

HONEYWELL **BATTERY MXP**

A Quality first AI driven approach to
Lithium-ion Battery Manufacturing



Honeywell

THE CHALLENGE OF MODERN GIGAFACTORIES

“If I had an hour to solve a problem I’d spend 55 minutes thinking about the problem and five minutes thinking about solutions.”
– Albert Einstein

CHALLENGES:



Complex Manufacturing Processes

Numerous production steps, each requiring precise control and monitoring.



High Scrap Rates

Material waste during ramp-up and steady-state operations (approx. 30% and higher) erodes profitability.



Scaling Difficulties

Speed to full capacity is critical but hampered by inconsistent processes and quality issues.



Traceability and Compliance

Growing regulatory requirements demand complete cell traceability.



Safety Risks

Thermal events and operational hazards require proactive monitoring and rapid intervention.



Sustainability Demands

Reducing energy consumption and carbon footprint is no longer optional — it’s expected by governments and customers.

WHAT IS HONEYWELL'S SOLUTION TO THESE CHALLENGES?

Unlike generic solutions in the market, Battery Manufacturing Excellence Platform (MXP) is a quality-first, AI-powered platform that integrates production management, in-line Quality Control Systems (QCS) vision systems, Supervisory Control and Data Acquisition (SCADA), Quality Management System (QMS) and Laboratory Information Management System (LIMS), thus empowering manufacturers to scale faster, reduce scrap and improving overall operational efficiency.



BATTERY MXP: OPERATIONAL STRATEGY:

1. START WITH A REALISTIC, CONSTRAINT-BASED PLAN

Unlike conventional planning tools, Battery MXP helps manufacturers build production plans, plan and optimize production runs – grounded in shop floor realities by factoring in equipment availability, raw material availability and real time quality disposition.

2. EXECUTE THE PLAN WITH CLOSED-LOOP CONTROL

MXP closes the loop on Operator Procedures, Process Controls, Equipment Performance and Plant Safety to keep the plan on track and meet customer commitments on cost, quantity and quality.

3. REAL TIME DEVIATION MANAGEMENT

MXP continuously compares plan versus actual KPIs. When deviations arise – whether from raw materials, equipment behavior or operator input – the system instantly flags the issue for quality disposition. MXP's early quality event detection helps prevent unnecessary added work, reduces cost of poor quality and unplanned downtime.

4. BUILD AND USE AN OPERATIONAL KNOWLEDGE BASE

Every quality deviation, root cause and its resolution are captured into MXP's growing knowledge base. This helps accumulate learnings, predict root cause analysis and fuel continuous improvement. The system supports corrective action preventive action (CAPA) workflows, enabling structured learning from past events with embedded Documentation and Training Management System.

5. A CONTROLLED SCALE-UP INSTEAD OF GUESS WORK

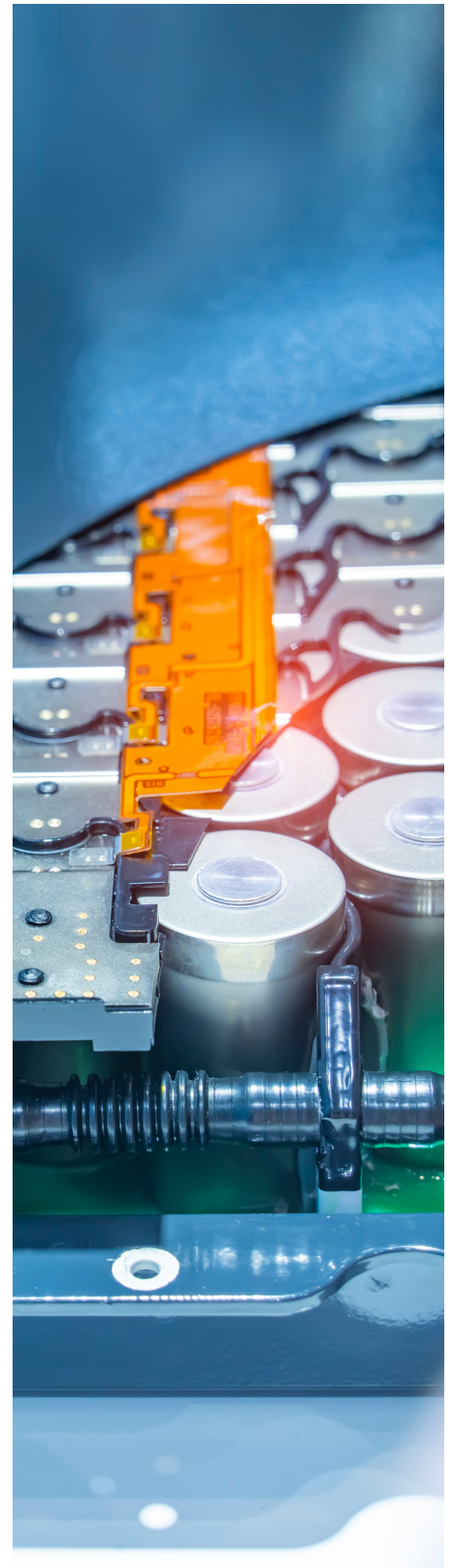
Scaling a production in gigafactory set-up introduces massive complexity – from synchronizing multiple lines and shifts to managing bottlenecks and operator variability. MXP facilitates scaleup by enabling repeatable best practices across lines, enforcing digital operating procedures and leveraging common data backbone that allows visibility from single line to enterprise-wide operations.

6. ACHIEVE SOP FASTER AND WITH HIGHER YIELDS OF GRADE A CELLS

With closed-loop feedback and quality disposition management, MXP reduces scrap during rampup and helps reach the start of production (SOP) faster. Factories can achieve Grade A cells from Day 1 of SOP by enforcing quality-driven process readiness before full-scale launch.

7. SUSTAIN PERFORMANCE THROUGH THOUSANDS OF FEEDBACK LOOPS

MXP supports a continuous cycle of improvement: Plan > Execute > Measure > Learn>Optimize. This built-in feedback loop ensures that manufacturers not only reach SOP quickly but continuously improve yield and throughput with advanced AI driven data analytics.



RAMPING UP START OF PRODUCTION OF GRADE A CELLS



Closed loop quality control

Battery MXP's seamless integration with Trackwise, Honeywell's leading QMS, not only records defects but also enables accelerated root cause analysis on quality deviations and CAPA, closing the quality loop. This real-time connected QMS allows proactive intervention and data driven process optimization, enabling manufacturers to accelerate SOP.



End-to-End Process visibility and control

Honeywell's Battery MXP with integrated process-controlled algorithms empowers manufacturers to adjust processes in real-time. This real-time process control accelerates optimization, reduces scrap, and enables manufacturers to achieve SOP of grade A cells ahead of the competition.

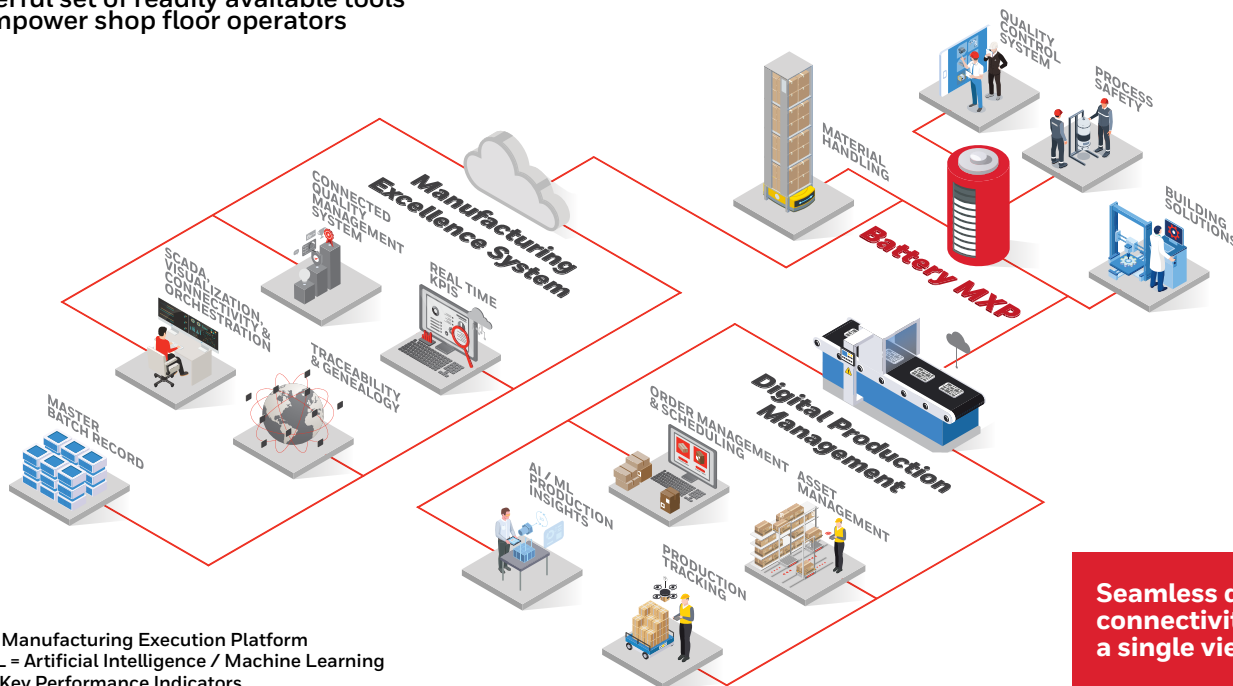


Flexible Architecture

Battery MXP's natively integrated SCADA layer provides real-time operational visibility by providing operators with dynamic process-KPIs for proactive decision making, eliminating the integration overheads associated with third-party SCADA.

ACHIEVE OPERATIONAL EXCELLENCE EXCELLENCE FROM DAY 1 OF SOP

Powerful set of readily available tools
to empower shop floor operators



MXP = Manufacturing Execution Platform
AI / ML = Artificial Intelligence / Machine Learning
KPIs = Key Performance Indicators

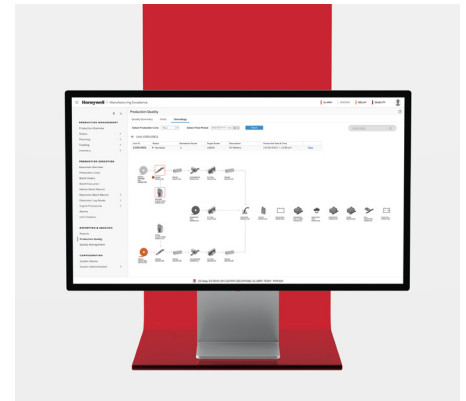
Seamless data
connectivity with
a single view

UNIQUE CAPABILITIES OF BATTERY MXP

KNOW YOUR QUALITY AT EVERY STEP

- Using **Master Batch Records (MBR) and production recipes**, MXP provides granular control over process parameters, sequencing and operating procedure compliance.
- **Quality disposition at every step** identifies compromised work in progress and routes them for rework or quarantine, protecting downstream process from propagation of errors.
- **Early event detection** continuously monitors deviations and alerts operators to anomalies for quality investigation.

Together, these tools stabilize processes and ensure a higher yield of Grade A cells from the very first batch.



REDUCE SCRAP RATE

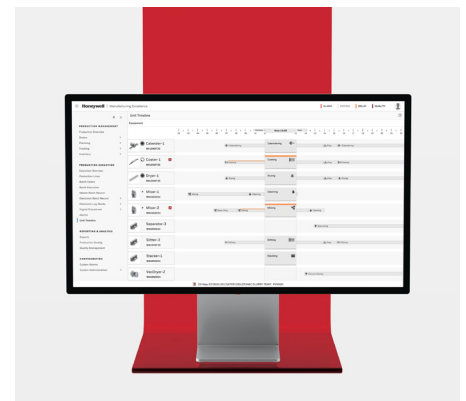
- The root cause of poor cell performance can often be traced back to electrode operations. Integrating Honeywell's 25+ years of experience electrode quality control area, MXP integrates online QMS, SCADA and QCS to create a **closed-loop control** environment.
- With full **traceability and inline quality checks**, scrap can be reduced at each process – especially during ramp-up, where up to 60% reduction is achievable.
- **Comprehensive Visibility** enables early identification of issues and immediate containment actions.

By embedding quality into every step of production, MXP minimizes waste and maximizes material efficiency



INCREASE SPEED TO SCALE

- **Single pane of glass production monitoring:** The open HTML5 platform offers tailored dashboards for each role, eliminating the need for multiple applications and windows, and maximizing impact for operations managers and operators.
- **Start the MXP journey with Pilot operations:** With built-in analytics and exception handling, it reduces startup calibration time and allows faster line commissioning – accelerating time to stable production, yield of Grade A cells from the very first batch.
- **Real-time Monitoring:** MXP transforms data into actionable insights by integrating data sources such as gigafactory assets, processes, and enterprise applications.



A FUTURE-PROOF PLATFORM FOR YOUR GIGAFACTORY

Honeywell's Battery MXP is future-proof. Battery MXP is built to scale with the future, backed by decades of global industrial expertise, continuous software evolution and long-term support. It doesn't just help you launch – it helps you lead.

UNIFIED ANALYTICS AND ROOT-CAUSE INSIGHTS:

Through AI/ML-powered insights, Battery MXP supports operators with contextual guidance – identifying patterns, reducing investigation time, and accelerating corrective actions.

COMPLIANCE BY DESIGN:

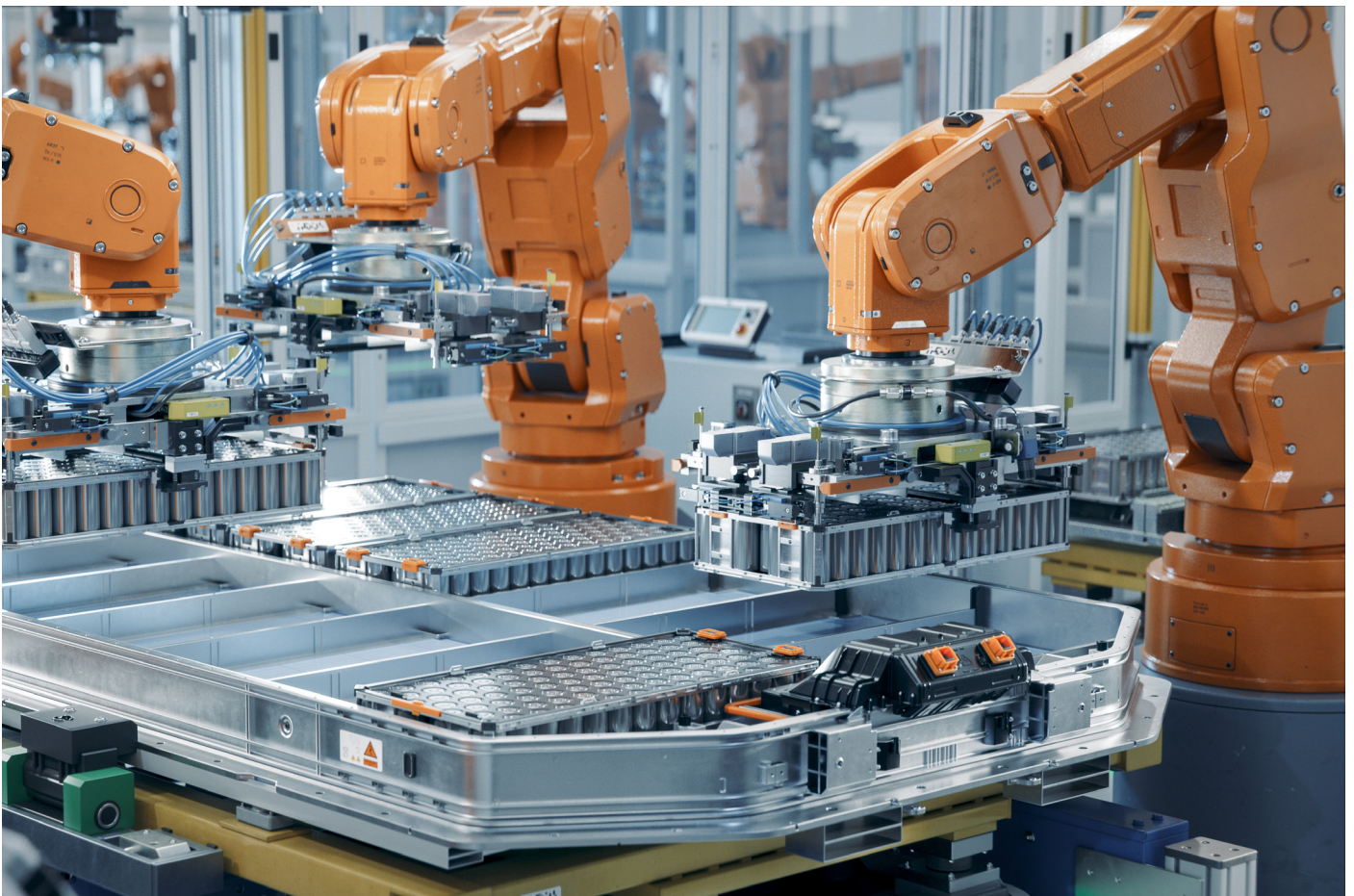
End-to-end traceability and genealogy support upcoming regulations like the battery passport, embedding quality standards and ensuring document management and training tracking to reduce human error risks and simplify preparations for ISO and IATF audits.

AI DRIVE OPTIMIZATION:

Battery MXP uses AI to build relationships between hundreds of thousands of data points and to recommend process adjustments, proactive maintenance and learning the plant's optimal operating envelope.

CONTINUOUS IMPROVEMENT AND COLLABORATION:

The MXP platform's seamless integration fosters data-driven collaboration with one source of data, making it the ideal backbone for future continuous improvement initiatives.



THE HONEYWELL ADVANTAGE



25+ Years of Lithium-Ion Battery Expertise

Honeywell brings decades of experience working with every major global battery manufacturer – driving continuous innovation and trusted customer outcomes.



Global Presence, Local Expertise

With engineering, manufacturing, and customer service hubs across North America, Europe, and Asia-Pacific, Honeywell ensures localized support wherever needed.



Seamless Project Delivery

From design to deployment, Honeywell's proven project execution methodology ensures rapid time-to-value.

HONEYWELL SUPPORT LOCATION

Local presence is key to support our customers.



For more information

<https://process.honeywell.com/us/en/industries/sheet-manufacturing/lithium-ion-batteries>

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IS
WHAT
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