

AI For EV Battery Validation

How Global Automotive Leaders Benefit From AI Accelerating EV Battery Testing And Validation Speed While Maintaining Safety And Quality

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Use AI To Accelerate EV Battery Testing And Validation

Engineering leaders in the EV battery sector are under immense pressure to deliver products faster amid geopolitical uncertainties, volatile growth in consumer demand, fierce competition, and risk to product quality. Finding ways to shorten testing and validation procedures is crucial to accelerating time to market; yet the highly complex, nonlinear nature of batteries makes it seemingly impossible to understand and solve performance problems quickly. Testing and validation in this sector are particularly challenging, with the need for physical testing hindering rapid response to market dynamics. Streamlining this process demands maximizing insights from sensor data to minimize model iterations and testing. This study finds that global automotive leaders expect to leverage ~~engineering-specific~~ AI to enhance productivity and data utilization, shorten time to market, and gain a competitive edge.

Key Findings



It is imperative to reduce physical testing of EV batteries while still ensuring quality and safety. AI is crucial to stay competitive in the EV battery market.



More than 60% of respondents recognize AI's potential in EV battery testing. Applications to use AI in the next 12 months include thermal design optimization, performance prediction, early hazard detection, and charging time reduction ~~amongst others~~.



AI solutions in EV battery development need time to be fully accepted. Alignment with internal data science teams, budgets, and liability are slowing adoption, and data quality challenges hinder AI efficacy.

Engineering Leaders Face A Dilemma — Getting To Market Faster Without Risking Battery Quality

Global automotive engineering leaders face a dilemma — they need to get to market faster while ensuring safe and reliable EV batteries. But current methods — namely physical testing and virtual validation — are not reliable. Two out of three respondents agree that it’s imperative to reduce reliance on physical tests while still ensuring compliance with safety and quality standards, and 64% feel a strong sense of urgency to reduce the time and effort spent on battery validation. Sixty-two percent (62%) of respondents agree that current virtual tools, including physical simulation, do not fully ensure that battery designs meet all validation criteria.

The potential of AI in battery validation is high, with more than half of respondents (58%) agreeing that utilizing AI technologies is crucial for staying competitive in the EV battery market.

Top Sentiments Regarding The Development Of Safe And Reliable EV Batteries

● Strongly agree ● Agree

It is imperative to reduce the reliance on physical tests while still ensuring compliance with quality and safety standards.



We feel a strong sense of urgency to reduce the time and effort currently spent on battery validation.



Creating in-house testing and validation facilities requires significant time and financial resources.



Virtual validation tools, including physical simulation, currently do not fully ensure that battery designs meet all validation criteria/requirements.



Utilizing artificial intelligence (AI) technologies is crucial for staying competitive in the EV battery market.

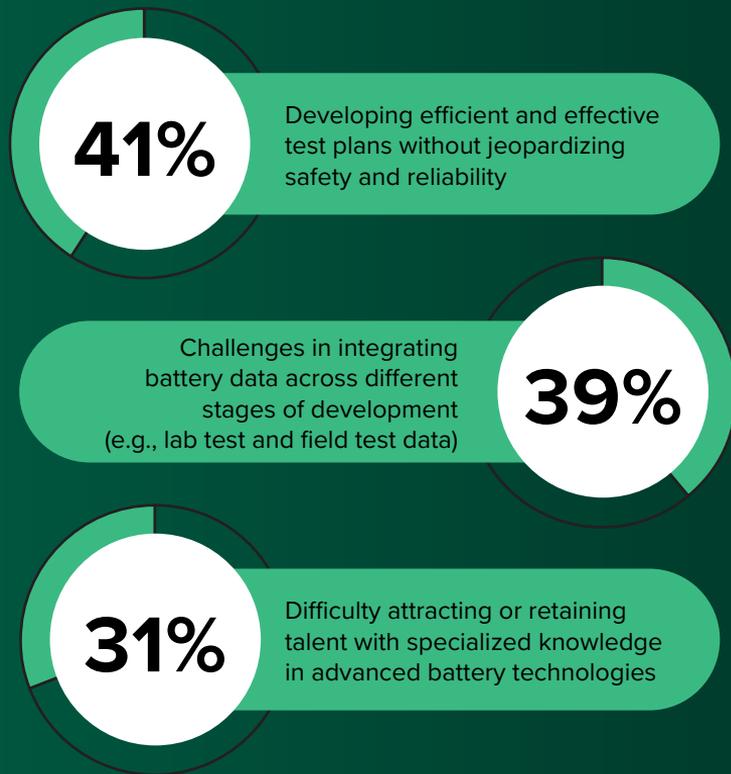


Base: 165 decision-makers in the automotive industry responsible for EV battery testing, validation, and development in the US and Europe
 Note: Showing top five responses
 Source: A commissioned study conducted by Forrester Consulting on behalf of Monolith AI Limited, April 2024

Creating Efficient Test Plans **And** Data Sharing Slow Down Development

Developing batteries with high energy density, faster charging, longer lifespans, and enhanced safety is a complex process that involves extensive research and testing. The validation phase in particular can be time-consuming, and failed tests or over testing can significantly delay the launch schedules. Therefore, it is crucial to develop efficient test plans that reduce the number of tests run or stop them early while maintaining safety and reliability. This is the primary obstacle **🔧** accounting for 41% of the challenges faced by battery developers. The second obstacle is integrating battery data across different stages, which requires standardized protocols, advanced data management tools, and collaborative efforts. In the current paradigm, not finding domain-specific experts reduces the potential testing volume, attracting and retaining talent is a third barrier with 31% reporting this as a challenge.

Top Three Barriers To Bringing EV Battery Solutions To Market



Internal Data Science Teams Lack Engineering Domain Expertise

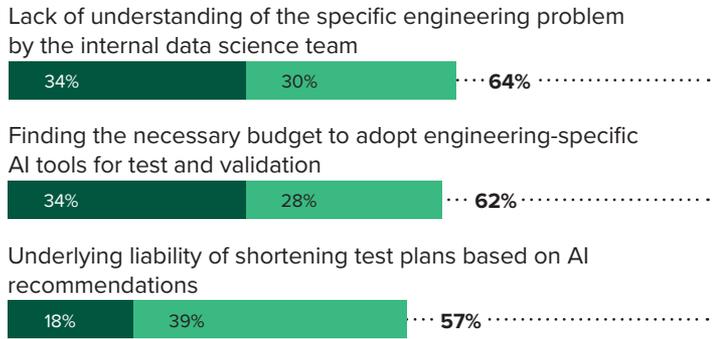
Respondents reported varying levels of concern regarding using AI solutions to develop safe and reliable EV batteries. The highest concern (64%) is the need for internal data science teams to understand the specific engineering problem. Another significant concern is securing the budget for engineering-specific AI tools (62%). Liability issues arising from shortening test plans based on AI recommendations concern 57% of respondents, reflecting their caution in applying AI solutions.

On the other end of the spectrum, respondents are least concerned about the impact on engineering resources (57%), the risk of slowing down product development with new tools (54%), or the time required to convince their organization to buy vs. build (49%).

Level Of Concern Around Using AI Solutions For EV Battery Development

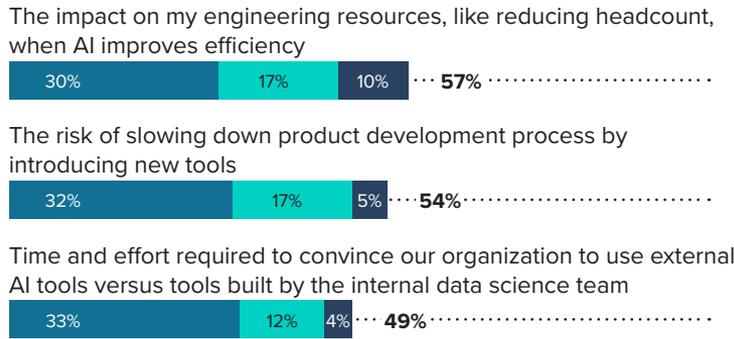
MOST CONCERNING

- Extremely concerning
- Very concerning



LEAST CONCERNING

- Moderately concerning
- Slightly concerning
- Not concerning at all



How Much Data Is Needed To Build **A** Reliable AI Model?

Data stands at the core of AI's effectiveness in EV battery validation. Over half of the respondents (59%) wrestle with insufficient test data from failed batteries, hindering their ability to pinpoint root cause failures. Equally, 54% struggle to adapt AI models to new battery chemistries and designs, reducing the reusability of AI models.

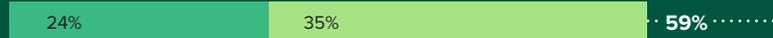
AI model reliability wavers for 52% of the respondents, as they feel they need more data to build AI models, indicating their maturity in using and applying AI. Moreover, 51% report an overflow of data that misses the mark in terms of relevancy.

These findings highlight the need for better clarification on how much data is actually needed to build a reliable, engineering-specific AI model, the format of that data, and what information the data needs to contain.

“How challenging are each of the following when using AI for EV battery validation?”

- Extremely challenging
- Very challenging

Having enough data from failed batteries to understand the root cause of failure



Being able to reuse AI models across chemistries or design changes



Having enough data to build a reliable AI model



Having too much data that doesn't contain the right information



Base: 165 decision-makers in the automotive industry responsible for EV battery testing, validation, and development in the US and Europe
 Note: Showing top four responses
 Source: A commissioned study conducted by Forrester Consulting on behalf of Monolith AI Limited, April 2024

Finding Complex Relationships In Data Is Highly Challenging And Nascent Battery Data Makes It Even Tougher

Given the competitive pressure to harness AI for EV battery validation, data again takes center stage. Over half (57%) of respondents cite deciphering complex relationships in vast, multiparameter datasets as a significant barrier. Access to benchmark data from battery suppliers also stands as a roadblock for 52%, and 49% highlight the difficulty in obtaining data for batteries still in the preproduction phase. Adequate data management processes that allow data storage for future reuse concern 48%, while ensuring data integrity and error-free measurements also remains a challenge for another 48%.

The pivotal hurdles that need clearing as the industry propels toward an AI-integrated future in EV development revolve around data, exacerbating the need for specialized partnerships.

“How challenging is leveraging data, when considering using AI for battery testing to accelerate development in your organization?”

● Extremely challenging ● Very challenging

Finding complex relationships in large datasets with many parameters



Access to benchmark data from battery suppliers



Gaining access to data for new batteries or cells that are not yet in production



Knowing we can trust our data and that it does not contain measurement errors

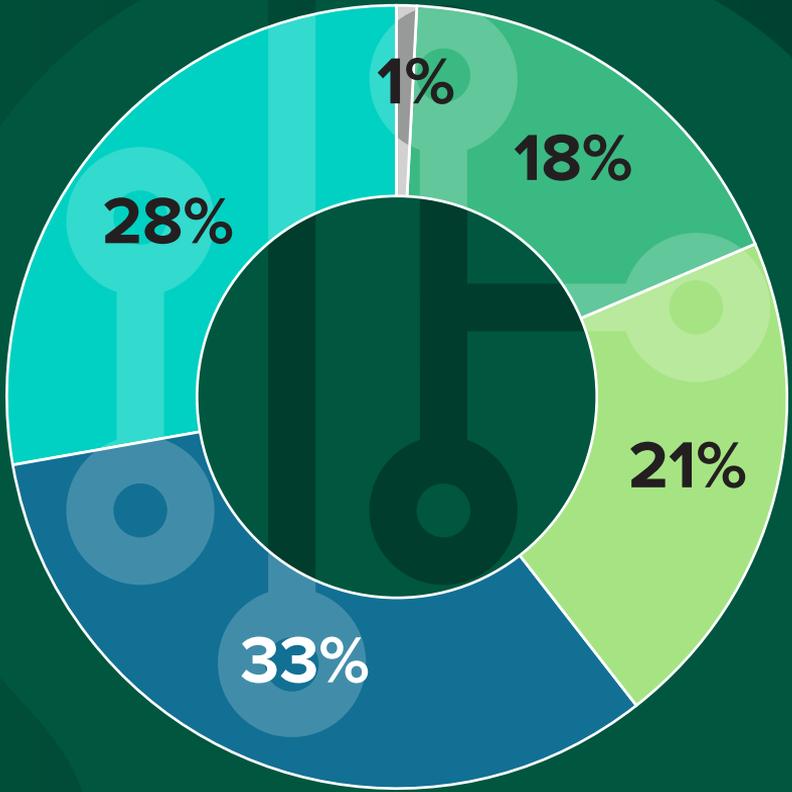


Recording and storing test data properly for others to reuse



Base: 165 decision-makers in the automotive industry responsible for EV battery testing, validation, and development in the US and Europe
 Note: Showing top five responses; percentages may not total due to rounding.
 Source: A commissioned study conducted by Forrester Consulting on behalf of Monolith AI Limited, April 2024

The Potential Impact Of AI Is Significant



- Not significant at all
- Somewhat significant
- Moderately significant
- Very significant
- Extremely significant

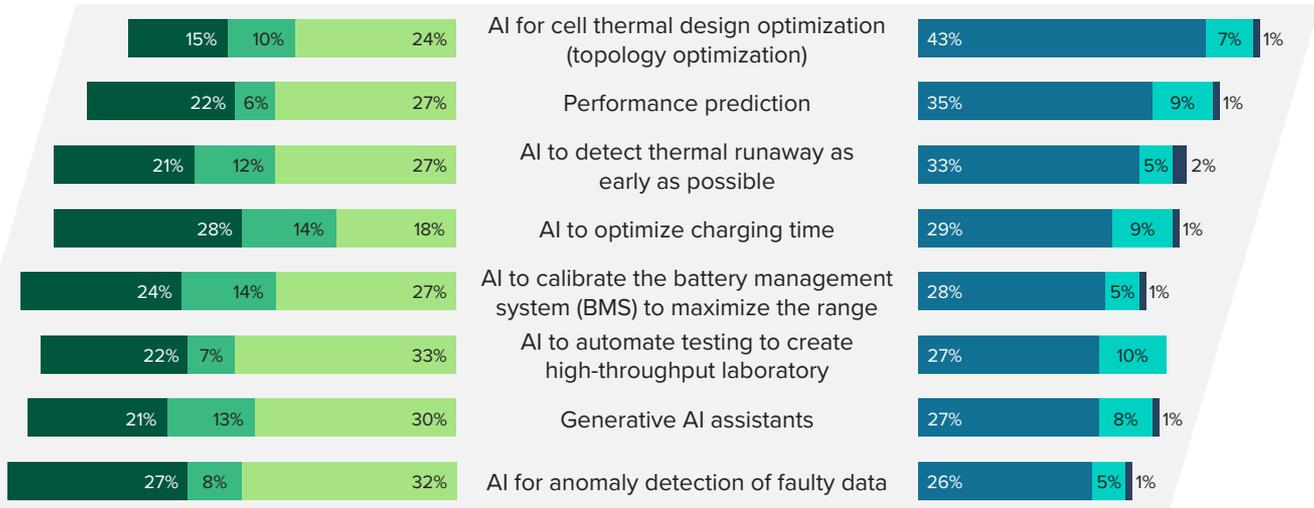


AI Is Intertwined With The Future Of EV Battery Development

EV development leaders are steering toward an AI-infused future with defined strategies for the coming year. Nearly half (43%) of respondents say their organization plans to optimize battery cell thermal designs with AI in the next 12 months, aiming for efficiency and safety. Next, 35% plan to focus on AI for precise performance predictions to enhance predictability and reliability, while 33% will deploy AI to detect thermal runaway early, which is crucial for preventing hazards. Charging time optimization is on roadmaps for 29%, promising faster and more efficient energy restoration, while 28% plan to employ AI to fine-tune battery management systems for extended vehicle ranges. Possibly focusing on automation, 27% look to automate testing for rapid lab operations and integrate generative AI assistants, and 26% will harness AI for anomaly detection to ensure data integrity.

AI Implementation Plans

- Implemented but no immediate plans to expand
- Implemented and currently expanding
- Implementing
- Planning to implement in the next 12 months
- Interested but no immediate plans to implement in the next 12 months
- Not interested



Optimizing Test Plans Without Risking Quality Is Top AI Benefit



There are significant benefits from integrating AI into battery testing and validation. Respondents agree the top benefit is enhancing the efficiency of test plans and refining critical parameters, which is crucial for shortening timelines (41%). Reducing the calibration time of complex physical models — contributing to operational efficiency — is another top benefit, alongside advancing the digitization of test data, which facilitates organization wide knowledge sharing. AI also plays a pivotal role in energizing the workforce, increasing engineer motivation. At 27%, respondents report improving root cause analysis, enabling domain experts to harness test data more productively, and gaining deeper insights into battery lifetimes and applications as top benefits. Finally, 26% observe AI as instrumental in boosting knowledge retention and transfer. All benefits demonstrate AI's transformative impact.

Top Benefits Of Implementing AI In Prototype Testing And Validation Of EV Batteries

- 
41% Improving efficiency of test plans and finding critical parameters to test further without risking quality
- 
34% Reducing time spent calibrating complex physical models to match test results
- 
33% Improving digitalization of test data and the ability to share data insights across the organization
- 
31% Motivating engineers by being able to work with new technologies like AI
- 
27% Improving the ability to conduct root cause analysis
- 
27% Enabling engineering domain experts to use their test data to be more productive
- 
27% Improving insights into battery lifetime prediction and second-life applications
- 
26% Increasing retention and transfer of knowledge and expertise

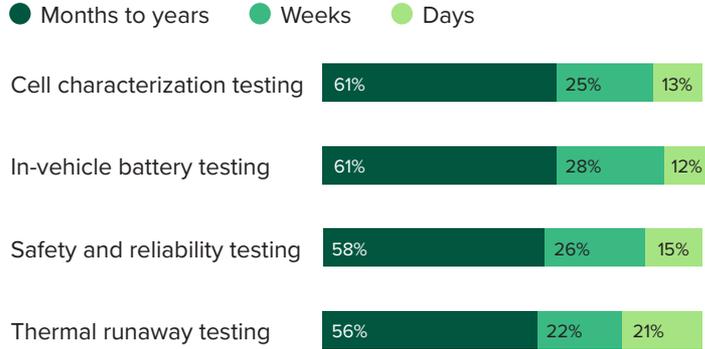
Base: 165 decision-makers in the automotive industry responsible for EV battery testing, validation, and development in the US and Europe
 Note: Showing top eight responses
 Source: A commissioned study conducted by Forrester Consulting on behalf of Monolith AI Limited, April 2024

Engineering AI Could Save Years — And Millions

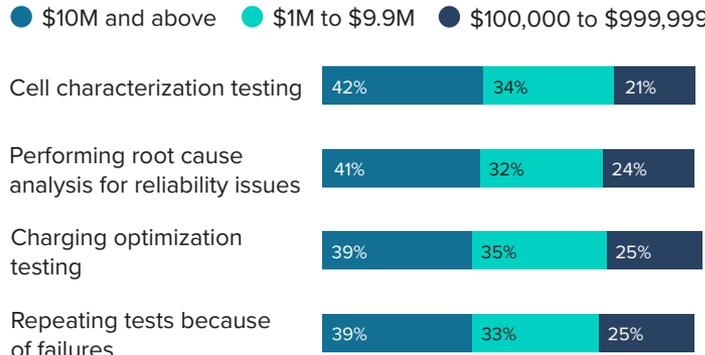
Automotive leaders expect developing engineering-specific AI to create substantial time savings in EV battery testing, and the data shows a consistent trend. Most respondents report a significant reduction in testing times, trimming months to years off of schedules. This time efficiency accelerates development cycles and enhances organizations' competitive edge in the EV marketplace.

AI also promises to cut millions of dollars in EV battery testing. The top expected cost savings relate directly to the challenges that slow EV teams down. Around 40% of respondents expect their organizations to save more than \$10 million in these crucial activities — including cell characterization, performing root cause analysis, and repeated testing — underscoring AI's role in driving economic efficiency in the EV battery development sector.

Time Savings From AI



Cost Savings From AI

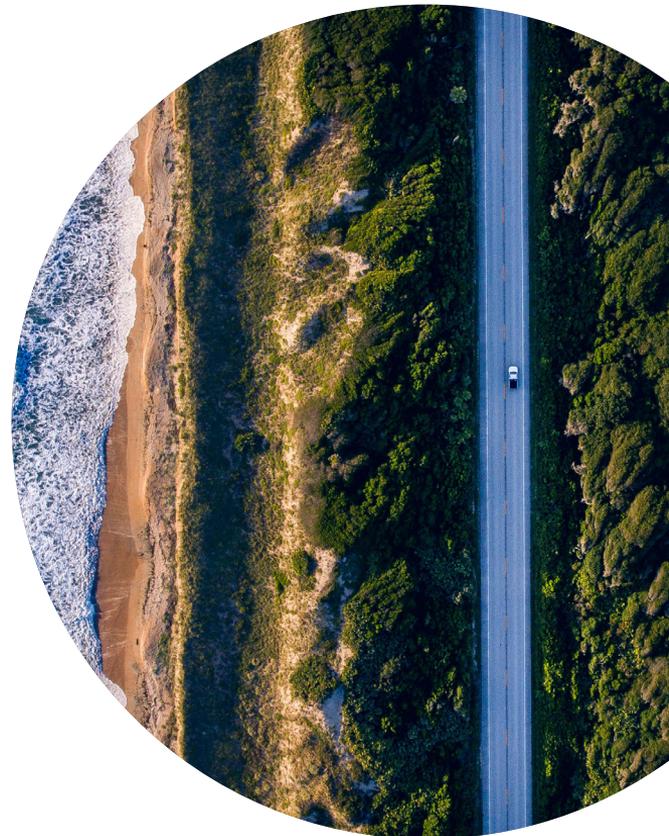


Base: 165 decision-makers in the automotive industry responsible for EV battery testing, validation, and development in the US and Europe
 Note: Showing top three responses for both time savings and cost savings
 Source: A commissioned study conducted by Forrester Consulting on behalf of Monolith AI Limited, April 2024

Conclusion

Engineering leaders developing EV batteries believe AI plays a crucial role in helping them stay competitive and get to market faster.

- Most respondents recognize the need to minimize reliance on physical tests and curtail the time and effort dedicated to battery validation while keeping battery quality high.
- The potential of ~~engineering-specific AI~~ is immense. Over half of respondents acknowledge AI's crucial role in maintaining a competitive edge in the EV battery market. It signals a shift towards more innovative, AI-driven development processes.
- AI solutions introduce both friction and confidence, but low concern about the impact on resources and product development speed indicates a readiness to embrace AI. This willingness could further the innovative application of AI in developing safe, reliable EV batteries.



Resources

Related Forrester Research:

[Executive Guide: Supply Chain](#), Forrester Research, Inc.,

September 21, 2023

[Artificial Intelligence Market Insights](#), Forrester Research, Inc.,

May 18, 2023

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Forrester's [Technology Architecture & Delivery](#) research group

Methodology

This Opportunity Snapshot was commissioned by Monolith AI Limited. To create this profile, Forrester Consulting supplemented this research with custom survey questions asked of decision-makers in the automotive industry responsible for EV battery testing, validation, and development in North America and Europe. The custom survey began and was completed in April 2024.



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Demographics

GEOGRAPHY	
US and Canada	50%
Europe	50%

ANNUAL REVENUE (USD)	
>\$2B	30%
\$1B to \$2B	32%
\$500M to \$999M	38%

RESPONDENT LEVEL	
C-level executive	19%
Vice president	39%
Director	41%

BATTERY-RELATED ROLES	
Develop and test	39%
Research and development	26%
Process and strategy	19%
Product management	10%
EV development	7%

Note: Percentages may not total 100 due to rounding.



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