This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

Uncertainty in Radical Innovation Market Determination: A Constraint-Based Approach to Reduce Uncertainty in Target Market Determination

Florian Karlstedt*

University of Leipzig, Ritterstr.26, 04019 Leipzig, Germany.
E-mail: florian.karlstedt@uni-leipzig.de

Bogdan Franczyk

University of Leipzig, Ritterstr.26, 04019 Leipzig, Germany.
E-mail: bogdan.franczyk@uni-leipzig.de

* Corresponding author

Abstract: The potential of radical innovations to address major economic and societal challenges is substantial; however, they exhibit low success rates due to uncertainty arising from limited availability of reliable market data, higher capital requirements and constrained information bases. This increases investment risk and disadvantages them in resource allocation. Insufficient data also limits corrective validation mechanisms and fosters biased assessments, making the systematic overestimation of target market potential a key root cause of failure.

A Design Science Research approach will be employed to create a framework founded on reverse methodological logic. This method broadens the traditional TAM/SAM/SOM framework by adding a constraint-focused view that systematically pinpoints limiting factors across customer needs, technical competitiveness, and value chain dependencies. Incorporating these constraints as corrective measures minimises overestimation and uncertainty, thereby facilitating a more resilient, uncertainty-aware evaluation of market potential.

Keywords: radical innovation; market uncertainty; market size estimation; innovation failure; TAM; decision-making under uncertainty; market evaluation framework; reverse methodology

1 Introduction

Over the past decades, innovation research has identified and empirically examined numerous determinants of innovation success. Despite these extensive efforts, aggregate innovation success rates have not improved substantially. At the same time, the likelihood of failure increases with the scale, novelty and technological complexity of innovation projects. In particular, breakthrough developments amplify market and demand uncertainty by disrupting established structures and value chains (O’Connor and Rice 2013). These challenges are especially pronounced in radical innovations, which are characterised by substantial technological discontinuities that transform markets, reshape value chains, and alter customers’ perceptions of value (Kristiansen and Ritala, 2018).

This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

This distinguishes them from incremental innovation, which primarily focuses on improvements within existing markets and demand structures (Ho, 2022).
The limited availability of reliable market data for radical innovation is to be understood as a key source of uncertainty, resulting from the fact that this innovation type targets new or not-yet-fully-developed markets (O'Connor and Rice 2013). The lack of comparable historical data restricts the application of conventional validation mechanisms for market projections and forecasts (Mauboussin and Callahan, 2015). Resultingly, it increases the risk of biased market assessments (Derbyshire and Giovannetti, 2017).
While radical innovations are essential for addressing major societal and economic challenges, such as sustainability transitions (Cooper, 2013), they are associated with high levels of uncertainty, lower success rates and increased investment risks (Schuh et al., 2020). As a result, they are often systematically disadvantaged in organisational investment decisions. To address this issue, this study adopts a Design Science Research (DSR) approach to analyse the sources of uncertainty in radical innovation and to develop a managerial framework to reduce uncertainty and improve survival rates.

2 Current understanding

Within the scientific discourse, innovation success factors have been examined from multiple analytical perspectives. Besides the traditional economically and technologically oriented approaches, research has increasingly incorporated socio-economic and behavioural-psychological analyses to identify determinants and project the likelihood of innovation success. Drawing from both empirical and conceptual research, the key determinants are categorised into two groups:

1. *Individual-related and firm-internal determinants,* including organisational culture, experience, socio-cultural characteristics, and individual traits
2. *Firm-external and market-related determinants,* comprising market conditions, value chain structures, technological factors, resource availability, and planning-related aspects (e.g. accuracy of Total-Addressable Market (TAM) estimation),

Across these studies, a common underlying factor emerges: the *accuracy of target market determination*. Determinants in (1) primarily shape susceptibility to cognitive bias (York and Danes, 2014) and uncertainty in the evaluation and strategic decision-making. Consequently, overconfidence in one's own capabilities and expertise, underestimation of potential threats and risks, and a homogeneous team mindset result in an increased likelihood of overestimating the potential target market. Thus, the determinants in (1) can be understood as shaping the organisational capability to identify the target market accurately. Table 1 provides a detailed list of internal success determinants (Annex 1).
In contrast, the determinants in (2) can be interpreted as factors driving the divergence between the projected target market and the actual market trajectories (see Annex 2). These determinants directly or indirectly influence the future accessible and serviceable target market; alternatively, factors like the availability of financial resources may themselves emerge as a consequence of inadequate target market identification (Maital and Shein, 2021). More broadly, this category reflects external market, regulatory, and societal conditions or represents consequences of inadequate target market identification, ultimately reducing the likelihood of innovation success (Kristiansen and Ritala, 2018). Accordingly, this study conceptualises *uncertainty in target market determination* as a central driver of innovation failure. The accuracy of the Total-Addressable Market

(TAM) projection depends fundamentally on the availability and quality of market data (Derbyshire and Giovannetti, 2017; O'Connor and Rice, 2013). Beyond providing initial market estimates, these data serve as a corrective mechanism by creating a comparative basis for identifying biased or inaccurate assumptions and enabling their correction or adjustment (Mauboussin and Callahan, 2015). These validations will be applied internally–through iterative reassessment–and externally, as investors and funding institutions critically review and challenge underlying assumptions, estimations, and forecasts, thereby increasing the robustness of market assessments.

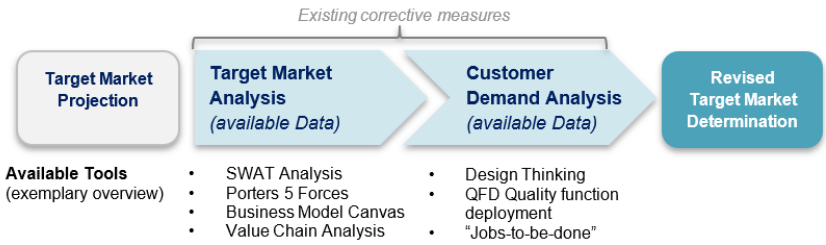
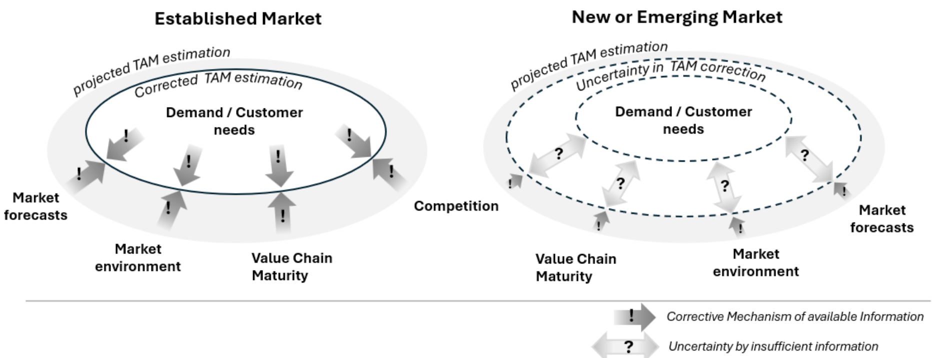


Figure 1: Corrective mechanisms in established markets, Source: Authors' own work

As a result, incremental innovations, which build on existing technologies and established markets, are significantly less affected by uncertainty in target market assessment. The availability of market data enables both the initial determination and delineation of the TAM and the subsequent validation of these assessments through data-driven corrective feedback. Based on available information about the market environment and customer needs, the initial estimate of the target market can be refined and restricted to the accessible market (see Figure 1).

Radical innovations, on the other hand, cause major market upheavals. Their technological breakthroughs not only change supply chains but also influence customer behaviours, lead to new complementary products, overhaul the entire value chain, and generate new markets (Talke, 2005). For these emerging markets, reliable data on projected growth and final market size are typically lacking (Derbyshire and Giovannetti, 2017; Ho, 2022).



The absence of market data in emerging markets significantly increases the uncertainty in

Figure 2: Corrective Mechanism of available Information; Source: Authors' own work

target market determination. This uncertainty is further reinforced by the lack of data required to apply corrective mechanisms (see Figure 2) that would otherwise enable validation and adjustment of market projections distorted by cognitive biases. Consequently, limited market information amplifies uncertainty through reinforcing effects and increasing the perceived investment risk from the perspective of capital providers (Derbyshire and Giovannetti, 2017).

Weakness of the reference market data

Due to the lack of reliable market information, business planning for radical innovations and emerging markets necessarily relies heavily on data derived from reference markets to estimate the TAM. While the initial TAM definition relies on a constrained set of data, subsequent corrective mechanisms allow the use of diverse data sources to validate, challenge and refine these projections. (Song et al., 2008). However, the use of reference market data increases the susceptibility to bias, as it affects both the selection of the reference market and the delineation of relevant submarkets. Furthermore, these approaches largely underestimate the dynamic nature of emerging markets by relying on historical data that are only weakly adoptable in the transformative market environment of radical innovations (Denning and Dew, 2015). The impact of radical innovation on market transformation further diminishes the usefulness of reference data. Significant structural changes in the market environment, customer demands, behaviours, expectations, and value-creation processes greatly limit the relevance and corrective capacity of historical data from reference markets. As a result, the reliability of analogical reasoning based on past market data is considerably reduced.

Tendency for overestimation and consequences

Although the absence of market data – and thus the lack of corrective feedback mechanisms - may, in principle, lead to both over- and underestimation of the target market, empirical observations indicate a pronounced tendency toward overestimation. This tendency can be attributed to both founders' intrinsic motivation and structural incentives that favour optimistic projections. Founders pursuing innovations bear substantial personal and financial risk (van Gelderen et al., 2005). As it requires strong personal confidence in the opportunity to successfully found a venture and attract early-stage investors, an indirect self-selection process is implied. As a result, the founder population tends to be more risk-tolerant and more susceptible to overconfidence, thereby becoming increasingly vulnerable to cognitive biases (Invernizzi et al., 2017). At the same time, more risk-averse individuals refrain from entering the process. In parallel, the competition for scarce financial resources creates structural incentives for overly optimistic market projections. Funding decisions tend to favour ventures projecting high growth and large target markets in the contest for funding over those based on conservative estimates (Arnott et al., 2021). As a result, TAM assessment for radical innovations tends to exhibit a systematic bias towards overestimation and overvaluation (Cornell and Damodaran, 2020). While such overestimations may facilitate access to financial resources in early funding rounds, they can contribute to inefficient capital allocation and inflated valuations. As market realities begin to diverge from initial projections, these distortions can undermine a venture’s ability to secure follow-on financing and may lead to significant valuation corrections (Arnott et al., 2021). As increasing amounts of information become available over time, validation of assumptions and forecasts against observable data are inevitable. If earlier projections prove overly optimistic, the resulting gap between projected and realised market outcomes can lead to premature depletion of financial resources and trigger a loss of investors’ confidence, thereby substantially hindering access to follow-on financing (Kristiansen and Ritala, 2018).

3 Research Question

The planning and evaluation of radical innovations are characterised by substantial uncertainty, particularly in assessing future market potential. In emerging markets, the absence of reliable market data and the limited availability of comparable reference markets constrain the accuracy of market size estimations. Resultingly, projections of market potential are often based on incomplete information and analogical reasoning, which increases the risk of systematic overestimation and may negatively affect investment decisions and subsequent success probability of radical innovations. Against this background, the present study addresses the following research question:

> *"Which alternative data sources are suitable for reducing informational uncertainty in the determination of the Total Addressable Market (TAM) for radical innovations?"*

In response to this research question, the study develops the following artefact:

> *"A framework for identifying and integrating alternative corrective data to reduce uncertainty in TAM determination for radical innovations"*

To address the lack of suitable and reliable information in the market analysis of radical innovations, this study follows the Design Science Research (DSR) methodology, as outlined by Hevner et al., to develop an artefact. Addressing a relevant problem in Innovation management, the research is based exclusively on secondary data. A systematic literature review using the keywords radical innovation, market uncertainty, data-driven decision-making, and the determinants of innovation success has been conducted to inform problem framing and design requirements, and to ensure research rigour. During the screening process, 43 significant studies were identified to concretise and refine the artefact. The artefact was developed through iterative research through design cycles, reflecting design as a search process. An ex-ante evaluation has been conducted analytically by assessing the artefact's utility, relevance, and fitness to current challenges in the automotive industry's transformation towards e-mobility. Demonstrating how the approach identifies inaccessible market segments through corrective adjustments and enhances the robustness of the target market assessment under real-world constraints. This includes technological developments, evolving customer value propositions, and regulatory uncertainty along the value chain. The domain-anchored evaluation is intended to demonstrate the approach's anticipated utility and assess its theoretical coherence, particularly in contexts characterised by high uncertainty and ongoing transformation.

4 Findings

To address this limitation of conventional market size estimations, this study introduces a reverse methodological approach (Bodell, 2012; Bono, 2003) that complements the conceptual logic of the TAM/SAM/SOM framework. While the TAM/SAM/SAM logic provides an inclusion-oriented top-down perspective on total-, serviceable-, and obtainable-market potential, it does not sufficiently account for emergent constraints or systematic overestimations that frequently arise in the context of new markets and radical innovation (Cornell and Damodaran, 2020). Indications of such a constraint-oriented perspective can already be observed in the varying interpretations of TAM in the literature. While the majority of studies interpret TAM as the *Total Addressable Market* (Mauboussin and Callahan, 2015), alternative interpretations, such as the *Total Available*

Market and the *Total Accessible Market* (Cornell and Damodaran, 2020) , also appear. Whereas *Total Addressable Market* and *Total Available Market* refer to overall, largely unadjusted market demand, the concept of *Total Accessible Market* introduces a first level of constraint. It excludes customers for whom the new product or service is not relevant given their specific needs or usage contexts. Accordingly, the study adopts TAM to denote the *Total Addressable Market*, while the new term TAcM refers to the *Total Accessible Market*.

Rather than validating initial market size and growth projections primarily by comparing them with reference market data, the proposed reverse methodology takes a broader view by incorporating additional sources of corrective information (Mauboussin and Callahan, 2015). These include observable constraints, boundary conditions, and potential failure indicators - such as adoption frictions, usage discontinuities, cost thresholds, or systemic dependencies within the value chain – that can limit the realisable market potential (Adner and Kapoor, 2016). The artefact developed in this study implements this perspective in line with the Design Science Research (DSR). While traditional market sizing approaches primarily focus on identifying and aggregating potential demand, the artefact complements these approaches by incorporating mechanisms to identify market-limiting factors. This enables more grounded assessments of the extent to which the initially estimated market potential can actually be realised. Consequently, the framework is designed to complement conventional models by enhancing their robustness and improving the treatment of uncertainty in market size estimations.

Following an initial TAM definition based on reference market data, the methodology will be applied to identify segments of customers within the TAM that are non-accessible, non-competitive, or non-serviceable, collectively referred to as the *Non-Serviceable Market* (NSM). In contrast to conventional approaches, which assess market projections based on the consistency and robustness of reference market comparisons, the proposed approach introduces a constraint-oriented corrective mechanism. Instead of validating forecasts by drawing analogies to existing markets, the reverse methodology takes a different approach. Starting with the initially estimated market potential, then reducing it step by step to account for limiting factors. To achieve this, the framework draws on alternative data sources that better reflect actual market constraints and boundary conditions. These include factors such as adoption barriers, technical drawbacks, cost thresholds, regulatory requirements, and dependencies across the value chain. Within the framework, the constraints will be systematically identified and deducted from the initial estimate. In this way, the “negative” correction factors are explicitly built into the market-sizing process, helping address the overestimations that often occur (see Figure 3).

The resulting Not Serviceable Market (NSM) consists of several sub-segments, each representing a different type of constraint. For clarity, these can be grouped into three stages, each capturing a distinct category of limitations that gradually reduce the overall market potential from the outset.

1. *Non-Accessible Market*, where essential customers' demands are unmet
2. *Non-Competitive Market*, where alternative technologies serve customer needs more effectively
3. *Non-Serviceable Market*, where value chain limitations hinder complete demand fulfilment

The stepwise mechanism shown in Figure 3 leads to a progressively narrower target market. It follows the general logic of the TAM/SAM/SOM framework, where SAM and SOM are increasingly refined subsets of the initial TAM. In contrast to the conventional inclusion-oriented perspective, this approach takes a constraint-driven view. In complementing conventional approaches by systematically reducing market potential by identifying and deducting limiting factors.

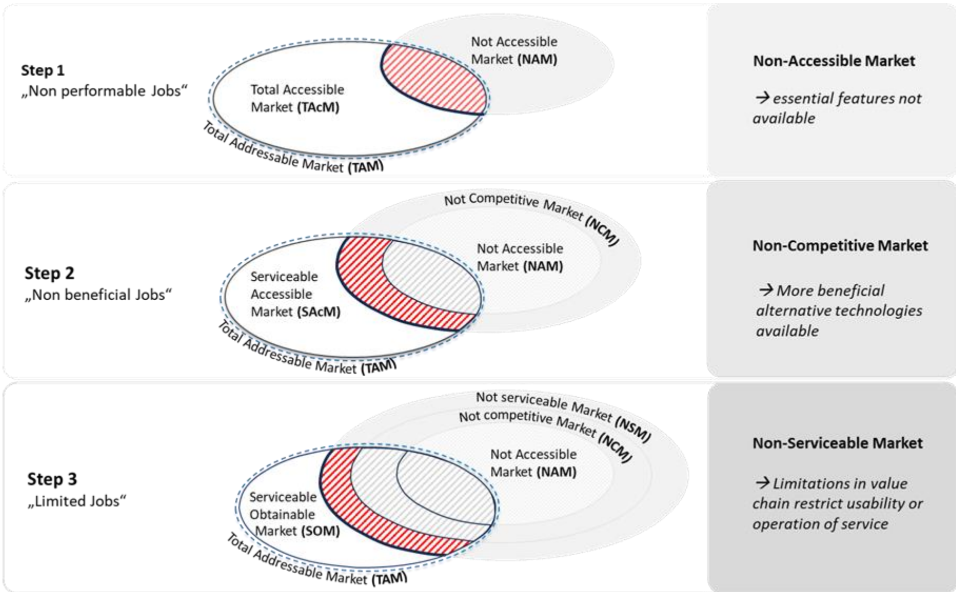


Figure 3: Application of Non-Serviceable Market; Source: Authors' own work

Starting from the projected TAM, *Step 1* focuses on identifying relevant attributes and need structures across distinct customer segments. Customer Segments whose critical needs cannot be adequately satisfied are classified as part of the Non-Accessible Market (NAM). By excluding these segments, the analysis yields the Total Accessible Market (TAcM). By this step, the traditional TAM perspective will be extended by explicitly incorporating heterogeneity in customer preferences, varying relevance of performance attributes, and differences in underlying use cases or "jobs-to-be-done".

In *Step 2*, the analysis evaluates the innovation's relative technological advantage over existing or alternative solutions by assessing how effectively each technology fulfils the relevant demand expectation ("Jobs-to-be-done") across the different customer segments. This results in the definition of the SAM, which, compared to the conventional approaches, provides a refined perspective by explicitly incorporating the alignment between technological performance and heterogeneous, job-specific value creation.

In *Step 3*, the analysis incorporates temporary and structural value chain constraints that may limit the ability to serve the remaining customer segments, even when the innovation offers a superior value proposition. These include limitations in production, distribution, integration or usability. Accounting for these factors further refines the market potential, resulting in a more realistic estimation of the Serviceable Obtainable Market (SOM).

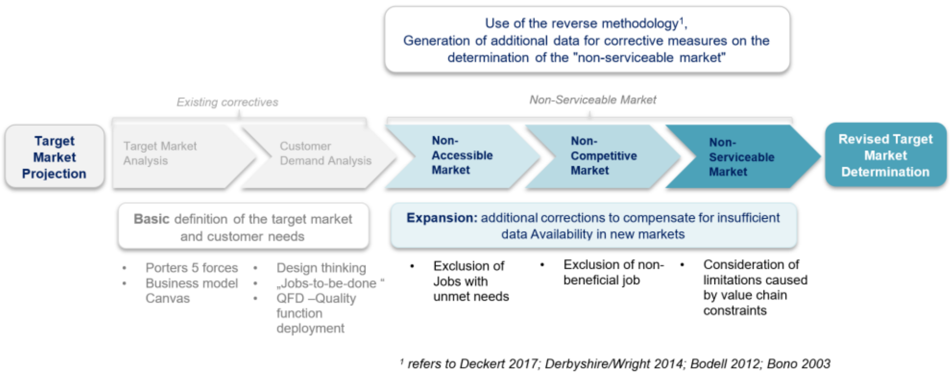


Figure 4: Integration of an additional corrective layer in the target market revision, Source authors own work,

The process illustrated in Figure 4 integrates steps 1-3 in the conventional approach outlined in Figure 1. While the initial target market estimate, based on reference market data, remains unchanged, the additional reverse-methodological steps add a complementary corrective layer. By integrating such constraint-oriented factors, the approach reduces uncertainty. Thus, it enhances the robustness of market estimations, enabling more reliable assessments of market potential, particularly in the context of radical innovations and emerging markets.

Determination of the non-accessible market

To specifically identify the Non-Accessible Market (NAM), it is recommended to classify customer segments using the jobs-to-be-done logic. (Christensen et al., 2016). Within each application context, distinct customer groups exhibit heterogeneous expectations profiles, reflecting differing preferences regarding relevant performance attributes. These categories can be structured into five overarching categories: (1) technical requirements, including core product and performance characteristics, (2) cost-related requirements, encompassing acquisition, operating, and complementary costs; (3) social and symbolic attributes, such as status, novelty, trends, sustainability and individuality; (4) risk and security considerations, including personal, technical, legal, and value related risks; and (5) flexibility and dependency factors covering availability, compatibility, dependency on complementary goods and services but also network effects.

The clustering supports the comprehensive identification of relevant attributes by ensuring broad, systematic coverage of key dimensions. The higher-level categories act as a moderating structure, guiding the analysis and preventing an overly narrow focus. The specific composition and relevance of these attributes depend on the respective technology, its application context, and the target market. In cases where only a limited number of segments are identified, additional attributes can support a more granular differentiation by enabling the formation of more specific subcategories.

To systematically capture these heterogeneous expectation profiles within the initially defined TAM, a matrix-based evaluation approach based on Quality Function Deployment (QFD) is recommended (Aumayr, 2019, p. 189; QFD Institute). This matrix enables a structured assessment of the relevance and fulfilment of specific attributes across segment-specific job profiles (see Annex 3). For greater differentiation, attributes can be classified into basic (hygiene), performance (standard), and excitement (additional) features, complemented by weighting factors and minimum threshold levels.

In Particular, the inclusion of hygiene factors is critical, as the insufficient fulfilment leads to exclusion of the solution from consideration by the customer segment, thereby assigning these segments to the NAM. Given the limited availability of quantitative data in emerging markets, the evaluation is appropriately conducted using a qualitative scoring approach (e.g. 1-10 scale), allowing for a structured yet flexible assessment under uncertainty and resulting in the determination of the Total Accessible Market (TAcM).

Determination of the non-competitive market

Based on the previously developed matrix for determining the accessible market, the same logic can be applied to qualitatively assess alternative technologies in terms of their value propositions across the identified jobs-to-be-done. This analysis should not be limited to existing technologies and their potential developments but should also consider emerging alternative technologies that may target similar applications or market segments.

In this context, incumbent technologies are expected to respond to the competitive threat posed by innovation, either through technological improvements or strategic price adjustments (Derbyshire and Giovannetti, 2017). The implications of such responses need to be evaluated across different customer segments and use cases. For each identified alternative, corresponding performance profiles should be constructed analogously to those for the focal technology, capturing each alternative's ability to fulfil the defined requirement dimensions.

By systematically comparing these performance profiles with the previously established expectation profiles, technologies can be assessed in terms of their relative qualitative advantage for each job-to-be-done. This enables the identification of customer segments in which the focal innovation does not provide a superior value proposition and is therefore not competitive. These segments are subsequently classified as part of the non-competitive market, which imposes an additional constraint on the refinement of overall market potential.

Determination of the non-serviceable market

Radical innovations that create new markets cannot rely on the existing value chains of established industries. These transformations necessitate the development of new supply chain structures for production and delivery, as well as adaptations across downstream stages of the value chain, including changes in customer usage patterns. Consequently, a non-serviceable market is partly determined by existing and potential constraints within the newly emerging value chain. Although such constraints are often temporary, they can significantly delay market development and decrease customer adoption rates. Particularly in the context of capital-intensive innovations, these delays lead to critical mismatches between expected and actual cash flows, thereby increasing financial risk while simultaneously providing additional time for alternative technologies to adapt to emerging demand conditions.

These limitations can be categorised into two primary dimensions: (1) supply-side constraints, encompassing all elements required for production and delivery of the offering, and (2) usage-related constraints, including all factors that influence or enable the use of the innovation. For systematic identification and assessment of these limitations, a matrix-based approach – analogous to an established risk assessment framework – is recommended. This approach evaluates value chain elements based on their impact and the likelihood of occurrence. As illustrated in Figure 5, the matrix structures are constrained into predefined clusters to ensure comprehensive coverage.

This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

Limitation of the offer (limitation of the provision of the expected product or service)	Temporal Impact	Impact	Probability	**Risk of Limitation**	**Limitation of demand** (limitation of utility or usability)	Temporal Impact	Impact	Probability	**Risk of Limitation**
Precursors/ Sub-Components					**Complementary Products**				
• Availability and dependence on critical intermediate products/ materials/raw materials					• Availability and technical maturity of essential complementary goods				
Supplies / Infrastructure					**Supplies / Infrastructure**				
• Availability and costs of processing materials • Availability of relevant infrastructure					• Availability and costs of operating materials • Availability and maturity of infrastructure for use				
Technological maturity					**Technological maturity**				
• Restriction by new technical standards • Technical maturity of the supply network					• Maturity of technical standards regarding usability • Compatibility with alternative solutions				
Capacities					**After Sales Service**				
• Capacities at suppliers and partners • Capacities own processes					• Maturity of service network • Regional presence of service Network				
Supplier/Partner Structure					**Circular Economy / Sustainability**				
• Monopolistic structure of suppliers/ Partners • Deviating interests of partners/suppliers					• Criticalness of consumed resources • Legal requirements for the circular economy				
Regulatory conditions					**Regulatory conditions**				
• Offer limitations by legal provisions • Relevant stakeholders and their interests					• Legal limitations of usability • Dependency on Subsidies • Relevant stakeholders and their interests				

Details
Temporal Impact: [temporary / permanent] additional classification of risk of limitation
Impact: [1-10] potential impact on market limitation
Probability: [1-10] probability of occurrence
Risk of Limitation: [1-100] resulting product from [Impact x Probability]

Figure 5: Value Chain Limitation Risk – Matrix; Source in reference to Adner, 2017; Adner and Kapoor, 2016

On the supply side, relevant clusters include raw materials, infrastructure, technological maturity, production capacities, supplier and partner structures, and regulatory conditions. On the demand and usage side, clusters comprise complementary goods, infrastructure and consumables, technological maturity, service network availability, sustainability aspects, and regulatory frameworks. These clusters are derived from observed and potential value chain limitations in the context of e-mobility and may differ across other industries and technological applications.
As illustrated in Figure 4, the clustering is intended to provide a structured orientation for identifying and analysing value chain constraints. The risk evaluation matrix does not claim completeness; rather, it functions as a guiding checklist to support a more comprehensive and systematic assessment of potential risks. The risk assessment follows established approaches using qualitative scoring scales (e.g., 1-10), in which risk is conceptualised as the product of impact and likelihood. In addition, the distinction between temporary and permanent limitation is introduced as a complementary dimension.

5 Application of the Framework: The Transformation of the Automotive Industry

The proposed framework will be validated by the application to the automotive industry's transformation toward electric mobility. Electric mobility can be considered a radical innovation, as it fundamentally transforms both the supply and demand sides. On the supply side, battery electric powertrains require new supply chains, while on the demand side, customers face a significant shift from fossil fuels to electricity. Given the uncertainty surrounding future market developments, companies focused solely on electric mobility have been associated with substantial overestimation of market potential and corresponding firm overvaluation. (Arnott et al., 2021, p. 6). These valuations were based on the total automotive market as the reference market, assuming the emerging BEV segment would nearly completely replace the existing internal combustion engine (ICE) vehicle segment, combined with expectations of strong market growth driven by high adoption rates. Applying the proposed framework indicates that these valuation assumptions are subject to significant limitations and should be critically reassessed.

Non-Accessible Market (NAM) for electrical mobility

Using a jobs-to-be-done perspective, customer requirements differ significantly across the different use cases and adoption stages. While early adopters are often driven by technological novelty, sustainability considerations and social signalling, later customer segments place greater emphasis on practical factors such as acquisition and operating costs, reliability, and infrastructure availability. In particular, the maturity and regional availability of charging infrastructure represent key constraints on accessibility (DAT Report, 2026). In addition, factors such as value stability, technical reliability, and regulatory certainty — previously of secondary importance during the early diffusion phase — have become more relevant as early adoption has progressed toward broader market uptake. Recent policy adjustments and increasing public scrutiny regarding total costs of ownership and residual values further reinforce this shift. As a result, these factors function as hygiene conditions for more risk-averse users (Tyfield and Zuev, 2018). Using a constraint-oriented perspective, their absence or underperformance may, at least temporarily, exclude certain customer groups from the accessible market, thereby reducing realisable market potential. Accordingly, besides the individual technical requirements of the heterogeneous customer groups, the non-accessible market for electric mobility is determined both by risk-averse customer segments that strongly perceive and negatively evaluate the uncertainty associated with the transition, and by customers who lack access to reliable charging and service infrastructure, as well as by uncertainty arising from regulatory changes (DAT Report, 2026). For clarity, the evaluation presented in the matrix in Annex 3 considers a selected set of customer need profiles (jobs)—their corresponding expectations and alignment with BEV performance profiles. Accordingly, conservative and technologically sceptical customer groups, as well as customers lacking sufficient access to or availability of charging infrastructure, are to be excluded from the accessible target market.

Non-competitive Market for electrical mobility

BEVs compete not only with conventional ICE vehicles but also with alternative technologies such as hydrogen powertrains and hybrid systems. In response, incumbent Western OEMs have leveraged existing competencies by adopting hybrid technologies that combine electric and combustion systems. These alternatives may provide a superior value proposition for specific applications, thereby limiting the competitiveness of purely electric solutions. The non-competitive market for BEV can be identified particularly among customer segments for whom the effort required to establish or access the necessary infrastructure is not yet sufficiently developed or widely available, or where electricity costs significantly exceed those of fossil fuels, leading customers to place higher value on the flexibility and reliability of existing refuelling infrastructure. With reference to the evaluation presented in Annex 3, existing or alternative technologies would be more advantageous for accessible customer segments if costs, such as operating costs, are lower while achieving a comparable level of status.

Non-Serviceable Market for electrical mobility

In the context of electric mobility, the transformation of the value chain results in both supply-side and demand-side constraints that limit the realisable market potential. On the supply side, the constraints primarily arise from the availability of critical raw materials and dependence on a limited number of battery manufacturers. Furthermore, uncertainties related to regulatory requirements and the pending technical standardisation of high-voltage systems also need to be counted as potential constraints. On the demand side, key limitations include perceived and actual technical maturity, the availability and reliability of charging infrastructure, electricity costs, and uncertainties regarding battery condition, resale value, and repairability. (Nippraschk et al., 2025). In addition, uncertainty regarding compatibility and standardisation further constrains adoption (Valentowitsch, 2019), as batteries continue to evolve rapidly under competitive pressure. These factors decrease perceived value added of the offering for the customer, increase investment risk, and slow adoption rates. An exemplary analysis of the value chain limitation risks is provided in Figure 7 (Annex 4).

Result

Following an initial phase of strong optimism among both new and established OEMs as well as the broader supplier industry, the observed stagnation in BEV market penetration has resulted in significant economic consequences, including substantial write-downs, firm exits, and increased market consolidation among the surviving players. The application of the proposed framework indicates that such market overvaluation could have been mitigated through earlier, systematic identification of relevant constraints. Supply-side limitations were partially anticipated during the build-up of production capacities and supply chains and were subsequently addressed through targeted investments. In contrast, demand-side constraints within the downstream value chain remained largely unanticipated (Nippraschk et al., 2025). This gap can be attributed to the complexity of the systemic transformation associated with electric mobility, which has led to predominantly reactive rather than proactive responses once constraints begin to materialise. In particular, dependencies on charging infrastructure and emerging ecosystem requirements – such as battery reuse and recycling – continue to act as structural constraints on market development (Nippraschk et al., 2025). These limitations increase perceived uncertainty from the customer's perspective and are reflected in the currently observed adoption patterns of electric vehicles.

6 Discussion and conclusion

A key limitation of the proposed framework is its reliance on qualitative assessments, which are constrained by the limited availability of reliable data in emerging markets and for radical innovations. The framework does not aim to provide precise quantitative market estimates; rather, it seeks to identify and structure constraint-based corrective insights systematically. In doing so, the framework supports the identification of inconsistencies and potential overestimations within conventional TAM projections.

Despite this limitation, this framework offers both practical and theoretical value. The insights derived enable firms to critically assess the robustness of their business models and underlying assumptions, particularly regarding reduced market size and slower growth trajectories. Resulting in more informed and risk-aware strategic adjustments. In addition, the framework provides a matrix-based approach to systematically compare heterogeneous customer expectations with the value proposition of the focal product and alternative solutions.

The evaluation is inherently sensitive to both the selection and the number of considered attributes, as both dimensions are susceptible to bias. The choice of attributes may be distorted by a tendency to emphasise positively framed or favourable characteristics, while neglecting less obvious factors that may nevertheless be critical for specific customer segments. In parallel, the quality of the analysis is directly impacted by the number of attributes considered - an insufficient set may oversimplify and fail to capture the heterogeneity of customer needs. In contrast, an excessive number can create a false sense of precision (Valentowitsch, 2019). Given the quality nature of the assessment, such over-specification may reduce transparency without necessarily improving the robustness of results. To mitigate these effects, it is advisable to apply reverse methodology principles when identifying relevant attributes. In particular, a structured brainstorming process should be employed to explicitly search for requirement dimensions that are (1) not fulfillable, (2) not competitively fulfillable or (3) cannot be fulfilled due to limitations in the value chain. By reversing the analytical focus from negative attributes and constraint-driven scenarios (Bono, 2003), the approach helps mitigate biases in attribute selection and enables a more comprehensive assessment. The framework deliberately avoids predefined checklists, allowing adaptation to different technologies and market contexts while retaining flexibility. It does not replace in-depth analyses of customer needs, markets, and competition, but rather complements existing TAM approaches by introducing a reverse perspective that enables a more critical interpretation of available information and the identification of potential misjudgements.

Moreover, the framework can be applied as a strategic tool for identifying bottlenecks in emerging value chains and supporting firms in aligning their business models with evolving market conditions (Adner and Kapoor, 2016; Derbyshire and Wright, 2014). This study contributes to research on target market determination for radical innovations by identifying alternative sources of corrective data that help reduce market-related uncertainty. It positions these corrective data as a complementary extension of the conventional TAM/SAM/SOM logic, particularly in high-uncertainty environments. It illustrates how a reverse methodological approach can be used to derive insights under such conditions. Future research should adopt more dynamic perspectives, particularly by accounting for evolving customer needs (Boateng et al., 2016) and changing market conditions over the extended adoption cycles characteristic of radical innovation (McDermott, 2002).

7 References

Adner, R. (2017) 'Ecosystem as Structure', Journal of Management, vol. 43, no. 1, pp. 39–58.

Adner, R. and Kapoor, R. (2016) 'Right Tech Wrong Time: How to make sure your ecosystem is ready for the newest technologies', Harvard Business Review: HBR, 11/ 2016, pp. 3–9.

Adner, R. and Levinthal, D. (2001) 'Demand Heterogeneity and Technology Evolution: Implications for Product and Process Innovation', Management Science, vol. 47, no. 5, pp. 611–628.

Arnott, R. D., Cornell, B. and Wu, L. J. (2021) 'Big Market Delusion: Electric Vehicles', SSRN Electronic Journal.

Arthur, W. B. (1989) 'COMPETING TECHNOLOGIES, INCREASING RETURNS, AND LOCK-IN BY HISTORICAL EVENTS', The Economic Journal, Vol. 99, No. 394, pp. 116–131

Aumayr, K. J. (2019) Erfolgreiches Produktmanagement: Tool-Box für das professionelle Produktmanagement und Produktmarketing, 5th edn, Wiesbaden, Heidelberg, Springer Gabler.

Baumgartner, S. and Peter, M. K. (2021) 'Strategic Foresight and Innovation Management: A Comparative Study across International Swiss Banks', Athens Journal of Business & Economics, vol. 2021, no. 8, pp. 1–19

Blank, S. (2013) 'Why the Lean Start-Up Changes Everything', Harvard Business Review: HBR, no. 05.

Boateng, P., Chen, Z. and Ogunlana, O. S. (2016) 'A dynamic framework for managing the complexities of risks in megaprojects', International Journal of Technology and Management Research, vol. 5, pp. 1–13.

Bodell, L. (2012). Kill the company: End the status quo, start an innovation revolution, Brookline, MA, Bibliomotion.

Bono, E. de (2003) 'New Thinking', Malta Medical Journal, Volume 15, Issue 02, no. 02.

Brillinger, A.-S., Els, C., Schäfer, B. and Bender, B. (2020) 'Business model risk and uncertainty factors: Toward building and maintaining profitable and sustainable business models', Business Horizons, vol. 63, no. 1, pp. 121–130.

Busenitz, L. W. and Barney, J. B. (1997) 'Differences between Entrepreneurs and Managers in Large Organisations: Biases and Heuristics in Strategic Decision Making', Journal of Business Venturing, vol. 12, pp. 9–30.

Cantner, U. (2007) 'Firms' Differential Innovative Success and Market Dynamics', SSRN Electronic Journal.

Christensen, C. M. (1997). The innovator's dilemma: When new technologies cause great firms to fail, Boston, Mass., Harvard Business School Press.

Christensen, C. M., Hall, T., Dillon, K. and Duncan, D. S. (2016) 'Know Your Customers: “Jobs to Be Done”', Harvard Business Review: HBR, September.

Christensen, C. M., Kaufman, S. P. and Shih, W. C. (2008) 'Innovation killers: How financial tools destroy your capacity to do new things', Harvard Business Review.

Cooper, A. C., Woo, C. Y. and Dunkelberg, W. C. (1988) 'Entrepreneurs' perceived chances for success', Journal of Business Venturing, vol. 3, no. 2, pp. 97–108.

Cooper, R. G. (2013) 'Where Are All the Breakthrough New Products?: Using Portfolio Management to Boost Innovation', Research-Technology Management, vol. 56, no. 5, pp. 25–33.

Cornell, B. and Damodaran, A. (2020) 'The Big Market Delusion: Valuation and Investment Implications', Financial Analysts Journal, vol. 76, no. 2, pp. 15–25.

Darvishmotevali, M., Altinay, L. and Köseoglu, M. A. (2020) 'The link between environmental uncertainty, organisational agility, and organisational creativity in the hotel industry', International Journal of Hospitality Management, vol. 87, p. 102499.

DAT Report (2026) DAT Report 2026 - Kurzbericht [Online]. Available at dat.de/report.

Day, G. S. and Schoemaker, P. J. (2005) 'Scanning the periphery', Harvard business review: HBR, March.

Deckert, C. (2017). Creative Heuristics. A Framework for Systematic Creative Problem Solving, Working Paper, Köln, Cologne Business School. Available at CBS Working Paper Series, ISSN 2195-6618.

Denning, P. J. and Dew, N. (2015) 'Why our theories of innovation fail us', Communications of the ACM, vol. 58, no. 12, pp. 24–26.

Derbyshire, J. and Giovannetti, E. (2017) 'Understanding the failure to understand New Product Development failures: Mitigating the uncertainty associated with innovating new products by combining scenario planning and forecasting', Technological Forecasting and Social Change, vol. 125, pp. 334–344.

Derbyshire, J. and Wright, G. (2014) 'Preparing for the future: Development of an ‘antifragile’ methodology that complements scenario planning by omitting causation', Technological forecasting & social change: an international journal, 82 (2014), pp. 215–225.

Hennard, D. H. and Szymanski, D. M. (2001) 'Why Some New Products Are More Successful Than Others', JMR, Journal of Marketing Research, vol. 38, no. 3.

Ho, J. C. (2022) 'Disruptive innovation from the perspective of innovation diffusion theory', Technology Analysis & Strategic Management, vol. 34, no. 4, pp. 363–376 [Online]. Available at https://doi.org/10.1080/09537325.2021.1901873.

Invernizzi, A. C., Menozzi, A., Passarani, D. A., Patton, D. and Viglia, G. (2017) 'Entrepreneurial overconfidence and its impact upon performance', International Small Business Journal: Researching Entrepreneurship, vol. 35, no. 6, pp. 709–728.

Jaffe, A. B., Newell, R. G. and N, S. R. 'Technological Change and the Environment', in Handbook of Environmental Economics, pp. 462–507.

Jaffe, A. B., Newell, R. G. and Stavins, R. N. (2004) A tale of two Market Failures: TECHNOLOGY AND ENVIRONMENTAL POLICY.

Kahneman, D. and Lovallo, D. (1993) 'Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking', Management Science, Vol. 39, No. 1, no. 39, pp. 17–31

Kaufmann, T. (2021) 'PESTEL-Analyse', in Kaufmann, T. (ed.) Strategiewerkzeuge aus der Praxis, Berlin, Heidelberg, Springer Berlin Heidelberg, pp. 19–28.

Kristiansen, J. N. and Ritala, P. (2018) 'Measuring radical innovation project success: typical metrics don’t work', Journal of Business Strategy, vol. 39, no. 4, pp. 34–41.

Kuru, K. and Artan, D. (2020) 'A canvas model for risk assessment and performance estimation in public–private partnerships', International Journal of Construction Management, vol. 20, no. 6, pp. 704–719.

Maital, S. and Shein, E. (2021) 'Before You Initiate, Investigate: A Visual Prelaunch Checklist', Commercialising Growth, vol. 2021.

Mauboussin, M. J. and Callahan, D. (2015). Total Addressable Market: Methods to Estimate a Company’s Potential Sales, Credit Suisse AG.

McDermott, C. (2002) 'Managing radical innovation: an overview of emergent strategy issues', Journal of Product Innovation Management, vol. 19, no. 6, pp. 424–438.

McDonald, R. and Eisenhardt, K. M. (2014). Competing in New Markets and the Search for a Viable Business Model. Paper, Harvard Business School.

Nippraschk, M., Brandl, L. and Karlstedt, F. (2025) 'Chancen und Risiken für den

Hochlauf von Dienstleistungen im 2nd-Life sowie Recycling von Lithium-Ionen-Traktionsbatterien', in Korne, T. and Schmidt, K.-J. (eds) Chancen und Risiken in der Automobilindustrie: Handlungsempfehlungen zur Transformation von Märkten, Produkten, Prozessen und Strukturen, Wiesbaden, Heidelberg, Springer Gabler, pp. 221–240.

O'Connor, G. C., & Rice, M. P. (2013). New Market Creation for Breakthrough Innovations: Enabling and Constraining Mechanisms. Journal of Product Innovation Management, 30(2), 209–227. https://doi.org/10.1111/j.1540-5885.2012.00996.x

Pisano, G. P. (2019) 'The Hard Truth About Innovative Culture', Harvard Business Review: HBR, 02/2019 [Online]. Available at https://hbr.org/2019/01/the-hard-truth-about-innovative-cultures.

Porter, M. E. (2014) Wettbewerbsvorteile (Competitive advantage): Spitzenleistungen erreichen und behaupten, 8th edn, Frankfurt am Main, New York, NY, Campus-Verl.

QFD Institute QFD-Definition [Online], QFD Institut Deutschland e. V. Available at https://qfd-id.de/qfd-defintion/ (Accessed 10 November 2025).

Roper, S., Du, J. and Love, J. H. The Innovation Value Chain, Birmingham, Aston Business School.

Schuh, G., Wetterney, T. and Voigt, F. (2020) 'Customer Need-based Product Positioning for Disruptive Innovations', Proceedings of the International Conference on Culture Heritage, Education, Sustainable Tourism and Innovation Technologies (CESIT 2020), vol. 1, pp. 300–307.

Simon, M. and Kim, J. (2016) 'Two Sources of Overconfidence: Incorporating Disconfirming Feedback in an Entrepreneurial Context', Academy of Management Proceedings, vol. 2016, no. 1, p. 12598.

Song, M., Podoynitsyna, K., van der Bij, H. and Halman, J. I. M. (2008) 'Success Factors in New Ventures: A Meta-analysis*', Journal of Product Innovation Management, vol. 25, no. 1, pp. 7–27.

Standaert, T., Knockaert, M. and Manigart, S. (2021) 'Venture Capital Winners: A Configurational Approach to High Venture Capital-Backed Firm Growth', British Journal of Management.

Talke, K. (2005). Einführung von Innovationen: Marktorientierte strategische und operative Aktivitäten als kritische Erfolgsfaktoren [Online]. Dordrecht: Springer. Available at http://gbv.eblib.com/patron/FullRecord.aspx?p=1997914.

Tyfield, D. and Zuev, D. (2018) 'Stasis, dynamism and emergence of the e-mobility system in China: A power relational perspective', Technological Forecasting and Social Change, vol. 126, pp. 259–270.

Valentowitsch, J. (2019). Konkurrenz und Diffusion von Technologien auf Märkten unter Standardisierungsdruck: Modellbildung, Simulation und Prognose. Dissertation, Stuttgart: Universität Stuttgart.

van Gelderen, M., Thurik, R. and Bosma, N. (2005) 'Success and Risk Factors in the Pre-Startup Phase', Small Business Economics, vol. 24, no. 4, pp. 365–380.

Wulf, T., Krys, C., Brands, C., Meissner, P. and Stubner, S. (2011) 'EIN RADAR FÜR DIE STRATEGIEPLANUNG', Harvard Business Manager, Nr. 3.

York, J. L. and Danes, J. E. (2014) 'Customer Development, Innovation, and Decision-Making Biases in the Lean Startup', Journal of Small Business Strategy, vol. 24, no. 2, pp. 21–40 [Online]. Available at http://libjournals.mtsu.edu/index.php/jsbs/article/view/191 (Accessed 20 January 2026).

Annex 1: Internal Determinants

Table 1: Internal Determinants for Success or Failure of Innovation

Internal factors	*Determinants*	*Reference*
Corporate culture	- Failure culture - Heterogeneous opinions - Openness to criticism	(Baumgartner & Peter, 2021; Deckert, 2017, p. 16; McDonald & Eisenhardt, 2014; Pisano, 2019)
Motivation	- Management Engagement - Employee Participation	(Baumgartner & Peter, 2021)
Overestimation of capabilities	- Overconfidence Bias - Overvaluing one's own skills and knowledge - Self-reflection	(R. G. Cooper, 2013; A. C. Cooper, Woo, & Dunkelberg, 1988; Cornell & Damodaran, 2020; Kahneman & Lovallo, 1993; Simon & Kim, 2016; York & Danes, 2014, p. 31)
Agility/Flexibility	- Adaptability of the organisation to changes in the market	(Cantner, 2007; Darvishmotevali, Altinay, & Köseoglu, 2020; Day & Schoemaker, 2005)
Strategy	- Marketing Strategy - Market barriers	(Hennard & Szymanski, 2001)
Resources	- Availability of resources - Availability Finance - Cooperations	(Maital & Shein, 2021; Song, Podoynitsyna, van der Bij, & Halman, 2008; Standaert, Knockaert, & Manigart, 2021)
Experience of the parties involved	- Experiences from failures - Dealing with complexity - Industry knowledge	(Busenitz & Barney, 1997, p. 16; Maital & Shein, 2021; Song et al., 2008)
Understanding of risks	- Consideration of market risks in the planning process? - Underestimation of risks	(Kahneman & Lovallo, 1993; Simon & Kim, 2016; van Gelderen, Thurik, & Bosma, 2005, p. 365)
Business Plan	- Overestimation Bias - Availability Market Data	(Arnott et al., 2021; Blank, 2013; Invernizzi, Menozzi, Passarani, Patton, & Viglia, 2017)
Product	- Price - Technical Advantage - Driving licence	(Christensen, 1997; Hennard & Szymanski, 2001; Maital & Shein, 2021)
Process	- Efficiency - Synergy - Economies of scale	(Hennard & Szymanski, 2001)

Annex 2: External Determinants

Table 2: External Determinants for Success or Failure of Innovation

Internal factors	*Determinants*	*Reference*
Market size	- Actual situation - Dynamics - Segmentation	(R. G. Cooper, 2013, p. 28; Cornell & Damodaran, 2020; Jaffe, Newell, & N, p. 490; Kristiansen & Ritala, 2018, p. 34; O'Connor & Rice, 2013; Song et al., 2008)
Growth	- Economies of scale - Limitations	(Song et al., 2008; Talke, 2005)
Market structure	- Neighbouring markets - Structure (Winner Takes it all) - Technology Standards	(Arthur, 1989; Cornell & Damodaran, 2020; Jaffe et al., p. 491; Valentowitsch, 2019)
Competition	- Established players - Niches/ Segments - Barriers	(Brillinger, Els, Schäfer, & Bender, 2020; Porter, 2014)
Value Chain	- Key Partners - Key Resources - Key technologies/processes - Critical network effects - Complementary goods	(Adner, 2017; Adner & Kapoor, 2016; Christensen, Kaufman, & Shih, 2008, p. 10; Roper, Du, & Love; Talke, 2005)
Technology	- Current developments - Potential developments - Maturity - Value Chain Status	(Adner, 2017; Adner & Kapoor, 2016; Christensen, 1997; O'Connor & Rice, 2013; Song et al., 2008)
Customers	- Customer Value - Heterogeneity - Influencing factors (e.g. trends)	(Adner & Levinthal, 2001; Day & Schoemaker, 2005, p. 10; Wulf, Krys, Brands, Meissner, & Stubner, 2011, p. 2)
Stakeholder	- Opinion leaders - Interest groups - Critical minorities	(Kuru & Artan, 2020; Song et al., 2008; Wulf et al., 2011)
Framework conditions	- Legal requirements - Developments - Infrastructure (Society)	(Jaffe, Newell, & Stavins, 2004; Kaufmann, 2021; Wulf et al., 2011)

Annex 3: Matrix for Usability Evaluation

Metric Range

		Relevance	Limits
1	Standard	[1 - 10]	[1 - 10]
2	Hygiene	[1 - 10]	[1 - 10]
3	Additional	[1 - 10]	

Description of Value Classification and Limit impact

		Benefit	Consideration of limits
1	Standard	[1-100]	Value below this thresshold are threate
2	Hygiene	max 0	Exclusion from job if lower limit cannot
3	Additional	only given as additional Info not impacting normalized Benefit	

Cluster / Categorie / Characteristics	Job 1 Company Car > 40tkm p.a. ("High-Miler") [longterm and high frequent users but not Owner]			Job 2 Company Car < 40tkm p.a. "local Heros" [high frequent users but not Owner]			Job 3 Privat Car Suburb-Commuter [high frequent users and Owner; Houseowner; Technology affin]			Job 4 Privat Car city dwellers [regular users and Owner, no fixed parking]			Job 5 Private Cars Conservative Users [Owner, no fixed parking; sceptic to new technologies]			BEV Performance Portfolio	Benefits Job 1	Benefits Job 2	Benefits Job 3	Benefits Job 4	Benefits Job 4
	Classification	Relevance	Limits	Classification	Relevance	Limits	Classification	Relevance	Limits	Classification	Relevance	Limits	Classification	Relevance	Limits						
Technical benefit assessment (Technical Criterias)																					
Technical																					
Range	Hygiene	9	7	Standard	6		Standard	6		Standard	5		Standard	7		6	N.A.	36	36	30	42
Power (hp/ KW)	Standard	7		Standard	6		Standard	6		Standard	5		Standard	7		7	49	42	42	35	49
Top Speed	Standard	7	5	Standard	6		Standard	7		Standard	5		Standard	7		6	7	36	42	30	42
Comfort	Standard	8	5	Standard	5		Standard	7		Standard	5		Standard	6		8	24	40	56	40	48
Payload / available space	Standard	3		Standard	3	4	Standard	3		Standard	3		Standard	5		7	21	9	21	21	35
Duration Refuelling /Charging	Hygiene	7	7	Standard	5		Standard	5		Standard	3		Hygiene	7	6	6	N.A.	30	30	18	-
Durability	Standard	8		Standard	5		Hygiene	6		Hygiene	6		Hygiene	6		5	40	25	-	-	-
Technical																[Benefit + Additional Benefit]	-	218 + 0	227 + 0	174 + 0	216 + 0
																normalized total benefit	**-**	**6,1**	**6,7**	**6,69**	**6,75**
Cost																					
Purchase Costs	Standard	1		Standard	1		Hygiene	6	5	Standard	8	5	Standard	8	4	5	5	5	-	-	8
Leasing costs	Standard	5	4	Standard	8	4	Standard	6	5	Standard	4		Standard	4		8	20	32	18	32	32
Operating Costs (Fuel / Enegergy) per 100km	Standard	5	4	Standard	8	4	Standard	8	5	Standard	5	5	Standard	8	5	7	15	24	16	10	16
Maintenance costs	Standard	8	4	Additional	5	6	Standard	3	7	Standard	5	4	Standard	8	4	8	32	40	3	20	32
Infrastructure Invest (home)	Additional	1		Additional	1		Standard	5	7	Additional	1		Hygiene	6	4	5	5	5	- 10	5	-
Costs																[Benefit + Additional Benefit]	72 + 5	61 + 45	27 + 0	62 + 5	88 + 0
																normalized total benefit	**3,8**	**3,6**	**1,2**	**2,8**	**3,1**
Individual benefit assessement (Individual needs)																					
Social																					
Social Status (Image)	Standard	6		Standard	5	4	Hygiene	7	5	Standard	5		Standard	5		7	42	15	-	35	35
Individualisation	Standard	5		Standard	5		Standard	7	7	Standard	5		Standard	5	5	8	40	40	7	40	15
Sustainability	Hygiene	4		Hygiene	4	8	Standard	4		Standard	5	4	Additional	2		8	-	-	32	20	16
Technical novelty	Standard	5		Standard	5		Standard	7		Standard	4		Standard	3		7	35	35	49	28	21
Design / Novelty Trend	Additional	3		Additional			Standard	7		Standard	7		Additional	3		7	21	-	49	49	21
Social Status																[Benefit + Additional Benefit]	117 + 21	90 + 0	137 + 0	172 + 0	71 + 37
																normalized total benefit	**7,3**	**6,0**	**5,48**	**6,6**	**5,5**
Safety / Risk																					
Personal Risk/Safety	Standard	3		Standard	3		Hygiene	5	4	Hygiene	5	4	Hygiene	8	4	4	12	12	-	-	-
Legal Insecurity (Subsidies)	Standard	5		Standard	5		Standard	5		Standard	5		Standard	8		8	40	40	40	40	64
Technical Risk	Hygiene	8	7	Hygiene	4		Hygiene	4	6	Standard	4	6	Standard	8		8	-	-	-	8	64
Value Stability (Used car value)	Standard	3		Standard	5		Hygiene	5	5	Hygiene	5	5	Hygiene	8	6	5	15	25		-	N.A.
Technical reliability	Standard	8	7	Standard	8	6	Hygiene	8	6	Additional	4		Hygiene	8	7	6	- 8	-	-	24	N.A.
Safety / Risk																[Benefit + Additional Benefit]	59 + 0	77 + 0	40 + 0	48 + 24	-
																normalized total benefit	**3,11**	**3,67**	**8,00**	**5,3**	**-**
Flexibility																					
Compatibility with alternative technologies / next generations	Standard	3		Standard	5		Standard	3		Standard			Standard			2	6	10	6	-	-
Availability Infrastructure Home	Standard	5	4	Standard	5	5	Standard	5		Hygiene	4	6	Standard	4	5	5	5	-	25	N.A.	-
Regional Availability (Infrastructure broadly reliable)	Hygiene	8	7	Standard	5		Additional	4		Standard	5	5	Hygiene	7	5	6	N.A.	30	24	5	-
Repairability Battery/Engine	Hygiene	5		Standard	6		Standard	5		Standard	5		Hygiene	5		4	-	24	20	20	-
																				-	-
Repairability																[Benefit + Additional Benefit]	-	64 + 0	51 + 24	-	0 + 0
																normalized total benefit	**-**	**3,05**	**3,92**	**-**	**-**
																General Usability	**no**	**yes**	**yes**	**no**	**no**

Figure 6: Matrix for Usability Estimation based on QFD Structure (QFD Institute; DAP 2026)

Annex 4: Value Chain Limitation Matrix

Limitation of the offer (limitation of the provision of the expected product or service)	Temporal Impact	Impact	Probability	**Risk of Limitation**	**Limitation of demand** (limitation of utility or usability)	Temporal Impact	Impact	Probability	**Risk of Limitation**
Precursors/ Sub-Components					**Complementary Products**				
Availability • Lithium / Nickel/ Cobalt • Cells/ modules/ batteries • Seldom Earth (for electrical engine)	P	9	9	**81**	• Spare Parts • Availability of charging infrastructure • fixed charging parking slots	T	8	9	**72**
Supplies / Infrastructure					**Supplies / Infrastructure**				
• Import Costs of Cells & battery mainly from Asia • Process Waste Treatment (Hazardous goods) • Regulations on Battery Warehouses and Transports	T	7	8	**56**	• Energy prices • reliability and performance of power grid and charging infrastructure • Green energy sources	P	8	9	**72**
Technological maturity					**Technological maturity**				
• required technical standards (Plug/ Safety /Battery Pass) • changing cell chemistries / fast-developing technology • Battery competencies needed (Quality / Process)	T	4	4	16	• Standard Charger (e.g. EU wide) • Technologie Standards • Compatibility between different battery generations	T	4	8	32
Capacities					**After Sales Service**				
• Battery Manufacturing Capacities in the EU • Integration with parallel ICE manufacturing	T	3	7	21	• Battery competence in existing service network • Repairability • Standardised SOH evaluation/certification	T	6	8	48
Supplier/Partner Structure					**Circular Economy / Sustainability**				
• Monopolistic situation of Cell Manufacturer (CATL/BYD/LG/…) • Change in Supply Chain (new Tier-n Structures)	P	6	8	48	• Recycling regulations • Re-Use Concepts (2nd Life) • Availability of the recycling network	T	7	6	42
Regulatory conditions					**Regulatory conditions**				
• Political dependency on a few raw material and cell-delivering countries • Environmental regulations • Dependency on Subsidies • Work Safety requirements	T	5	6	30	• Change in subsidies • incentive to energy prices • Warranty conditions • Safety regulations • CO^2 Footprint	T	7	7	49

Details
Temporal Impact: [temporary/permanent]additional classification of risk of limitation
Impact: [1-10] potential impact on market limitation
Probability: [1-10] probability of occurrence
Risk of Limitation: [1-100] resulting product from [Impact x Probability]

Figure 7: Value Chain Limitation Risk Evaluation Matrix – EV-Market reference to DAP 2026, Nippraschk et. al. 2025; Tyfield & Zuev 2018