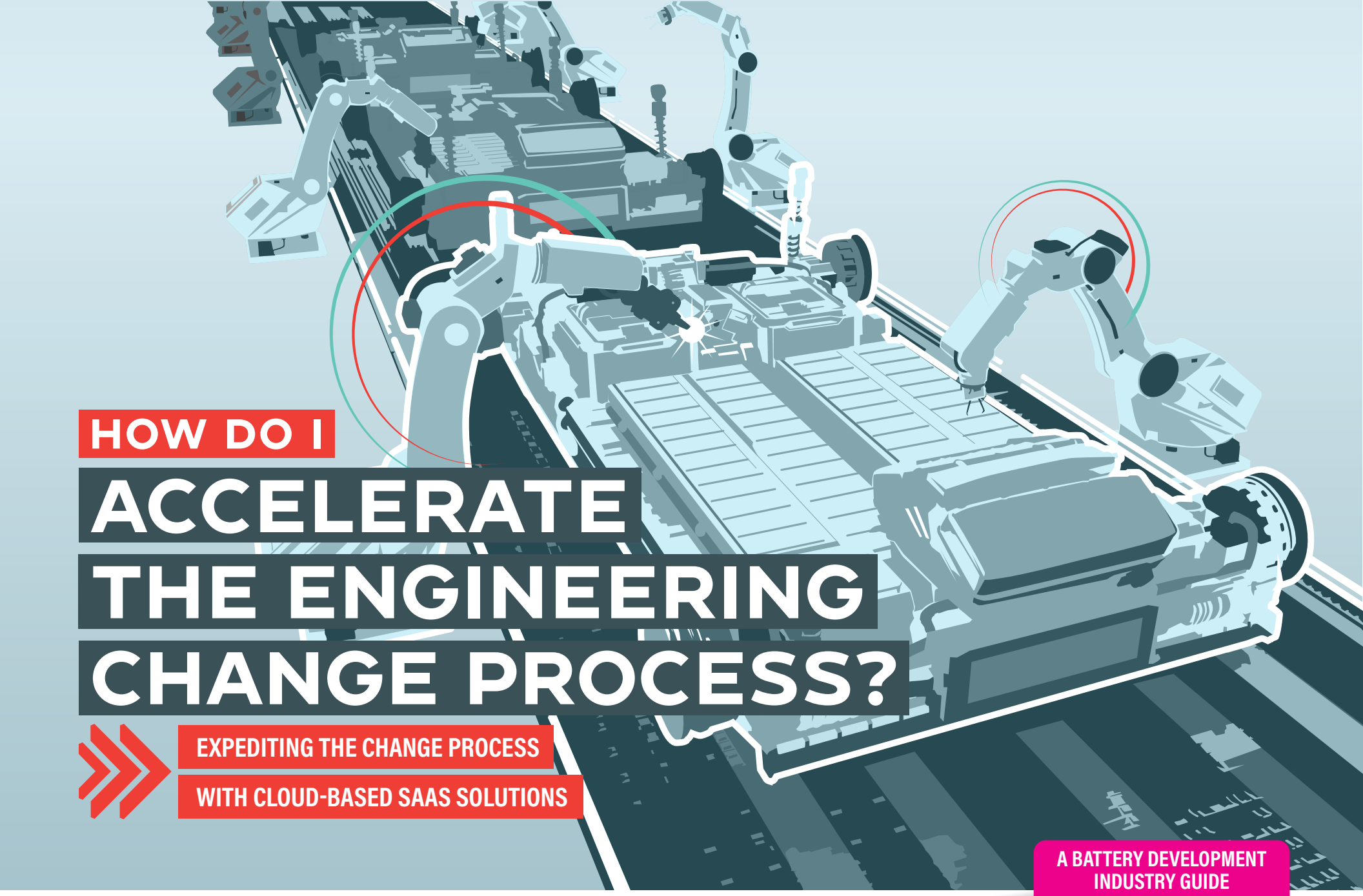

HOW DO I ACCELERATE THE ENGINEERING CHANGE PROCESS?

EXPEDITING THE CHANGE PROCESS WITH CLOUD-BASED SAAS SOLUTIONS

A BATTERY DEVELOPMENT INDUSTRY GUIDE

LIFECYCLE INSIGHTS

Accelerating Engineering Transformation

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Introduction

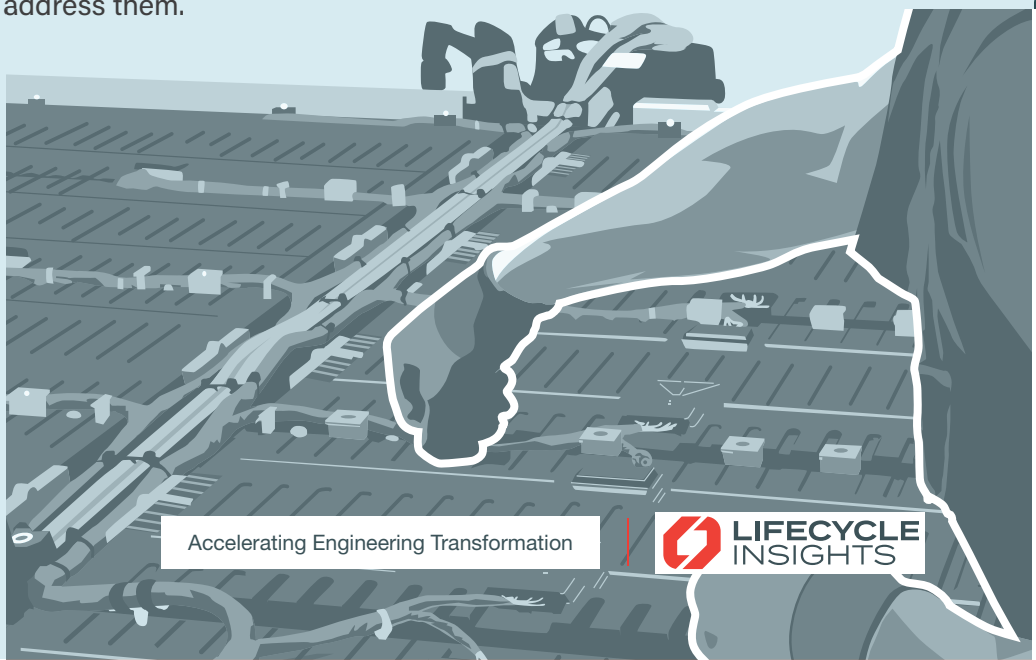
It seems like every industry is undergoing an electrification transformation in one way or another. At the center of that transformation is an increasing reliance on industrial battery systems and a rapidly growing demand for more powerful and efficient batteries.

As their market grows, battery development companies have a considerable opportunity. But developing new batteries involves numerous complex engineering challenges. Engineers face competing constraints in the form of peak power draw, high power capacity for longer vehicle ranges, long lifetimes, and low weights. The potential for thermal runaway and chemical fires also makes safety an essential concern. In addition, batteries' fundamental physics involve complex thermo-chemical interactions. Furthermore, their control systems incorporate complex electronics and software. An array of mechanical, chemical, electrical, electronic, and software engineers and analysts are needed to do the job right.

Coordinating work between these stakeholders, however, presents its own challenge. Managing product data and development processes with general purpose tools—such as shared documents and spreadsheets—makes it easy for team members to lose sight of design changes. This limits engineers' ability to make fully informed engineering decisions and increases the potential for errors that may go unaddressed prior to prototyping and testing. Projects become delayed and costs rise. Out-of-date or inaccurate information also makes procuring the right parts and managing the supply chain more challenging for those outside of engineering.

Battery development companies require more modern tools to manage the complexity of the battery lifecycle. Product lifecycle management (PLM) solutions create a single digital thread that gives stakeholders up-to-the-minute insights into design and requirements changes. This allows engineers to coordinate work across disciplines more efficiently and ensures that decisions are made based on the latest, most accurate information possible. As a result, organizations reduce errors as well as the amount of prototyping and testing required to reach a viable design, lowering costs and shortening the development cycle in the process.

This eBook is one of a series focusing on the challenges facing battery development companies and how PLM solutions can address them.



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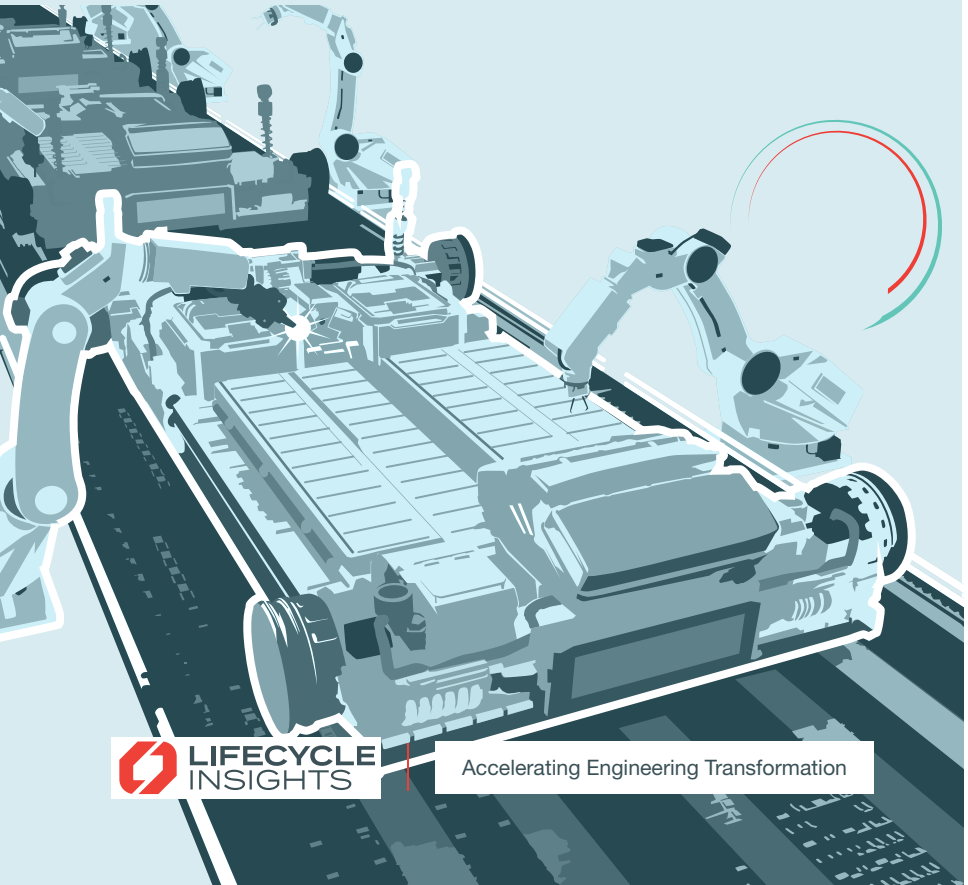

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Table of Contents

Change Is Inevitable in the Product Lifecycle

Battery development industry executives want to see development advance from design to manufacturing with few changes. Alas, as executives know all too well, this is a rare occurrence. Modern battery development is a collaborative and iterative process, and changes are inevitable.

That's where change management comes into the picture. Battery development company executives need a robust system to initiate, review, plan, and execute changes in product design. Effective change management is critical to the product's ultimate success.

An efficient change management process has myriad benefits, which differ across companies. For some organizations, supporting a fast process enables faster time to market. For others, it's all about delivering superior customer service. No matter what their particular needs may be, battery developers benefit from strong change management processes. Lifecycle Insights' research has shown repeatedly that the most progressive companies have the fewest change orders per project. This eBook will discuss change management in general and highlight how a cloud-based software-as-a-service (SaaS) approach can help battery development companies better tackle it.

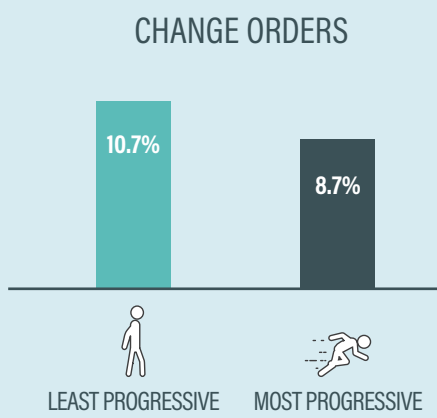
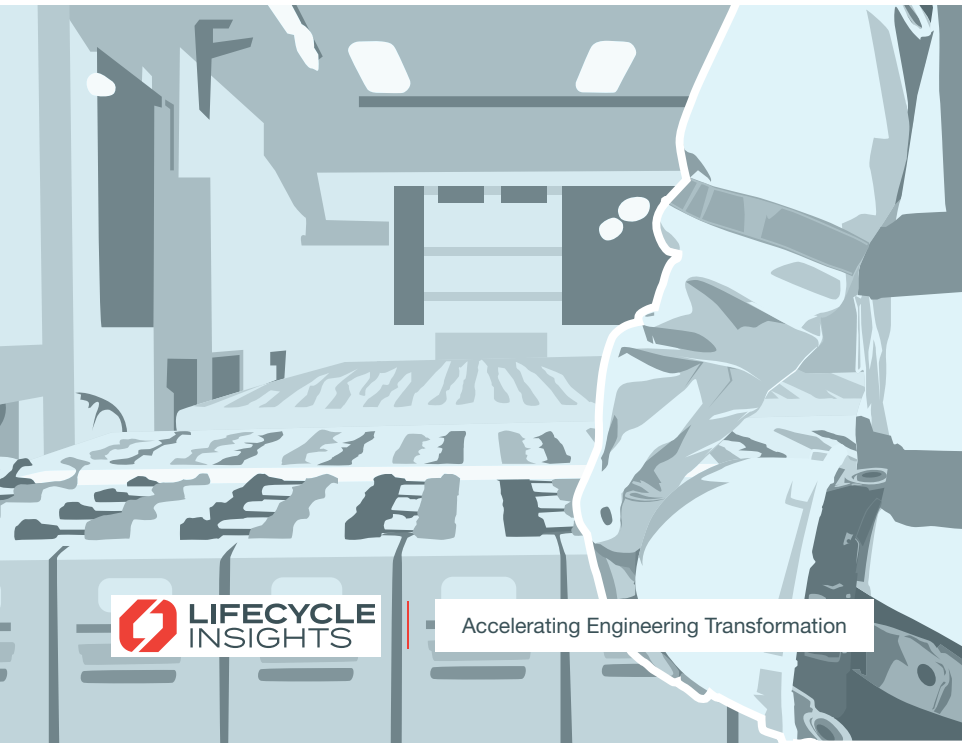


Figure 1
*Compared to their least progressive peers, the most progressive companies have close to 20% fewer engineering change orders (ECOs) per project.**

** Source: Lifecycle Insights' Engineering Executive's Strategic Agenda study.*

Figure 2
Some 30% of study respondents ranked satisfying target requirements as their biggest development challenge.



Fulfilling Dynamic Requirements on Tight Timelines

Lifecycle Insights' Engineering Executive's Strategic Agenda study showed that engineering executives consider satisfying target requirements one of their biggest development challenges. In fact, approximately 30% of respondents ranked this as their top challenge.

Change management can help here. When target requirements shift (from the field or due to regulatory demands or new customer input), changes can occur even in the very last stage of product development. Battery development companies with a robust process in place can handle such changes more efficiently and with less disruption.

Given how critical change management is, any solution must be able to clearly communicate changes and their design implications to all stakeholders. Traditional methods like email exchanges, team-wide meetings, and shared drives aren't going to cut it. As a result, many organizations have already made investments in product lifecycle management (PLM) and product data management (PDM) platforms to improve their existing change management products. These PLM solutions can help streamline communication and connect all internal and external stakeholders.

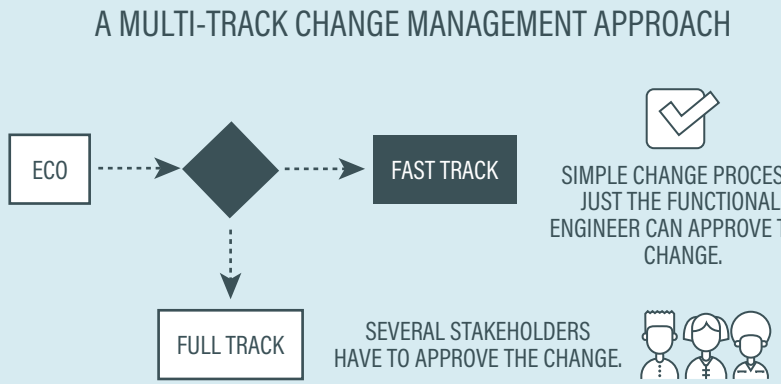


Figure 3
Processing changes on multiple tracks promotes smooth and efficient change management.

The Perks of a Multi-Track Change Process

Changes to a battery's design are inevitable, but they aren't all equally pressing. Some alterations are more expensive or extensive than others. On average, it's quicker and easier to make decisions about low-cost changes than higher-cost ones.

Traditionally, battery development companies tended to use a straightforward single-track change process. In principle, this approach treats all changes as equal: Each one goes through the same rigorous steps to approve, from verification to impact analysis. This can slow the change process profoundly, impeding the entire team's productivity and delaying the delivery date.

Implementing a multi-track change process, however, can meet some of these challenges head-on. A fast track allows staff and first-line managers to move quickly on low-cost changes. This approach also supports a full track, where higher cost and more impactful changes receive more diligence and executive oversight. It can also include additional tracks based on an individual organization's needs. This multi-track approach enables smooth and efficient change management and automated workflows, automatically updating the bill of materials (BOM) and reducing the time and effort required to implement changes.

The Inherent Connection to Requirements

Making informed decisions during change management is critical. Proper assessment of change requests calls for evaluating each one against product requirements. Requirements for today's batteries span multiple disciplines, and good change management requires the ability to validate changes across all domains.

In the past, battery development companies relied on spreadsheets to manage requirements. But as their products grew more complex, various departments began validating them against requirements using their own tools. As a result, any change order now requires managing all of these vital checks, communicating findings, and making decisions based on the recommendations.

A modern PLM solution that captures all product requirements and connects all stakeholders via a digital thread provides a much more efficient way to evaluate changes against requirements. Departments can easily estimate and document the cost associated with any change and note its impact on the project as a whole. The PLM solution captures evaluations and recommendations and shares them with concerned stakeholders, automatically updating the requirement checklist, and letting even external participants know what needs to be done and who needs to do it.

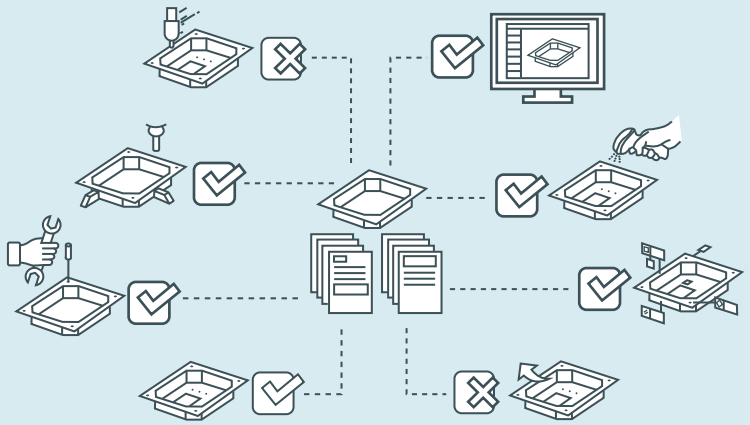


Figure 4
Good change management requires the ability to validate changes across all domains.

The Value of Visualization in the Change Process

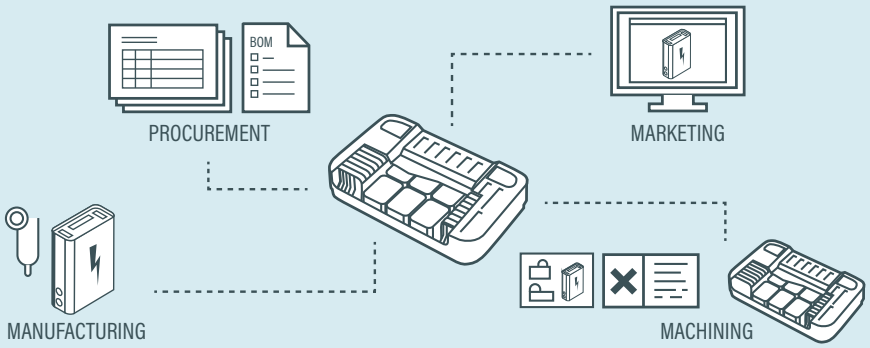
Many stakeholders need to assess potential changes. Engineering must ensure any alteration leaves form, fit, and function intact. Manufacturing needs to evaluate costs. Procurement has to look at the risks involved in sourcing. When participants can access the latest design data, they can visualize the impact of the change.

Battery developers need a system that enables all stakeholders to access and view the data. In the old days, people shared screenshots of computer-aided design (CAD) models or spreadsheets. But without a central repository where stakeholders can access real-time data to make informed decisions, it becomes much more difficult to approve changes and get the product out the door.

A more progressive approach, using a modern PLM platform, permits visualization of the latest designs. That means any stakeholder with the necessary permissions can view the data to understand the implications of any changes before approving them. Teams can even work remotely without disruption to their workflow. Any changes are automatically reflected in the BOM, which serves as the underlying document for manufacturing, procurement, finance, and sales.

Figure 5

Multiple stakeholders from manufacturing to procurement need to visualize the design change to understand its implications.



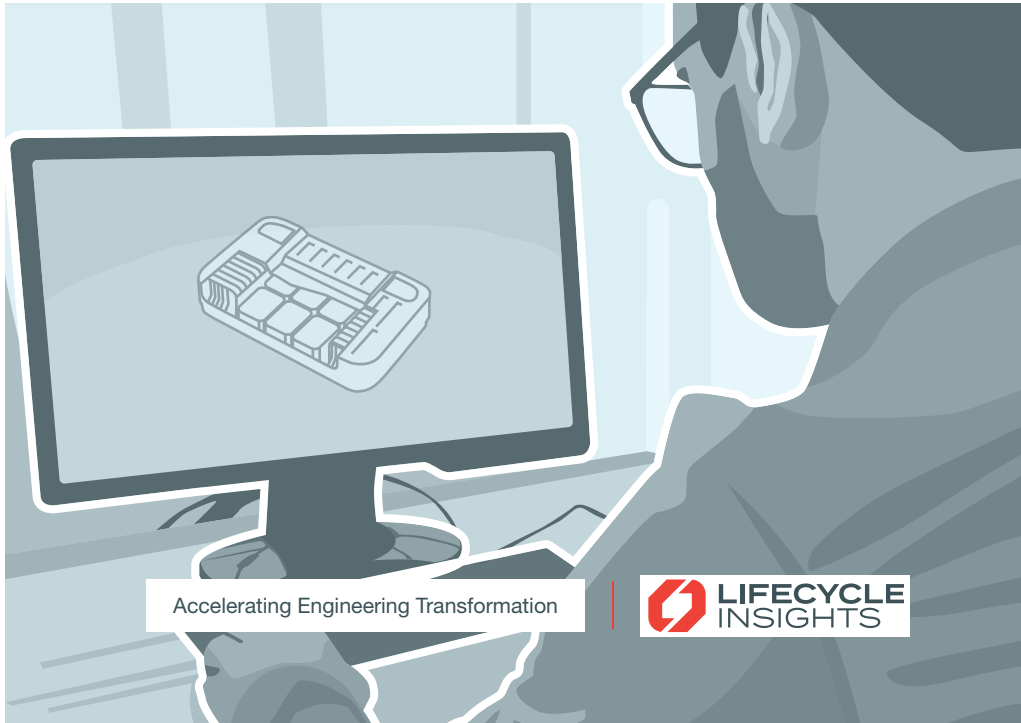
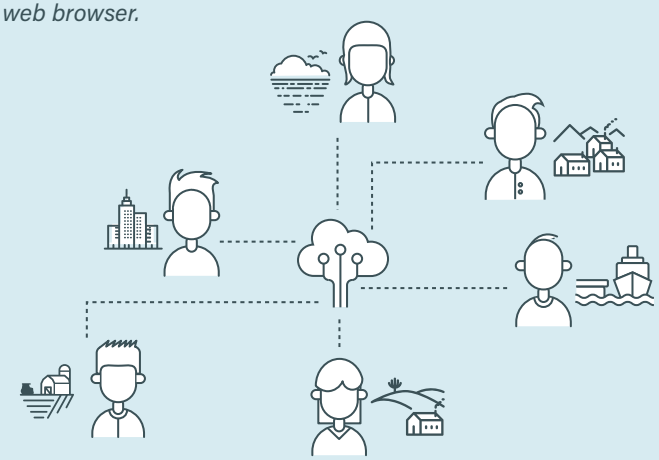


Figure 6

SaaS PLM allows engineers to access requirements, evaluate changes against the requirements, and successfully execute a change order inside a web browser.



The Advantage of SaaS Solutions

Cloud-based SaaS solutions can help battery developers with change management. These solutions come with built-in best practices, curated by the solution provider, that allow organizations to easily tailor the technology to fit their needs. Battery development companies can then quickly and accurately access requirements, evaluate changes against those requirements, and successfully execute change orders. Cloud-based SaaS PLM offers the following benefits:

- **Efficiency:** With built-in prescriptive best practices, battery developers can customize the solution to meet their specific needs.
- **Productivity:** Solutions harness artificial intelligence/machine learning (AI/ML) to gain insights into the company's workflows to predict and correct potential issues.
- **Fast implementation:** Once a company purchases a subscription to a SaaS PLM solution, they can access the solution any time, from anywhere, on any device using a simple browser.
- **Distributed total ownership:** By paying a subscription, solution costs can be an operating expense (OPEX) instead of a major capital expenditure (CAPEX).
- **Extended collaboration:** SaaS solutions connect internal and external stakeholders with ease.
- **Security:** These solutions allow battery development companies to set the appropriate standards and permissions to ensure intellectual property is always secure.

Organizations can save time and cut costs by supporting a robust change management process with the right technology platforms.

Recap and Conclusions

Battery development companies continue to struggle with satisfying increasingly complex product requirements. Changes are inevitable during a new battery's design and development.

Organizations can save time and cut costs by supporting a robust change management process with the right technology platforms. Progressive PLM solutions support secure access to engineering data so stakeholders can make decisions about changes more quickly and easily.

- Managing changes using traditional methods often means there is no single source of truth regarding product design data. Modern PLM solutions enable centralized, automated, multi-track change processes.
- Modern PLM solutions can help battery development companies keep track of all requirements in a central repository, automatically updating that information and communicating that data to stakeholders when changes occur.
- Being able to visualize data across different domains can help executives make more informed decisions about proposed changes.
- PLM platforms, including cloud-based ones, offer stakeholders easy access to requirements and other design data in a secure manner. They facilitate communication that can support change management across the battery lifecycle, reducing delays and costs related to change requests.

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Lifecycle Insights is a trusted research, advisory, and publishing firm providing data-driven insights and industry-proven guidance on engineering transformation.

We empower better people, process, and technology decisions for tech-led engineering initiatives, driving the development of better products in less time.

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