actors moving in the same direction. We find AVS providers are forging ecosystem alliances on two levels: i) by *creating a critical mass of resources* in the affiliated ecosystem; and ii) directing the resources by *orchestrating ecosystem dynamics* to build an ecosystem structure that support AVS delivery for a larger market.

First, AVS providers collaborate with a few ecosystem actors to *create*

the critical mass of resources required for the autonomous vehicle solutions to materialize. Critical mass of resources refers to the essential amount of resources required for autonomous vehicles to function in real operational contexts. We find ecosystem actors add to the affiliated resource pool either through sharing practices or by developing new resources. Sharing resources, such as data and domain knowledge, with other ecosystem actors is essential to enable problem identification, solution development, and implementation. Since autonomous vehicle solutions are highly contextual, they need to be configured to replace the drivers’ sensing, cognition, and actions for each sub-task of an operation. AutoSweep explains why the sharing of domain knowledge between ecosystem partners is key to developing effective autonomous services:

“That line of communication must go on every single domain, otherwise you risk that your digital process deviates too much from the business process, and then it will be a failure. The domain knowledge is very important to catch. And that means that it is a knowledge that must be taken care of and refined, you could say.”

AutoSweep, CEO

Second, creating the right conditions to commercialize autonomous vehicle solutions may require resources that are unavailable or non-existent in the affiliated ecosystem. AVS providers and partners, therefore, need to develop and build such resources to support their innovations. We found providers often build or co-develop two notable resource types: remote operators and autonomous infrastructure. For example, AutoMar collaborates with academia, authorities, and other ecosystem partners to develop a training program for skippers to become remote operators. Another keystone resource development activity was building autonomous infrastructure, such as separate road lanes, telecommunication, charging stations, and digital infrastructure. AVS providers saw autonomous infrastructure both as a necessity to shape the right conditions in order to realize their solutions and as an opportunity to innovate products that could be profitable in their own right and help them position their ecosystems for competitive advantage in a future market. For example, AutoFerry stressed how developing automatic charging infrastructure for its autonomous ferry could become a valuable resource for other ecosystem actors and serve as a future standalone asset:

“And they thought it sounded exciting to be involved, especially on the docking side. Not just for the sake of the ferry, but when you first build an electric-charging wharf, you can well imagine that the infrastructure you build can be used for electric boats, small boats or, for that sort of reason, scooters, city bikes, or anything.”

AutoFerry, COO

Next, we found AVS providers were *orchestrating ecosystem dynamics* to shape an ecosystem structure that supported their autonomous vehicle solutions. In our analysis, this theme emerged from market-shaping activities that enable efficient collaboration between ecosystem actors. Since early business ecosystems may lack companies that take the position required to fill competence gaps, we found that AVS providers activate other actors from adjacent ecosystems to participate in making the autonomous solution a reality. To illustrate, rather than building connectivity capabilities internally, MineCo invited connectivity providers to establish positions in the ecosystem, bringing with them their enabling expertise. By activating other ecosystem actors rather than building capabilities in-house, AVS providers leave ecosystem positions to other actors and, in so doing, prioritize ecosystem expansion (size of pie) over their own market share (piece of pie). To further facilitate efficient ecosystem structures, AVS providers set up modular interfaces, enabling other actors to leverage value creation.

“I believe that the business model must be quite dynamic. We are now looking at selling autonomy as microsystems as a cloud solution, where you just pick out a piece or whatever it is supposed to be, and then it may be that some of those pieces are not autonomy either. It is just a service that enables others to deliver autonomy solutions together with us. Only with another supplier.”

AutoSweep, CEO

We noted the practice of providers employing co-creative problem solving to empower other ecosystem partners. For instance, AutoSweep helped its partners overcome issues, recognizing how an efficient ecosystem is mutually beneficial:

“We have a computer that we can put on board to connect sensors and such. But that is not our core business, it is something we have done to help the others raise their level.”

AutoSweep, CEO

4.1.4. Catalyzing institutional changes

The final market-shaping dimension uncovered in our analysis is catalyzing institutional changes. Catalyzing institutional changes refer to market-shaping activities directed toward macro-level actors over whom the AVS providers have less direct influence. Yet, the themes, influencing societal approval and promoting regulatory changes, consist of market-shaping activities directed toward breaking down detrimental barriers to autonomous vehicle solutions.

Public skepticism of autonomous vehicles is a real concern for AVS providers because it creates resistance to adoption. Our analysis revealed how AVS providers influence societal approval through different market-shaping activities. For example, MineCo arranged public exhibitions of its autonomous equipment to create familiarity and spread information on how the solutions would benefit the local quarry. AutoFerry ran a public campaign in the newspapers to spur a political debate in support of using local waterways. Others such as AutoMar expounded their vision for autonomous vehicle solutions at different fora, including non-buying actors. Autonomous applications, such as public transportation systems, are often perceived by the public, who are the end users, as unsafe. Therefore, AutoDrive arranged inner city pilots to familiarize both passengers and other road users with autonomous buses. Furthermore, we noted how AVS providers were keenly aware of how accidents involving driverless transportation could severely damage the public's perception of safety. AutoFerry stressed the importance of safety demonstrations with a skipper on board:

“That it gives us the experience that enables us to build trust that this actually works. And it has two sides. One is the public, who must trust that the technology works. The audience will also forget the technological

aspect of this at one point or another, but in the beginning it will still be important. But most of all, it is also due to a bit of risk management on our part. So that moment, in an accident you can always blame human error, you can always blame external factors, and you can always say the skipper was unlucky and we had an accident, and we crashed a kayak or did something like that.”

AutoFerry, COO

AVS providers face several regulatory barriers when commercializing autonomous vehicle solutions. Existing regulations do not meet the requirements for driverless technology, thereby placing obstacles in the way of introducing various appliances. We found that providers employed several means to promote regulatory changes. First, they work to identify different regulatory barriers. These barriers appear at different levels of authority from local to global and encompass aspects such as product certifications, standards, political regulations, and law texts. In the Norwegian context, AVS providers have successfully initiated intermediary regulations enabling applications for autonomous piloting. Building on this, we further noted the practice of inviting regulatory bodies to test sites, thereby facilitating learning and promoting regulatory change. Similarly, providers engaged accredited bodies to promote standardization that was advantageous. However, lifting regulatory barriers is not accomplished in a vacuum. Changing regulations often has implications far beyond the specific application areas. In other words, regulations that govern autonomous buses can also impact autonomous trucks. Therefore, we found that different AVS providers joined project groups to influence the regulatory direction – for example, by initiating intermediary regulations for autonomous vehicles and vessels. Curiously, we found that competitors held bilateral meta-conversations to decide what they could talk about when collaborating on the matter:

“We have had bilateral talks between [competitor] and us and made clarifications about what we can talk about in [the project] and what we can't talk about in [the project].”

AutoFerry, COO

Having outlined the key disruptive market-shaping dimensions, we now turn to how they are employed in a coherent process framework.

4.2. Disruptive market-shaping process framework

This section presents a disruptive market shaping process framework. Building on the thematic analysis, we further organized the findings presented according to the temporal order in which they were employed. While several activity themes were active longitudinally, their intensity varied along the process. Table 4 displays the intensity of the market-shaping activity themes employed along the process.

Table 4
Intensity of market-shaping themes.

Market-shaping dimension	Market-shaping themes	Market Exploration	Market Preparation	Market Experimentation
Shaping the Value Logic	Redefining value drivers	**	–	*
	Redesigning value objects	–	–	**
	Changing value exchange mechanisms	–	**	*
	Exploring contextual value potential	**	–	*
Nurturing the Demand Side	Customer-centric experimentation	–	–	**
	Supporting user acceptance	–	*	**
	Creating critical mass of resources	*	**	*
Forging Ecosystem Alliances	Orchestrating ecosystem dynamics	–	*	**
	Influencing societal approval	–	*	**
Catalyzing Institutional Changes	Promoting regulatory changes	–	**	**

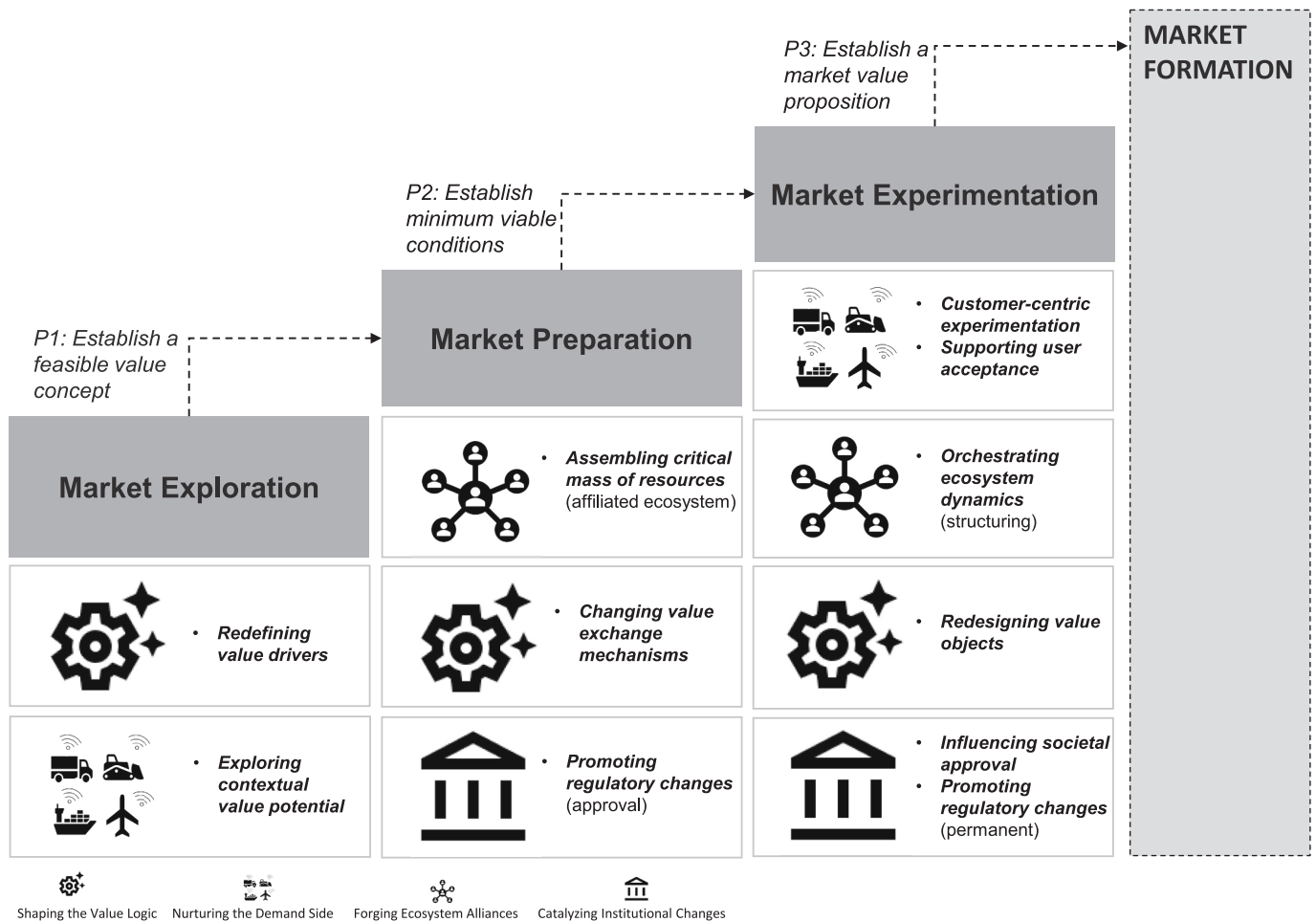


Fig. 3. Disruptive market-shaping process framework.

The organization of temporal order and intensity allowed us to identify three phases with distinct objectives, leading to the market-shaping framework presented in Fig. 3. The disruptive market-shaping framework consists of three phases: *market exploration*, *market preparation*, and *market experimentation*. In the following sub-sections, we further explicate the disruptive market-shaping process framework by explaining how the market-shaping dimensions are employed in each of these three phases. We then develop propositions explaining conditions required to move to the next phases in the progression toward market formation.

4.2.1. Phase 1: Market exploration

The disruptive market-shaping process for autonomous vehicle solutions starts with the *market exploration* phase. The main objective of this phase is to establish the value potential of implementing autonomous vehicle solutions in real industrial contexts. Concretely, in this phase, we find an interplay between the themes of *redefining value drivers* and *exploring contextual value potential*. In line with previous findings on market shaping as a collaborative process (Baker & Nenonen, 2020; Maciel & Fischer, 2020; Schaumann & Tarnovskaya, 2023), the first phase of the market-shaping process starts with AVS providers and certain potential customers jointly probing concepts on how autonomous vehicle solutions can drive value for customers in a future market. The joint process is important. Here, the AVS provider sharpens the value concept of *what* will drive value for the market through inputs from customers. Often, customers have specific reasons for exploring autonomous vehicle solutions, such as increasing environmental sustainability, workplace safety, and relieving driver shortage, in addition

to potential cost savings and increased production. This includes discussing how the customer can reorganize its operations to maximize the value potential from autonomous vehicle solutions – for example, by suggesting new work shifts or redesigning industrial sites. Correspondingly, in this phase, the AVS providers work to identify potential bottlenecks and specific requirements to launch a pilot with the specific customer and develop a plan to deal with identified barriers. Essentially, they make rough calculations, estimating the potential customer value and the cost of implementing the solution. If the value logic of the AVS concept is established with promising context-specific value potential and implementation feasibility, the parties sign an international agreement to pilot the solutions, allowing the AVS provider to progress toward the next market-shaping phase. However, if the parties are not able to arrive at a sufficiently promising or feasible value concept, the providers may need to restart the process with a different customer. We therefore propose:

P1: Market-shaping activities related to a) redefining value drivers and b) exploring contextual value potential positively impact the establishment of a feasible value concept required to progress toward the market preparation phase.

4.2.2. Phase 2: Market preparation

The second phase in the disruptive market-shaping process for autonomous vehicle solutions is the *market preparation* phase. The main objective of this phase is to establish the minimum viable conditions to start piloting the solutions. Concretely, in this phase, we find a complex interplay between the themes of *creating critical mass of resources*,

promoting regulatory changes, and changing value exchange mechanisms. Having developed an understanding of basic requirements in the market exploration phase, the AVS providers start the application process to obtain approval for autonomous testing at each specific site. Since this is uncharted regulatory territory for the authorities, the application process is highly iterative, going back and forth and often involving identification of additional resource requirements to ensure solution safety. Once in place, the AVS providers then initiate an affiliated ecosystem by activating ecosystem actors capable of furnishing the required resources. For instance, AutoMar gathered affected actors, such as ports, telecom providers, hardware/software suppliers, and academia, into project groups to arrange the basic infrastructure at the site. This required developing the necessary competence for supervising and intervening with autonomous vehicles, as well as securing integration with adjacent actors. By activating the ecosystem, the AVS providers signal the coming transition toward autonomous vehicle solutions. Similarly, providers change the value exchange mechanisms to align incentives between suppliers, customers, and other ecosystem actors. Because the value exchange mechanisms govern the responsibility and value distribution matrix, they carry integral implications for ecosystem roles and for the legal responsibilities of each party. For example, in quarries, the AVS providers receive a fee per tonne-kilometer of mass moved, which in turn has implications for surrounding operations and the responsibility of operations and services. When the minimum viable conditions are met for piloting, the AVS providers progress to the market experimentation phase. Thus, we propose:

P2: Market-shaping activities related to a) promoting regulatory changes, b) assembling a critical mass of resources, and c) changing value exchange mechanisms positively impact the establishment of the minimum viable conditions required to progress toward the market experimentation phase.

4.2.3. Phase 3: Market experimentation

The third and longest phase in the disruptive market-shaping process for autonomous vehicle solutions is the *market experimentation phase*. The main objective of this phase is to test and establish the required conditions for market formation – essentially establishing a market value proposition (resource-integration promise) (Storbacka & Nenonen, 2011). The market experimentation phase involves an intricate interplay between the themes of *customer-centric experimentation, supporting user acceptance, orchestrating ecosystem dynamics, redesigning the value objects, influencing societal approval, and promoting permanent regulatory changes*. Central to this phase is customer-centric experimentation because testing autonomous vehicle solutions in a real operating environment enables learning that is critical in achieving the right market conditions for market formation. Several market conditions require shaping. Overarchingly, permanent regulations that allow driverless usage is a prerequisite for wider market formation. Customer-centric experimentation interacts with the promotion of permanent regulatory changes because AVS providers invite regulatory and standardizing bodies to the test sites to facilitate the development of regulations and favorable technological standards. Thus, there is a need for an ecosystem structure that can support the delivery of an AVS value proposition to the wider market. By testing the autonomous vehicle solutions in real operating environments, AVS providers learn how to organize implementation and identify its effects on adjacent ecosystem actors. The responsibility matrix between the actors is thus clarified. Feedback is sent to suppliers with recommendations for change and to standardizing bodies to influence technological standards. This in turn stimulates orchestration of ecosystem dynamics by setting directions for the supply side. Because public opinion can exert pressure on regulatory decisions, AVS providers work to influence societal approval through exhibitions and safety demonstrations in efforts to win over the public. Furthermore, to enable expansion on the demand side, the AVS providers support user acceptance for workers. Our informants stressed that

user acceptance was especially pertinent when transforming large traditional customers because of their fear that workers may persuade their employers' organizations (customers) to shy away from new solutions. Moreover, user acceptance is needed to avoid conflicts with unions that may potentially hamper permanent regulatory changes.

In addition to learning, the market experimentation phase is about validation. AVS providers prioritize the validation of solution safety because it is a prerequisite for new regulations, user acceptance, and societal approval, and it carries implications for solution design and, therefore, for suppliers. Through a series of iterative cycles of learning and validation, the AVS providers turn customer-centric experimentation into a lighthouse case to illuminate the way for other customers and ecosystem actors to follow. In parallel to safety validation, AVS providers ascertain the fit between value drivers and the contextual value developed in the market exploration phase in a real operating environment. This way, they demonstrate scalability to the demand side and signal to ecosystem actors that it is time to actively take a position for the coming AVS-market. The market experimentation phase may also reveal severe barriers that impede the scalability of the solution to a wider market – for example, if the pilot demonstrates a high degree of customer-specific customization.

A bird's eye view of the interplay between all the market-shaping themes at play reveals that AVS providers are not simply working to shape individual market conditions in order to deliver their autonomous-solution value propositions. By shaping an extensive set of interrelated market conditions, AVS providers establish market value propositions aimed at displaying sufficiently attractive configurational fit for potential market actors to instigate the formation of new AVS markets. We therefore propose the following:

P3: Market-shaping activities related to a) customer-centric experimentation, b) supporting user acceptance, c) orchestrating ecosystem dynamics, d) redesigning value objects, e) influencing societal approval, and f) promoting regulatory development positively impact the establishment of a market value proposition required to progress toward market formation.

5. Conclusions

5.1. Theoretical implications

This study makes several contributions to the literature on market shaping and autonomous vehicle solutions. First, *we contribute to the market-shaping literature by theorizing on disruptive market-shaping processes based on rich empirical insights*. Specifically, our study is the first to empirically examine disruptive market shaping as a process, thereby providing a robust anchoring for both theory and practice. Empirical market-shaping research has focused largely on practices, activities, and capabilities (Nenonen et al., 2019; Storbacka et al., 2022), downplaying the actual processes of market shaping by a focal firm. Thus, our insights contribute to the nascent research stream focusing on firm-centric market-shaping processes, which hitherto has been mainly limited to conceptual papers delineating market-shaping processes in the broad phases of generic markets (Flaig et al., 2021a; Storbacka & Nenonen, 2015). Our empirically grounded process framework adds to existing knowledge by providing an in-depth explanation of the market-shaping themes involved, their interrelations, and the temporal order they unfold in the context of developing AVS markets. Specifically, we contribute by dissecting the disruptive market-shaping process into four dimensions (shaping the value logic, nurturing the demand side, forging ecosystem alliances, and catalyzing institutional changes) and three phases (market exploration, market preparation, and market experimentation). In this way, Our disruptive market-shaping process framework provides nuance and contextual anchoring to the current understanding of the market formation stage (Flaig et al., 2021a).

Second, *we contribute to the market-shaping literature by providing*

micro-level contextual insights into the processual dynamics and phase shifts in disruptive market-shaping processes. Thus, we provide further precision and refinement of the generic descriptions of market-shaping processes (Flaig et al., 2021a; Jaworski et al., 2020; Storbacka & Nenonen, 2015). We delineate the specific processes of disruptive market shaping with the aim of forming new markets. One implication of our process framework is that it provides clarity on the temporal evolution (e.g., starting points and progressions) of disruptive market-shaping processes emphasizing the iterative nature of market shaping (Flaig et al., 2021a; Schaumann & Tarnovskaya, 2023; Storbacka & Nenonen, 2015). We contend that, when it comes to establishing new markets for disruptive innovations, the market shaping follows a multi-phased processual trajectory because it requires the reconfiguration of market conditions from the ground up. This processual perspective (rather than viewing it as just one stage) allows us to further illuminate the sequencing of activities required by a focal firm to move from early market exploration via market preparation and market experimentation toward the end goal of inducing market formation. Moreover, where previous frameworks are ambiguous on the conditions required to progress toward the next phases of the market-shaping process, we develop three propositions that specify the outcomes and linkages in and between the specific disruptive market-shaping phases.

Third, we illuminate the central role of market value propositions as engines for market formation. Building on the original conceptualization of Storbacka and Nenonen (2011), we demonstrate the importance of developing a market value proposition in disruptive market-shaping processes that encompasses the stable conditions required for market formation. Thus, we revive it as a valuable concept that deserves a more prevalent position in the market-shaping literature (Storbacka & Nenonen, 2011). Our finding relates to the market vision or market image concept (Flaig & Ottosson, 2022; Kindström et al., 2023). However, we show that the concept evolves dynamically through the market-shaping phases as market conditions materialize, and it is not a static, pre-determined concept. In this way, we highlight the inherent uncertainty of market-shaping processes and respond to the call of Kohli and Jaworski (2023) for research on how market visions evolve. In particular, the interplay between the shaping value logic and the other market-shaping dimensions shows that companies shape and adapt their conceptual blueprint on how value will be created and captured in the emerging market. Consequently, we highlight the centrality of value logic in market-shaping processes.

Finally, we contribute to the AVS literature by developing an empirically grounded market-shaping process model for autonomous vehicle solutions. Research has highlighted the potential of AVS to radically change the business models, ecosystems, and markets of traditional industries (Leminen et al., 2022; Turienzo et al., 2023) without explaining the fundamental change of logics. We argue that, by rethinking the approach toward driverlessness as a mere cost saver and implementing a granular system logic (i.e. collaborative network of multiple smaller AVS instead of one large vehicle) for autonomous vehicle solutions, providers can challenge conventional industry logic and introduce more flexible and sustainable solutions. Studies have outlined the complexity of commercializing autonomous solutions (Kohtamäki et al., 2022), highlighting the need for simultaneous technology, business-model and ecosystem maturation (Makkonen et al., 2022; Thomson et al., 2021). Our framework demonstrates how AVS providers shape markets for autonomous vehicle solutions by creating conditions that enable the simultaneous maturation of technology, ecosystems, and business models whilst addressing institutional and regulatory challenges. Consequently, our findings contribute to the discussion on the implementation of AI in industrial markets by highlighting how the processes adopted by companies to address these challenges center on the technological affordances provided by AI (Kohtamäki et al., 2022; Kumar et al., 2016).

5.2. Managerial implications

This study carries some important implications for managers engaged in commercializing autonomous vehicle solutions. The first implication is that *managers can actively change market conditions in favor of their autonomous vehicle solutions through market-shaping processes*. Certainly, large external barriers exist for companies seeking to commercialize autonomous vehicle solutions (Frandsen et al., 2022; Makkonen et al., 2022; Sandvik et al., 2021; Tsvetkova et al., 2021). Our framework may serve as a roadmap for companies to actively forge the right conditions for their solutions. Specifically, we provide propositions that can guide companies' progress in the process. First, managers should engage with potential customers to develop a coherent value logic that is feasible to implement in practice (P1). Then, they should gather a complete understanding of what constitutes the minimum viable conditions required to start piloting – this includes assessing potential external contingencies. To assemble the minimum viable conditions, companies should cooperate with customers to obtain approval from the regulatory authorities and align ecosystem actors by designing new value exchange mechanisms (P2). Next, they should leverage the pilot as a lighthouse case to spread the vision of a coming AVS market to customers, ecosystem actors, and authorities. To do so, they must verify solution safety, as well as showcasing that the value logic provides superior value when implemented in a real operating environment. Moreover, companies must develop a market value proposition (MVP) capable of attracting a substantial group of different market actors for a market to start forming. Thus, managers should strive to lower entry barriers by pushing for permanent regulations, structuring ecosystems, and inducing societal approval (P3).

Second, our findings suggest that shaping a coherent value logic is the most important component in developing a market vision because it determines the value potential of a coming market. *Managers should, therefore, consider how new technology affords new ways of organizing for value creation when developing value logic*. Autonomous vehicle solutions represent driverlessness yet organizing them the same way as traditional solutions merely saves driver costs. Instead, managers should leverage driverlessness to increase its value creation potential. Our finding of the granular system logic suggests companies should re-design solutions as smaller units and implement them in a system of multiple units working in collaboration to perform value-generating tasks. This way driverlessness is leveraged to provide flexible on-demand routing, rush-hour scaling, continuous operations, and increased accuracy and safety. To this end, *managers should support other market actors in reorganizing their operations to facilitate implementation of autonomous vehicle solutions*. For example, as worker resistance can be a barrier to reorganization, providers can include them in the innovation process or highlight worker benefits of adopting the solutions. Additionally, as part of shaping value logic, *managers can change the value focus by developing value logics that connect to macro trends*. Markets are influenced by external trends that can change value perceptions in the marketplace. Our findings suggests that, by developing value logics for autonomous vehicle solutions that connect the current sustainability paradigm, managers can generate a tailwind to help convince both customers, ecosystem actors, and regulatory authorities that a transition is required.

Finally, since our findings outline how managers can tackle complex barriers in their journey to commercialize autonomous vehicle solutions by shaping market conditions, our framework may equally *help managers in incumbent firms to sense potential market disruptions* in time by identifying the disruptive market-shaping processes initiated by other market actors.

5.3. Limitations and future research

Our study has certain limitations that, nevertheless, provide avenues for future research. While our study has demonstrated the need for further refinement of the broad market-shaping stages (Flaig et al.,

2021a), our data set lacked clear success and failure cases that either progressed beyond the market experimentation phase or withdrew from the process. Future research could include success and failure cases and extend the process framework by examining “market scaling” as a potential next subprocess following market disruption.

While the present study employed qualitative methods, we highly encourage quantitative studies in this field. Future research could, for example, develop scales and collect quantitative data to conduct a factor analysis to test the robustness of the four identified market-shaping dimensions. Similarly, future studies could build on our propositions to further analyze the link between market-shaping phases, through quantitative testing. Particularly, our propositions forth market-shaping activities to progress to the next phases, and eventually induce market formation. Testing these propositions would provide important knowledge on the link between market-shaping activities and the process phases, and requirements leading to new markets as an outcome (Dolbec et al., 2022; Flaig et al., 2021a; Harrison & Kjellberg, 2016). Our study revives the market value proposition (P3) as a valuable concept linking market-shaping processes with market creation outcomes (Storbacka & Nenonen, 2011). We therefore call for researchers to further investigate its implications.

While our multiple case approach is aimed at theory building (Eisenhardt, 2021), the theoretical generalizability may be limited to the autonomous vehicle solutions context. Future research could explore the generalizability of the market-shaping dimensions and extend the process framework to other contexts. Similarly, while our study is based in a Scandinavian context, it is likely that disruptive market-shaping processes may unfold differently in other geographical contexts where the institutions and culture may differ. Future research could benefit from investigating disruptive market-shaping processes in geographical areas with lower autonomous readiness. Moreover, our findings provide scope for autonomous vehicle solutions researchers. Of particular promise is our identification of the granular system logic as the key to unlocking the disruptive potential of autonomous vehicle solutions. Given that we have only scratched the surface of the concept under study, further research is needed to fully comprehend its implications for the coming AVS markets, for example by integrating perspectives of established marketing theories such as lead user theory or solution sales. Finally, we find providers connect to macro trends to harness tailwind for autonomous vehicle solutions. Future studies could extend their focus to delve deeper into the sustainability potential of autonomous vehicle solutions, and particularly their capacity to foster circular business models (Madanaguli et al., 2024), paving the way for more environmentally conscious and economically efficient solutions (Sjödén et al., 2023).

Compliance with ethical standards

All authors have contributed to the study conceptualization and design.

CRediT authorship contribution statement

Håkon Osland Sandvik: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **David Sjödén:** Writing – review & editing, Validation, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Vinit Parida:** Validation, Supervision, Funding acquisition, Conceptualization. **Thomas Brekke:** Validation, Supervision, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

None.

Data availability

The data that has been used is confidential.

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