

Smart Manufacturing Case Study:

MES Implementation for Next-Gen Fuel Cell Manufacturing for Carbon Capture

BACKGROUND:

Our client wanted to build something bold: a next-generation fuel cell manufacturing operation to massively scale carbon capture capabilities – from scratch. But how do you do that for a technology that demands micron-level precision across 14+ subprocesses? With a lack of MES infrastructure and a high-mix fuel cell production, the challenge was steep.

They needed an integrated smart manufacturing solution engineered for precision, speed and adaptability – and the right partner to help them achieve it. With our experience in digital manufacturing and MES, we became an extension of their team.



OBJECTIVES:

This project began when the client, familiar with our work, approached us for feedback on and facilitation with a fuel cell assembly problem that had hit a wall. After exploratory conversations about their goals, timelines, constraints, and preferred stack, we joined the core project team as subject matter experts and OT support.

With their aims and preferences in mind, we began with project definition – kicking off by aligning on a clear goal: enabling high-mix fuel cell production with <0.5% defect rates. We knew that key challenges would include managing batch-based upstream processes with downstream automated stacking requiring 0.1mm alignment accuracy.

Then we structured the project into five technical focus areas, laying the groundwork for full smart factory implementation:

1. Foundational Documentation
2. MES Vendor Selection
3. Conflict Resolution
4. MES System Design
5. Stakeholder Alignment

Our challenge was to architect a digital ecosystem that ensures seamless data flow for a highly precise process, allowing critical quality and process decisions to happen in real time

RESULTS:

Foundational Documentation

We worked side-by-side with their team to map undocumented processes, co-developing digital twin templates and implementing interactive digital SOPs with embedded IoT checks.

MES Vendor Selection

We then guided the selection and stress-testing of an MES vendor that could adapt in real time to adjust operator instructions and integrate complex systems – through real-world anomaly simulations.

Conflict Resolution

To bridge R&D and production priorities (the demand for excessive process variables versus the need for 150% assembly time improvement) we implemented edge computing nodes to help optimize build criteria and create repeatable processes.

However, with the new manufacturing autostacking process still in development, there was still a disconnect in operational MES deliverables. So we developed “plug-and-play” MES-ready automation templates for when final systems were installed.

MES Design

Our collaborative MES design combatted material deviations through operator-assisted assembly with component scanning, vision system verification, and upstream deviation logging. We added real-time quality gates through in-line spectroscopy and adaptive Statistical Process Control limits. Finally, we developed a process synchronization engine to integrate traceability and combine dynamic data caching with batch system communication using a Physical-to-Digital Kanban method.

Stakeholder Alignment

Lastly, we aligned cross-functional teams by resolving latency and analytics conflicts, while a unified failure mode criticality matrix helped balance R&D and production priorities. To strengthen security without slowing operations, we implemented zero-trust architecture. And by bridging IT and OT expectations and preparing the operations team with the right infrastructure, we streamlined onboarding and optimized MES implementation.

IMPACT:

While implementation is ongoing, the project is already delivering transformative value and measurable results, a real-world example of an effective digital factory transformation:

↓ **46%**

Reduction in deviation investigations

↓ **41%**

Reduction in change order conflicts

Clear path to **sub-0.5%** defect rates

CONCLUSION:

This project was so much more than installing software. It was about engineering resilience into every layer of our client's manufacturing operations and helping their team build a system that worked for them. Here's what they had to say.

“Working closely with Live Solutions, we mapped out our processes and defined our MES requirements. Their expertise and thorough evaluations gave us confidence that our chosen system would deliver the traceability and genealogy needed for our complex manufacturing operations.”

From defining production goals and resolving operational tensions, to designing MES-ready automation and aligning IT/OT infrastructure, we helped engineer a system that balances technical complexity with usability, enabling sub-0.5% defect targets.

Our collaborative approach supports our five core pillars of people, processes, design, equipment, and technology to ensure sustainable improvements in productivity, accuracy, and overall operational excellence.