



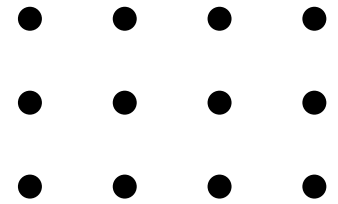
FIRST
RESONANCE

HOW LEGACY TOOLS ARE FAILING INVENTIVE MANUFACTURING ENGINEERS

AND HOW TO FIX IT

FIRST RESONANCE

INVENTIVE ENGINEERS ARE BEING TASKED TO DELIVER TRANSFORMATIVE PRODUCTS USING LEGACY TOOLS BUILT TO OPTIMIZE MASS PRODUCTION.



Despite the critical need for physical world innovation, manufacturers only have a legacy toolset built to scale up product processes from decades ago. Yet, manufacturing visionaries recognize that innovation is the new currency.

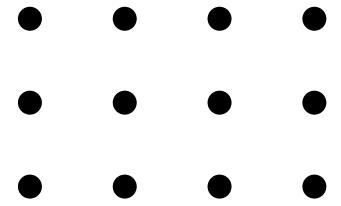
Innovating on new types of products takes more than just good ideas. It requires an innovative approach and set of tools to build in a new way. Only then can the industry accelerate ground-breaking innovation.

Engineers tasked with delivering these hardware innovations deserve better. Cumbersome barriers are preventing radical advancement at a time when information should move freely and flexibly. To improve hardware quality and delivery, factories must automate to collaborate; use the power of data to predict problems; and provide real-time insights on the factory floor.

Hardware manufacturing is the bedrock of our society; at its core, it is a technology-based industry that requires agility to meet market demands.



A HISTORIC LOOK BACK



Wealthy families dominated manufacturing during the industrial revolution in the most prominent industries, such as steel and oil refining. These moguls were pushed aside by new factory plants that produced automobiles, farm machinery, electrical equipment, textiles, and more.

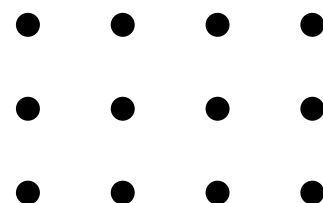
By the turn of the century, advanced machines and technology dominated factories. Factory equipment was explicitly designed to simplify mass production so ownership could employ a cheaper, unskilled workforce. This optimized profits by increasing productivity and lowering labor costs with fewer product varieties. Management made decisions from a centralized location far away from the large factory complex floors where tens of thousands of workers toiled.

Quality control replaced hardware invention, and as a result, we built more things more reliably. The “innovations” in hardware manufacturing became quality and process control.

In the information age, computers and mass production became far more intricate. To increase productivity, managers focused on planning and scheduling. As a result, the plant became a carefully managed flow of parts, materials, and employees.

Instead of evolving as we entered the digital age, manufacturing chose to stay focused on efficiency. Digital tools like MES continue to squeeze additional efficiency out of the factory.

But efficiency doesn't equal innovation. And MES doesn't support the needs of innovative engineers and their visionary employers. If we want society to create new solutions to solve today's challenges, it's time to transform the factory workflows to support those innovative efforts.



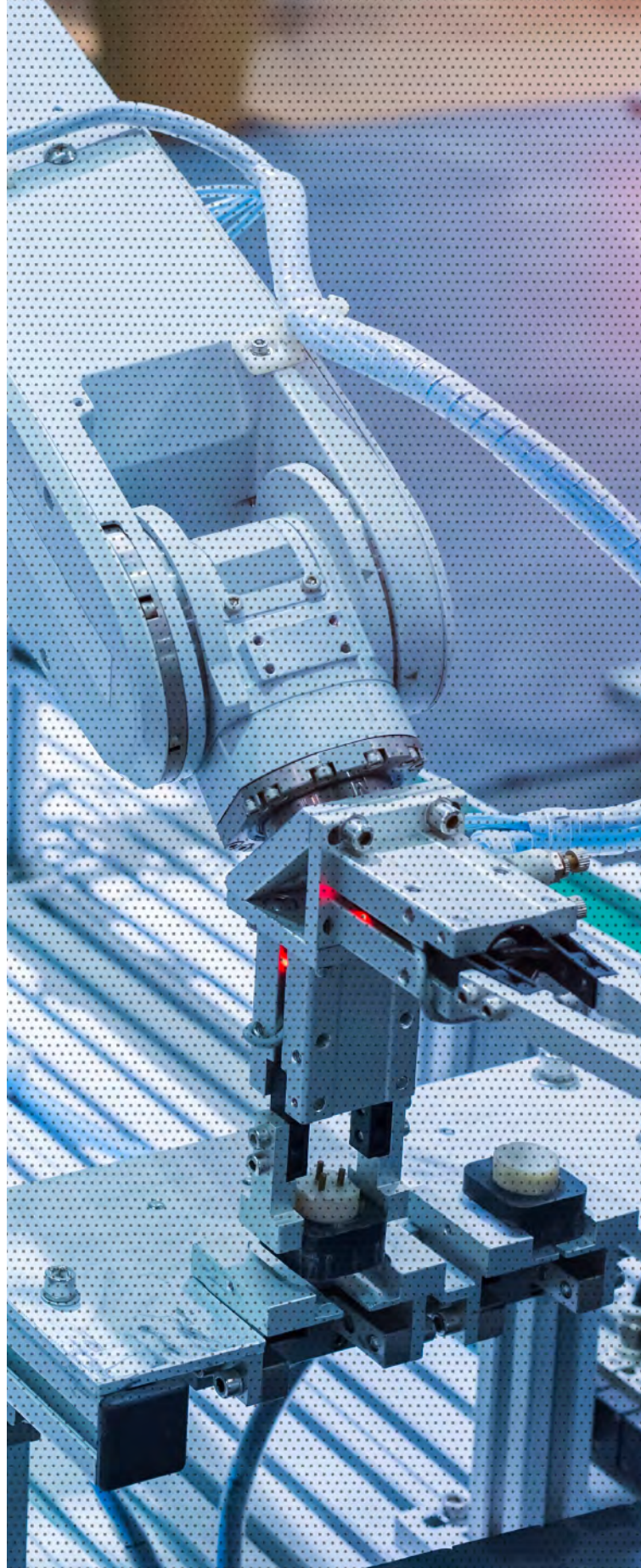
WHO IS SUPPORTING THE INNOVATORS?

Visionary entrepreneurs, startups, and new product lines at incumbent hardware companies are transforming hardware development. They work from a different blueprint. They dream of what's achievable without constraints. They see a future powered by autonomous vehicles, robots to manage mundane and dangerous tasks, new types of vehicles to explore our planet and the universe, sustainable forms of energy, and more.

Their foresight relies on innovative engineers to bring their ideas to life by making their designs feasible in the physical world. Talented manufacturing engineers recognize that iterating through testing, failing, and testing again is the best way to find a viable solution.

The prototype MVP is only the beginning.

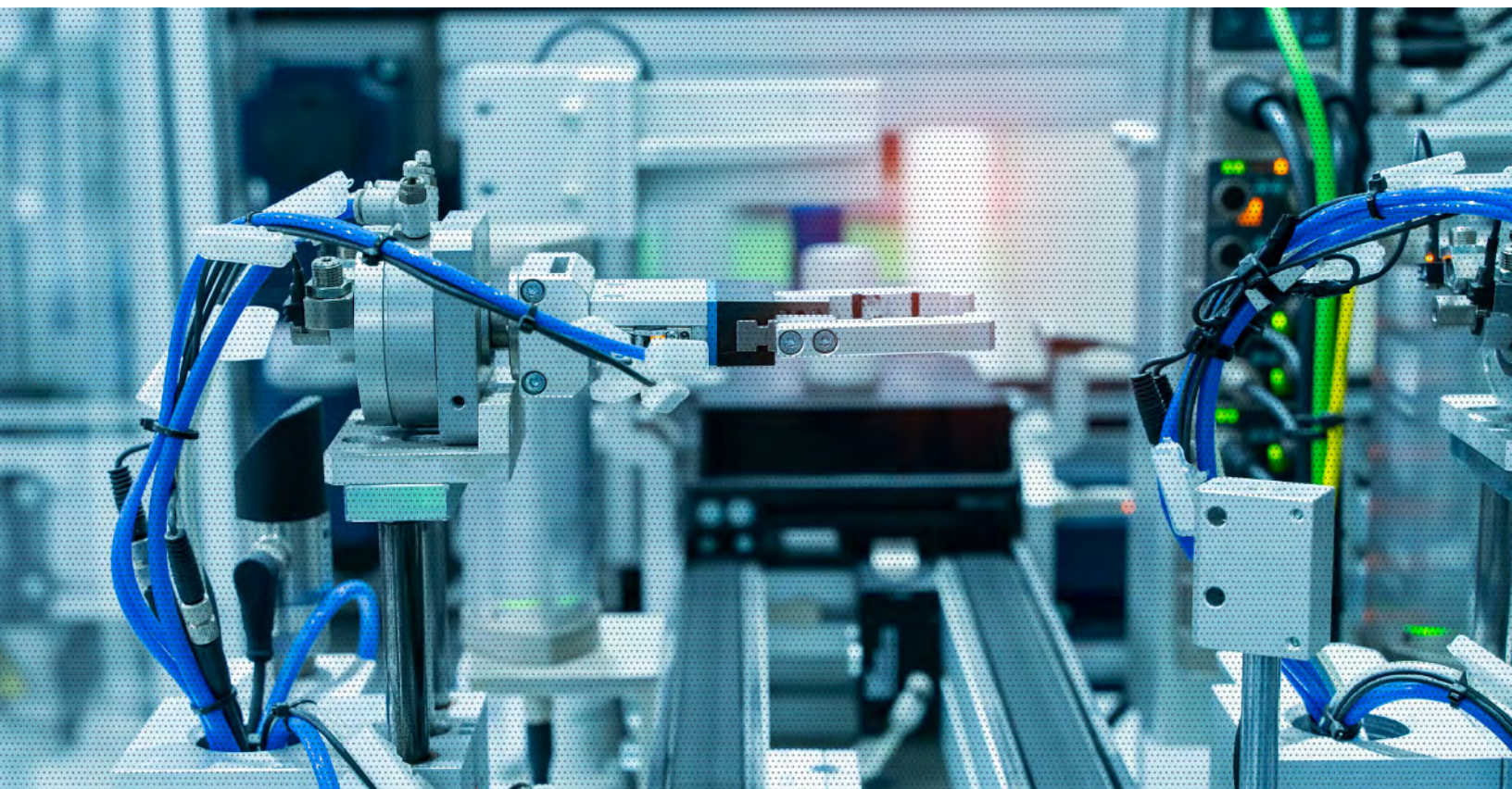
Engineers work against aggressive deadlines. Time—there is not enough of it. Certainly not enough to waste. Therefore, with tasks to produce working models, track components, record test runs, and update workflow processes there is certainly no lack of frustrations around manual processes. If less time to strategize alone doesn't require manufacturers to stay agile, the competitive pressures will force these leaders to innovate.



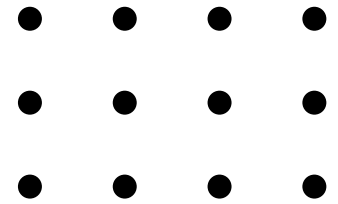
Enterprise resource planning (ERP) software and manufacturing execution systems (MES) being pieced together out of necessity and cost considerations are less-than-ideal. Because they've been designed to meet everyone's needs, they've ended up meeting no one's needs.

Unfortunately, using cut-to-fit systems and manual workarounds — spreadsheets and paper decreases flexibility and negatively impacts the time and productivity required in modern manufacturing.

To support innovation in manufacturing, engineers not only require but also deserve a better solution, a new building method that prioritizes flexibility, free-flowing data, and automation. It's time to transform the factory workflow to support the innovative pursuits of today's game-changers.



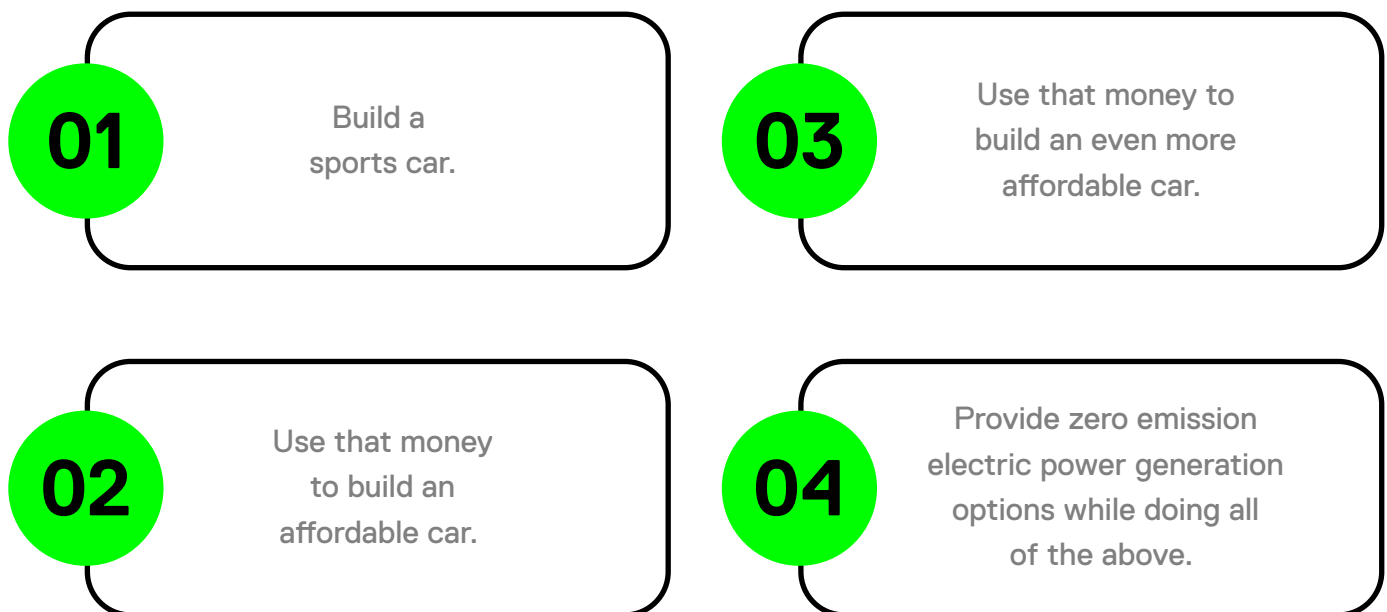
HOW EVS ARE DISRUPTING THE AUTOMOTIVE INDUSTRY.



Legacy automotive manufacturers were skeptical about moving to electric vehicles. In no small part, their hesitation was financial. It stemmed from concerns that the move would require significant investments in pricey Capex factory upgrades they've already made, like robotics and intelligent design along the way.

Even with the catastrophic impact of climate change visible on the horizon, automakers refused to move forward with vehicle electrification. They justified the delay by saying consumers would not be interested in paying the higher price of clean vehicles.

Elon Musk believed it was time and he could find a way to interest consumers in EVs. The masterplan was to¹:



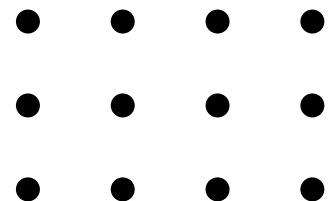
So how did a single automaker impact an industry as old as manufacturing itself? By focusing on the factory is the product – and declaring that the factory would be powered by a modern digital stack. This priority changed the rules of the game.

Early on, Musk realized that the Tesla team required more than their existing tools were capable of. Software companies built solutions for legacy manufacturing models. These solutions were not flexible enough to meet Tesla's unique needs. So, Tesla developed their own manufacturing software from the ground up instead of wasting time and energy attempting to build workarounds. This expensive software development took over a decade. In fact, it is still ongoing. Most companies cannot afford this kind of investment of time or money.



**Traditional tools
failed to meet
the needs
of these
visionaries.**

¹<https://fabric.inc/blog/tesla-strategy/>



MARKET-READY SOLUTIONS ACCELERATING WINNERS

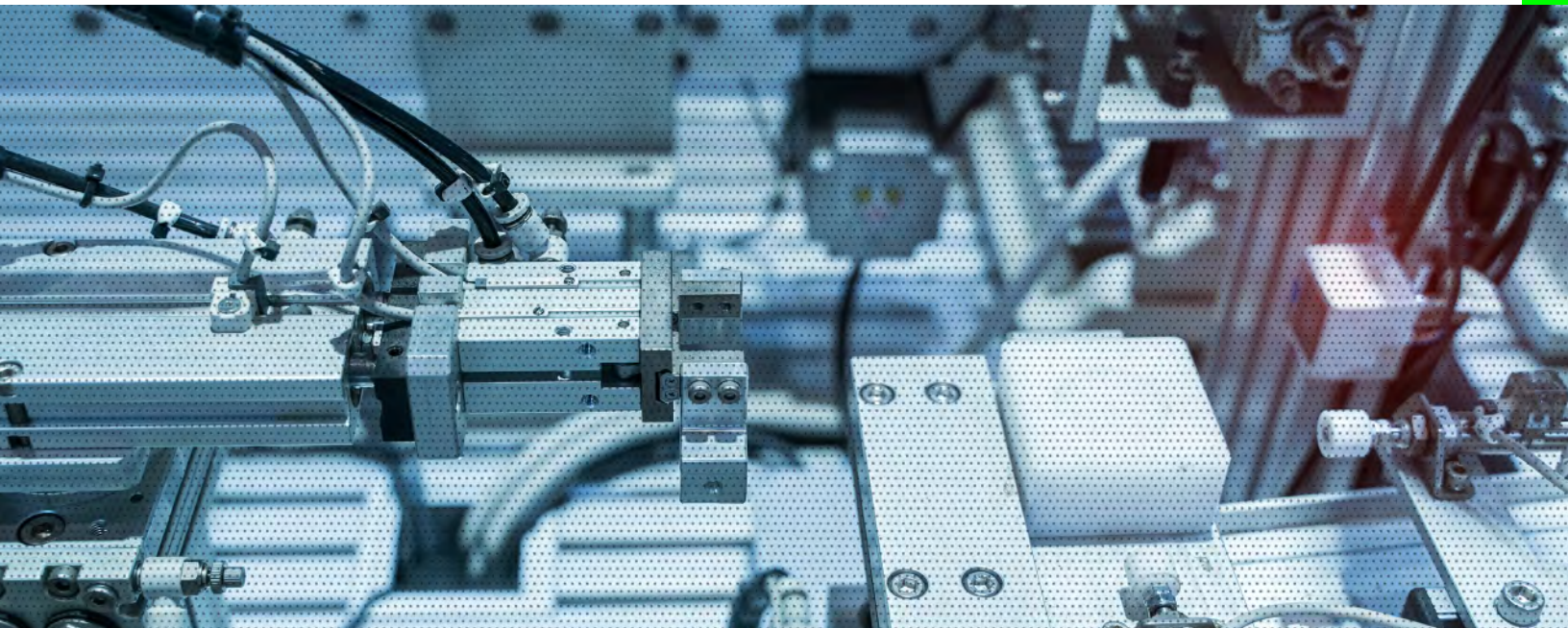
Most organizations cannot afford to wait a decade or spend millions to create their own software like Tesla. And they no longer need to.

Forward-thinking manufacturers are winning the innovation race by relying on market-ready solutions like ION Factory OS to accelerate their product development process.

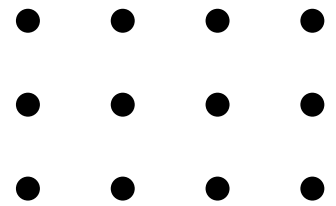
Laggards will continue to fall behind with siloed patchwork solutions as they proceed to standardize and streamline operations, while failing to deliver accelerated innovation.

ION Factory OS

Is the innovative manufacturing software built for innovators.



WHAT INNOVATION LOOKS LIKE WITH AN FACTORY SOLUTION BUILT FOR INNOVATORS



aBOMs for Granular Traceability

AGILE Space Industries is building attitude control thrusters for NASA's Griffin Lander trip to the moon's South Pole in late 2023.

Their thrusters enable missions to complete never-before-done missions with precision, like rendezvous and proximity, and even accommodate never-before-seen thermal environments.

Using additive manufacturing, AGILE space is delivering entire clean sheet designs from concept to first hot fire in under 6 weeks. According to Jeff Max, Chairman, and CEO, AGILE considers its superpower to be its ability to integrate design, manufacturing, and test capabilities tightly so they can design, manufacture, test, analyze and iterate in days, not weeks or months.

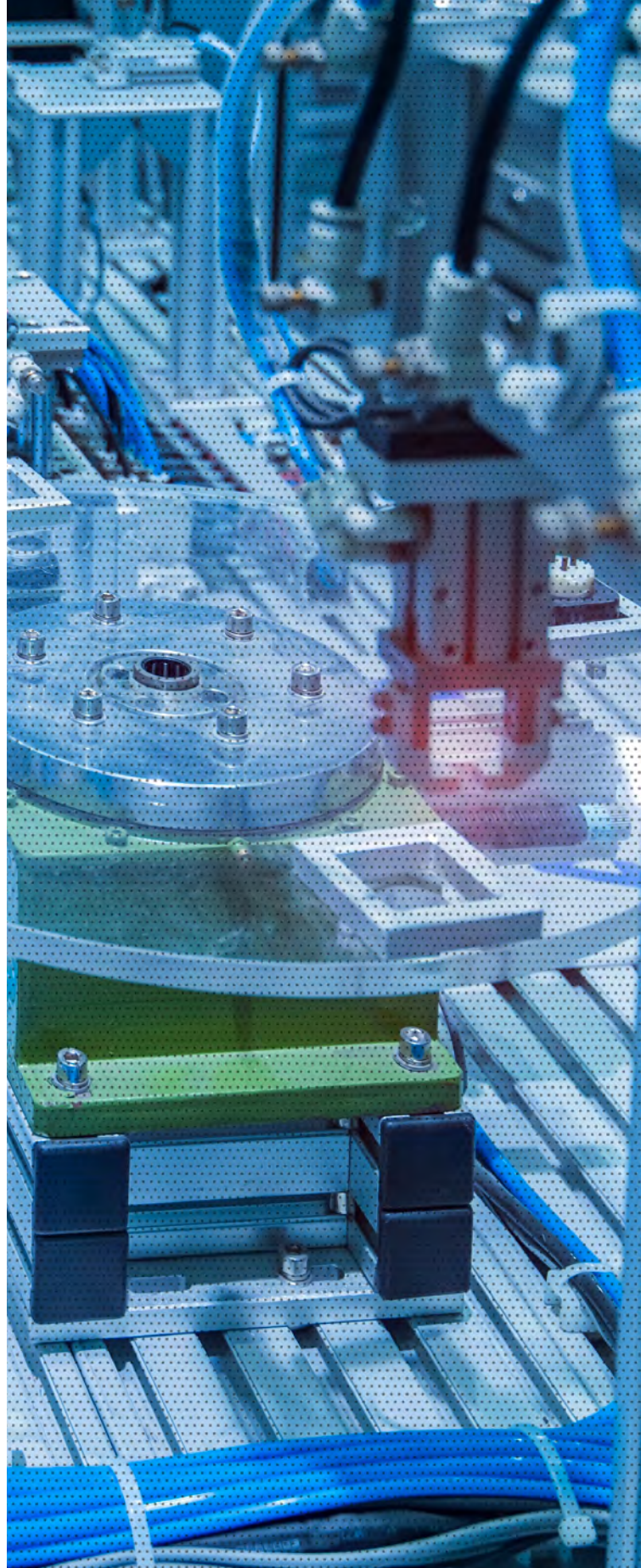
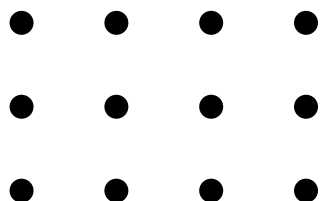


ION supercharged the AGILE team with aBOMs, (as-built bill of materials), which gives granular traceability and access to process and part information down to the serial number, including details on who performed the action and when.

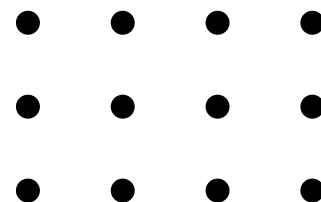
With ION, AGILE tracks everything from powder feedstock for its 3D printers to hot fire test data from its rocket engines. In addition, the way ION collates data saves engineers hours of information gathering and triaging. Plus it makes it easy to grow a team without losing institutional knowledge.

For AGILE, ION's flexibility and interconnection delivers a digital thread throughout the factory, which allows information to flow quickly and seamlessly across all departments providing the traceability they need to resolve issues quickly, find parts, and deliver quality. AGILE shares aBOM information between supply chain, operations, manufacturing, and production.

Accelerating qualifying designs with repeatable, bankable quality and procedures gives AGILE the confidence to convince mission directors that they are the ideal vendor to deliver quality products on time, at a lower competitive cost.



WHAT INNOVATION LOOKS LIKE WITH AN FACTORY SOLUTION BUILT FOR INNOVATORS



DoD-level security compliance and Agility

With a focus on agile, innovative, and lean manufacturing, Epirus rapidly develops and builds smart power applications for the defense and commercial sectors.

ION delivered a solution that Epirus implemented in minutes, given its flexible and speedy cloud-based architecture.

Industrial Engineer Jackson Lisec manually collected time study data in the past to assess manufacturing process improvement. After implementing ION, measurement and instrumentation are built-in, so Jackson now focuses on analyzing the data in real-time and developing solutions to improve Epirus' production output and quality.

Epirus reduced production errors by 30% by improving communication and clarity across the growing team. In addition, by aggregating production, quality, and configuration data into one unified view, ION saves each Epirus engineer precious hours every week by eliminating data search time.

These improvements helped Epirus secure a strategic agreement with Northrop Grumman to build the Leonidas Systems, which use solid-state, software-defined High-Power Microwave (HPM) technology to enable next-generation counter-electronics effects.

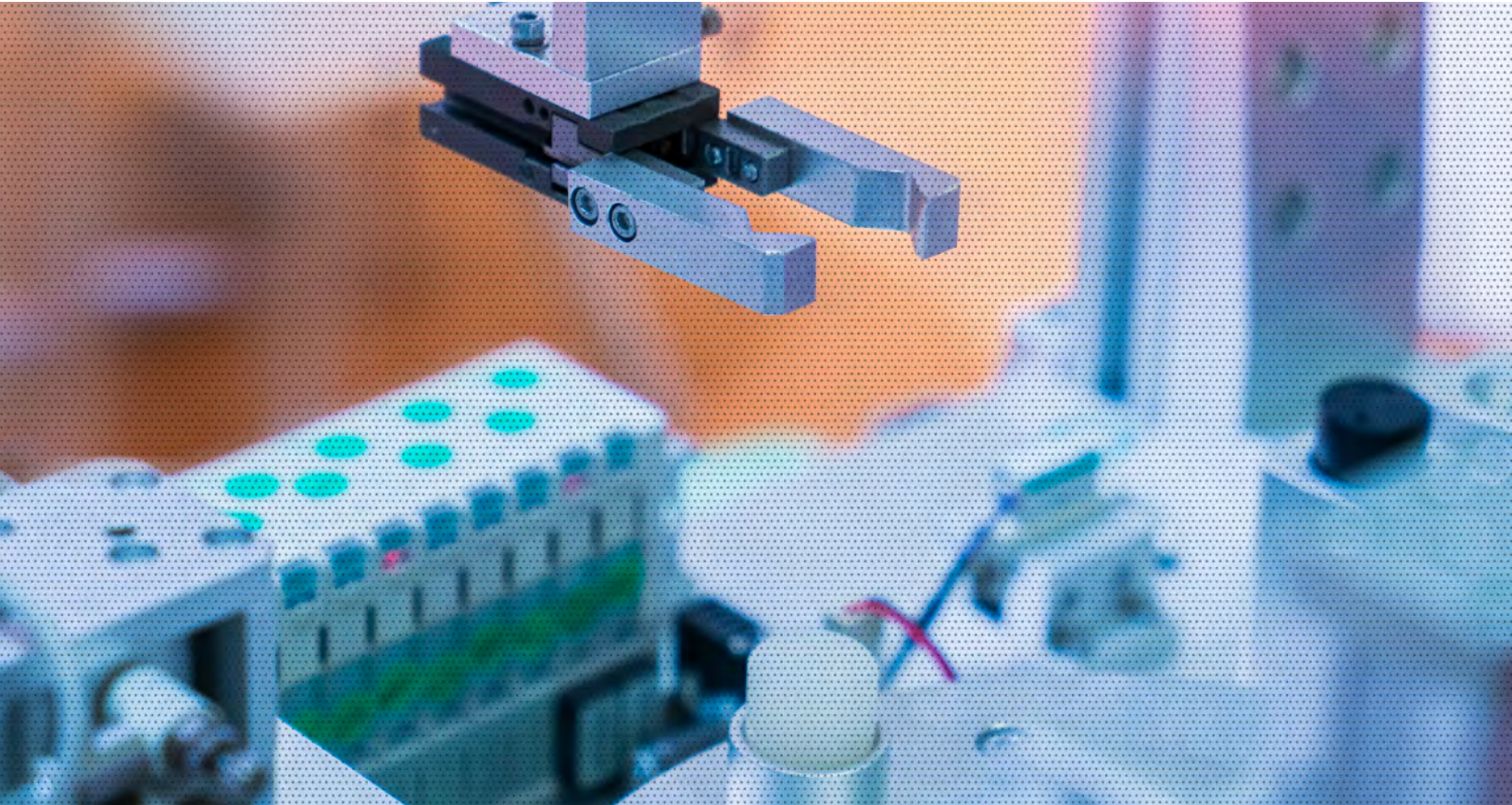
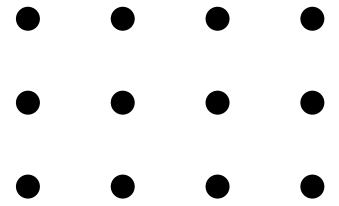
The company recently closed \$200 million in Series C funding at a \$1.35 Billion unicorn valuation.

What do these Manufacturing Innovators have in Common?

They analyze data to gain insights and rethink the manufacturing process. They use technology to connect people, processes, and machines for game-changing successes.

Even with the vision, the means, and talent, these elite manufacturing teams struggled, using piecemeal solutions and legacy systems to track processes manually before finding ION.

THE FUTURE IS NOW.



No longer do talented manufacturers like yourself need to be constrained or frustrated by outmoded legacy systems that don't support how you must work to succeed.

You no longer need to update PDF instruction manuals or use spreadsheets by hand to track runs or iterations.

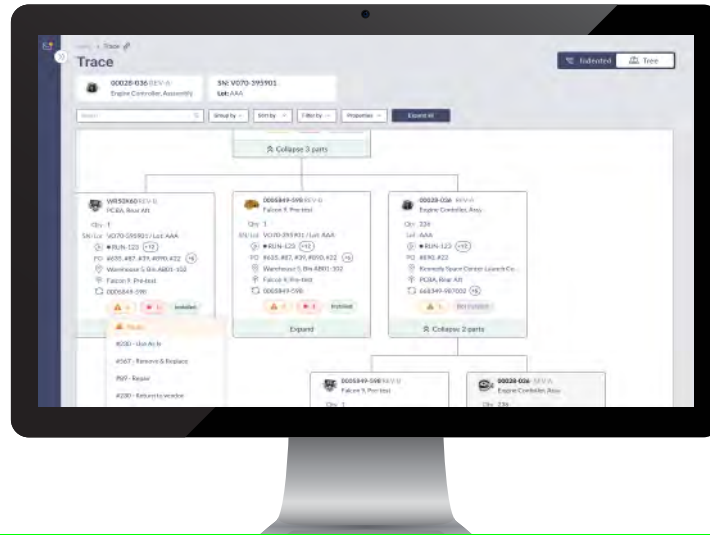
You're building amazing new products for the next generation. You can now rely on tools that better support your work, software purposely designed for data with flexibility, agility, scalability, and speed. Moreover, you can enjoy decentralized operating systems that track design changes and iterations, trace components, and evaluate test runs locally in real-time.

MASS PRODUCTION FACTORY SYSTEMS

- ✓ Rigid, controlled, yet disconnected factory processes and systems
- ✓ Centralized repository of information
- ✓ Massive, costly, time-consuming specific customization, especially for complex operations
- ✓ Parts records end at shipping
- ✓ Systems and process control constrains engineers from innovation

ION FACTORY OS

- ✓ Designed for Data
- ✓ Built for collaboration, not centralization
- ✓ Creates connectivity at the design, test, and production levels so engineers can resume problem-solving and innovation
- ✓ Facilitates interchange that allows decisions to get made upstream in design and downstream at machines
- ✓ Accelerates workflows by removing rigid controls
- ✓ Connectable building blocks with interfaces accessible to developers and machines to extend the system to fit within complex operations
- ✓ Allows for embedded customization and infinite extensibility
- ✓ Maintains record of parts throughout entire product lifecycle
- ✓ Interconnected traceability up and down the process
- ✓ Modular workflows to accelerate execution, information searches, data exploration, and applied learning



ION FACTORY OS

From precise aerospace thrusters to custom-fit bike frames to HPM defense technology, ION is helping innovative engineers today change the world tomorrow by providing them with rapidly deployable software that:

- Creates comprehensive and granular traceability with its unique aBOM structure
- Automatically tracks iterations and updates workflows
- Scales with the factory, de-risking large implementation plans, and allowing flexible operations

Teams can deploy ION Factory OS in days or weeks: say goodbye to the 6-month deployment of buggy customized solutions.

Find out more about what ION can do for you.

ABOUT



**FIRST
RESONANCE**

First Resonance is a technology company that delivers a new standard for modern hardware manufacturing. High-performance teams use our software to accelerate and problem-solve their iterative production processes in progressive industries such as aerospace, automotive, and robotics.