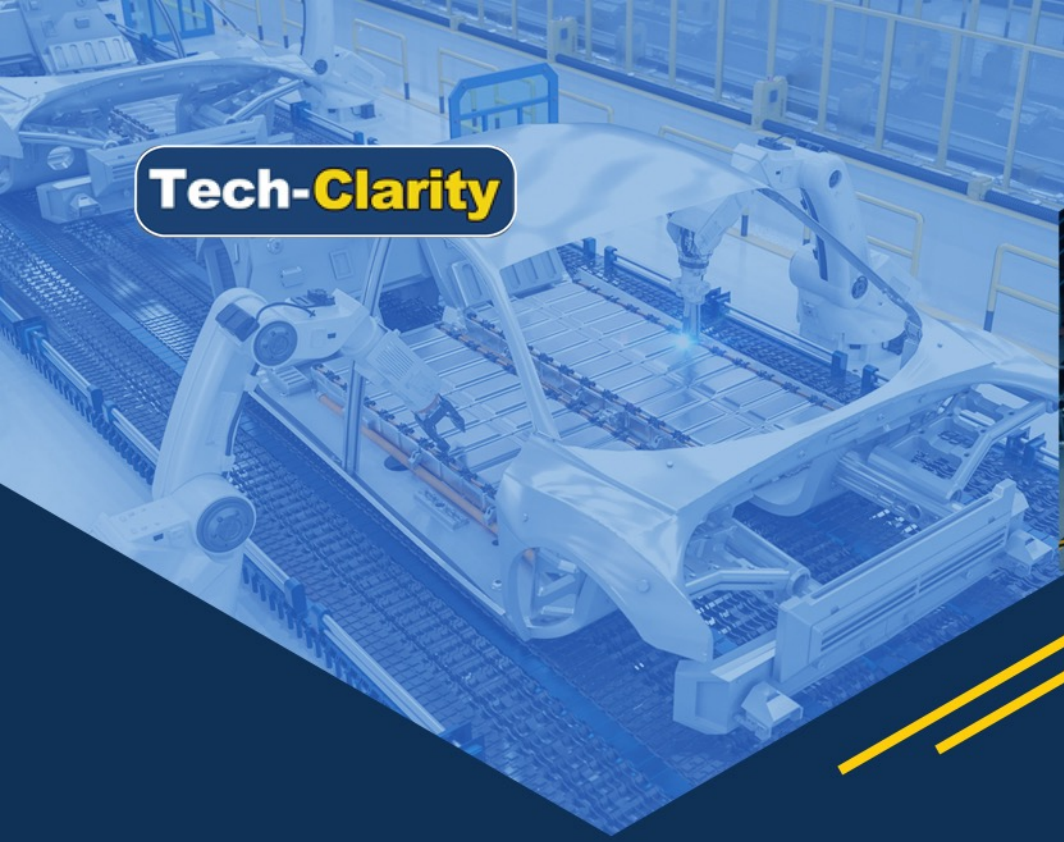

Transforming Manufacturing Planning in the EV Era

Jim Brown, President,
Tech-Clarity

EVs are a Disruptive Force

Electrification is Disrupting the Transportation Industry

Our data shows that risk and disruption increased for about two-thirds of automotive and transportation companies over the last five years, and for roughly one-third, it "significantly" increased.[1] The electric vehicles (EV) transition is causing upheaval and is undoubtedly a big contributor to the problem. The impact is significant on both pure EV manufacturers and traditional internal combustion engine (ICE) driven vehicle producers combatting new entrants. Today's rapid pace of innovation has disrupted the status quo, resulting in the need for speed, innovation, and agility. Leading automotive companies are taking the opportunity to turn disruption to their advantage, creating a chance to innovate and differentiate themselves.

Driving Change through Better Manufacturing Planning

The EV-driven disruption demands digital transformation across the business. One area that can make a strategic difference is manufacturing engineering. Companies need to improve production planning to drive faster, more agile introduction of innovation in EV and ICE programs alike. And they have to do this despite increased complexity and without disrupting quality. Fortunately, the automotive industry is accustomed to change, and best practices already exist. Our research shows that top-performing automotive companies are more likely to leverage proven practices for manufacturing engineering, specifically 3D modeling, simulation, and collaboration.

This eBook explores:

- How can automotive companies leverage digital manufacturing best practices to launch and scale EV programs faster?
- How can they set the stage for greater agility to drive innovation and improvements of all kinds into production?

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The EV Revolution Demands Change

Transformation is Mandatory

The move toward electric vehicles is picking up pace. New entrants paved the way and created a market that demands alternative fuel source transportation. In many cases, these companies have innovated in manufacturing processes in addition to vehicle designs. Some changes have been necessary because of new processes like battery assembly and fundamental powertrain differences. But these companies have also pushed the limits on new materials and new production processes like additive manufacturing and Tesla's Giga Press.

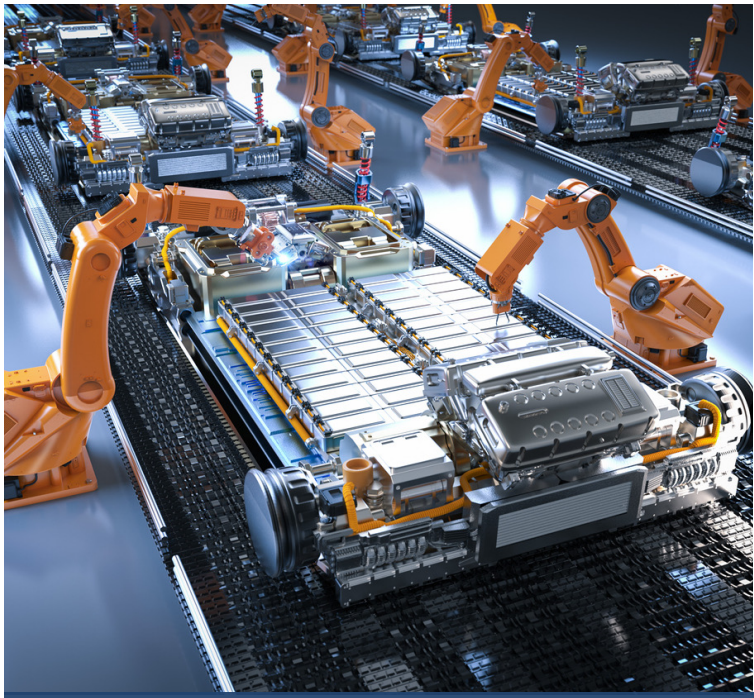
“

This is much more than modular production. It’s eliminating steps that were standard, creating new patterns of working, increasing speed, and reducing complexity.”

Jan-Philipp Büchler[2]
Researcher
Free University of Dortmund

Don’t Forget Lessons Learned

Some manufacturing methods have to be revised, reinvented, or invented in the first place to bring EVs to full-scale production effectively. However, traditional manufacturers have decades of experience and knowhow on effectively planning and launching vehicle programs at scale. Many of the basics still apply, and manufacturers shouldn't discount decades of learning. That knowledge must continue to be captured, reused, and continuously improved. At the same time, new materials and methods from EV programs can be evaluated for ICE production. Of course, it's important to remember that even "traditional" vehicle production needs to transform to accommodate increasingly software- and systems-oriented vehicles, shorter vehicle lifecycles, and greater vehicle personalization.



- Electrification will continue to gather pace over the next few years.
- Many changes are taking place in the manufacture of integral car components, namely batteries.

Source: JP Morgan[3]

Adopt Best Practices in Production Planning

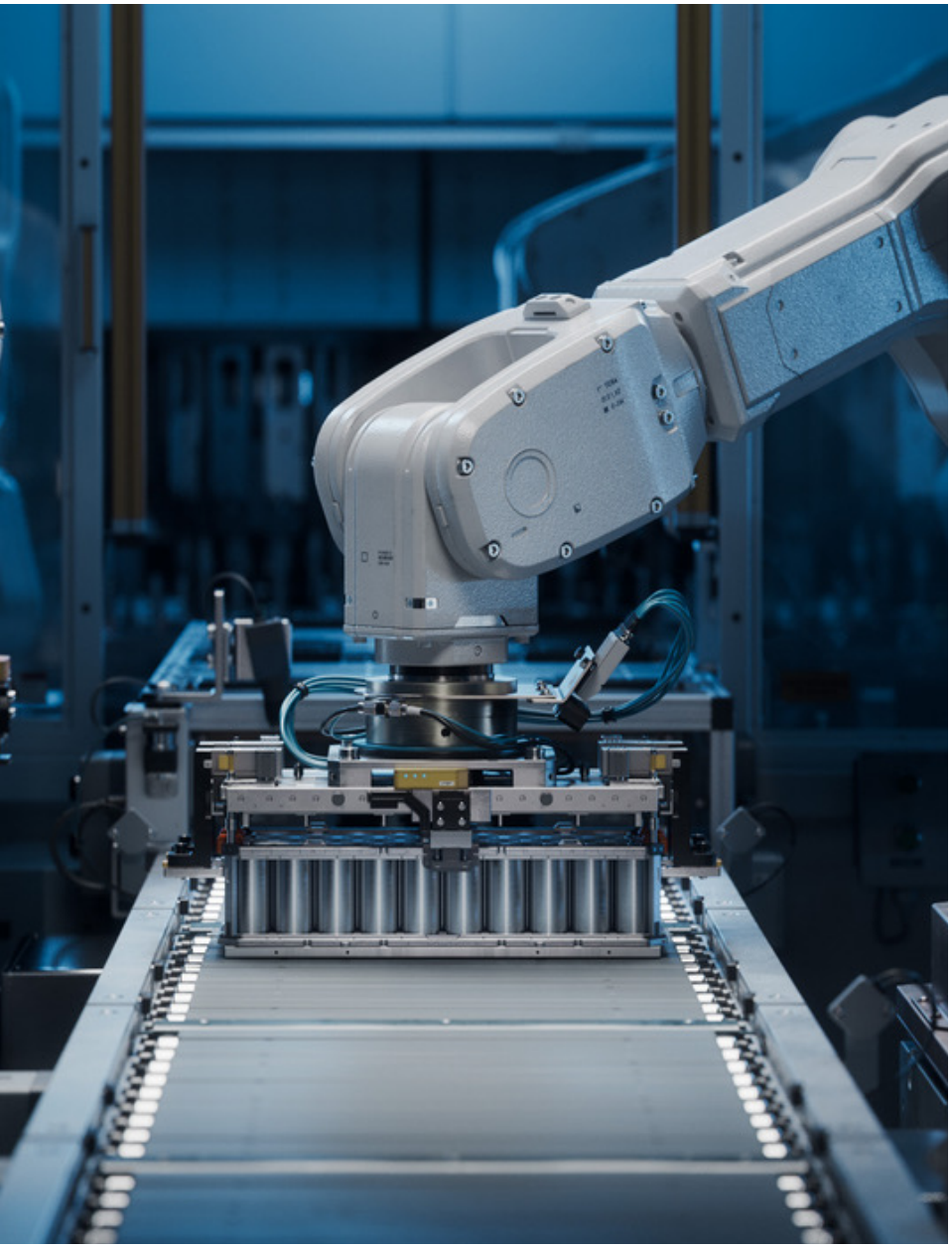
Top Performers are transforming manufacturing engineering through digitalization, better collaboration, 3D, and simulation allowing them to overcome efficiency, quality, and cost challenges.[4]

Top Performers Show the Way

Rapid innovation demands manufacturing planning to be faster and more responsive to quickly achieve high-quality production at scale. Engineering and manufacturing need to work together more closely, designing and validating plant layouts, line designs, material flow, tooling, and other details in parallel with vehicle design. Production planning teams need to learn from best practices in manufacturing engineering as they reuse or reinvent processes.

Our research on digitally transforming manufacturing engineering shows that top performing manufacturers do things differently. These best practices allow them to eliminate non-value-added work, reduce the need for physical prototypes, suffer from fewer engineering changes in production, and get vehicles to market faster. These leaders are transforming manufacturing engineering through digitalization, better collaboration, 3D, and simulation, allowing them to overcome efficiency, quality, and cost challenges.[4] We'll explore how each of these allows EV manufacturers, traditional manufacturers transitioning to EV, and those implementing innovation stemming from EV to drive tangible business benefits through better manufacturing planning.

Digitally Transformation Manufacturing Planning



Streamline Innovation and Enable Collaboration

Let's start with digital transformation and improving collaboration between engineering and manufacturing teams. This isn't a new concept for the automotive industry, but it's becoming more critical because of the significant changes required to produce EVs. It's essential to get everyone working together and share ideas to design products for manufacturability and design manufacturing resources to produce high-quality vehicles at scale.

Digital transformation significantly impacts collaboration because it offers the opportunity to streamline the process. The leaders take a more holistic, integrated approach that bridges the traditional gap between design and manufacturing. Manufacturers can't afford to work on different data and models across departments and shouldn't collaborate with spreadsheets and emails. A platform approach to digital manufacturing allows manufacturing engineers to leverage plant, vehicle, and production models in context to make better decisions on processes and equipment. This allows rapid iteration and validation of design concepts and their impact on manufacturability.

Collaborate with a Holistic Digital Thread

Designing a manufacturable product is critical, but collaboration and the digital thread can't stop with a design. An integrated, collaborative approach allows the factory to program and test robots and automated equipment offline in a virtual environment. They can test ideas or corrections in a digital environment and then rapidly deploy them through virtual commissioning. Further, in production, MES and IoT feedback can fuel lean processes with contextual data to identify trends and find root causes, and create the basis to apply AI for continuous improvement.

Increase use of 3D Modeling

Innovate with Confidence

Let's move to the next proven best practice, 3D modeling. Again, 3D design is not new to the automotive industry. However, extending the use of 3D modeling beyond design and into manufacturing planning can help engineers define and validate new processes and equipment required to implement EV manufacturing or related innovation. It's essential to model and optimize new processes or changes in a virtual environment before committing orders to suppliers or making physical changes in the plant.

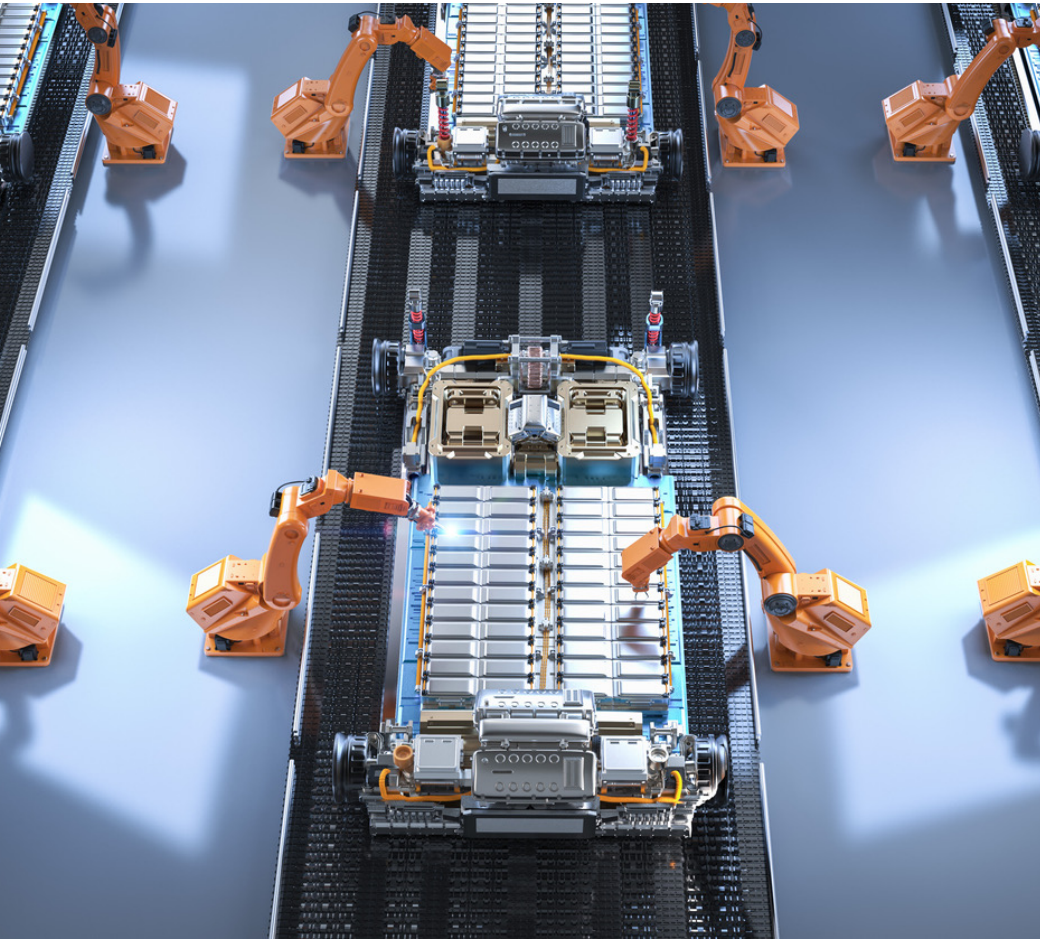
Digital transformation leveraging holistic 3D modeling allows manufacturing engineers to create visual representations that eliminate, and go beyond, physical prototypes. There is no longer time or money available to learn from repeated physical prototyping. Instead, engineers can leverage virtual, digital twins as the basis for collaboration to identify errors such as clashes or missing steps and visually develop build sequences.

Realistic modeling also allows process planners to get better feedback and buy-in from the plant through greater collaboration. Finally, a common modeling approach creates the basis for simulation, which we'll discuss later, and encourages reuse of proven manufacturing approaches.

Apply Modeling Across the Lifecycle

Modeling in a common environment helps early in design, but the value doesn't end there. The digital vehicle twin can also be used to design and validate the digital twin of production. It allows engineers to optimize production line placement in the plant using a BIM model or scanned plant data to avoid expensive mistakes like a line clash with a structural element that can't be moved. Vehicle and production models can also be used downstream for visual training and operator instructions and training, potentially leveraging augmented reality (AR).

Simulate, Validate, and Optimize Production



Top Performers are more likely to use 3D and/or simulation to validate manufacturing operations across a wide variety of manufacturing engineering process steps.[4]

Get it Right the First Time

Let's discuss the final best practice identified by our research, simulation. Like the others, this is not a new concept to the automotive industry, but it has typically been used more in design and as point solutions in production. Simulation leverages 3D models but can also leverage 2D, 1D, and mathematical / AI modeling techniques. Simulation helps designers go beyond visualization to virtually experience, iterate, optimize, and validate production processes.

Digital transformation sets the stage for more holistic, integrated manufacturing process simulation and emulation. It allows early validation of simple mechanical models all the way to optimizing systems of systems. Simulation is critical because manufacturing no longer has time to "dial in" or fine-tune production processes in a live environment or shut down production for test runs. They have to be able to find errors and be free to try new things, iterate, and fail in a safe, virtual environment that doesn't disrupt plant productivity or put expensive equipment at risk.

Gain Simulation Value Across the Lifecycle

Manufacturing simulation has come a long way from point solutions. Digital transformation encourages model reuse and integration across processes from plant layout to material flow, assembly sequences, line balancing, workcell detailing, operator ergonomics, and tooling design. Leveraging common data and more accessible applications lowers the barriers to widespread use in manufacturing. As with the other best practices, the value continues into the plant to program and validate equipment by emulating machine controls, testing work processes, and even validating with hardware or software in the loop to streamline virtual commissioning.

Conclusions and Next Steps

Adopt Digital Transformation and Best Practices

Vehicle electrification and related innovations drive risk and disruption in the transportation industry and significantly impact manufacturing planning. Automotive manufacturers, whether producing EVs or ICE vehicles, are facing dramatic change. It's time to digitally transform manufacturing engineering and adopt proven production planning processes, which our research shows are collaboration, 3D modeling, and simulation in the plant. The value is available for those that are willing to change.

Target the Right Benefits

Identifying the value that will help move the needle for your company is essential. For most automotive companies, speed to market is the key to business success. For others, it may be scaling production or improving quality. With the right benefits in mind, digital transformation can help companies achieve the following benefits, among others:

- Faster to market
- Faster to scale to full production
- Higher quality
- Less expensive, late changes like tooling changes
- Fewer change orders
- Reduced need for physical prototypes

Create a Foundation for Future Benefits

Beyond short-term shifts, the automotive industry will continue to transform with autonomous vehicles, more personalization, and additional innovations that will impact manufacturing. Manufacturing engineering must be efficient, fast, innovative, and agile so they can confidently react and respond to new ideas and unexpected demands. Manufacturers that can rapidly model, simulate, and collaborate to adapt their manufacturing processes and equipment will have a competitive advantage over slower, more static manufacturers. The path is not new, the value is proven, and it's time to get started.

Validating manufacturing processes with 3D and virtual simulation technologies allows companies to eliminate **40%** of their physical prototypes, saving time and money. They can also reduce time to market by over **one-third**, launching products faster to increase revenue and sales margins. In addition, they can minimize engineering change orders by **42%**, saving time, money, and the potential for disruption and quality issues.[4]

Acknowledgments

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About the Author

Jim Brown founded Tech-Clarity in 2002 and has over 30 years of experience in the manufacturing and software industries. Jim is an experienced researcher, author, and speaker and enjoys engaging with people with a passion to improve business performance through digital enterprise strategies and supporting software technology.

Jim is actively researching the impact of digital transformation and technology convergence in the manufacturing industries.

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Tech-Clarity is an independent research firm dedicated to making the business value of technology clear. We analyze how companies improve innovation, product development, design, engineering, manufacturing, and service performance through the use of digital transformation, best practices, software technology, industrial automation, and IT services.

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