

CAD across Manufacturing Operation

Improve Speed, Cost, and Quality
with 3D Communication

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Vice President



Unlocking Manufacturing Operations Support Productivity with CAD

How Expanding 3D CAD Can Remove Bottlenecks

How much time could you save with improved communication during manufacturing planning?

Operations support staff face many challenges that hinder their progress. Some find that more accessible CAD can help. By enabling manufacturing planners, quality engineers, and shop floor technicians to directly interact with 3D models, they can improve efficiency, streamline communication, and capture workflow improvements that deliver significant gains.

About the Research

This research examines the unique challenges that manufacturing operations support staff face when working with traditional CAD and highlights the potential benefits that accessible CAD solutions can offer. The findings include perspectives from practitioners to provide a balanced and practical view of how accessible CAD can improve manufacturing outcomes.





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Executive Summary

Growing Competition

Manufacturers face increasing pressure to compete on speed, cost, and quality. Time to market affects market share, while cost and quality impact profitability and reputation. Achieving all three simultaneously is challenging, yet crucial to success amid today's global competition.

Communication Barriers

In this environment, accelerating manufacturing planning can be a critical business advantage. However, ineffective communication introduces operational bottlenecks, especially when support staff depend on inefficient methods to share information.

Impact of 3D Communication

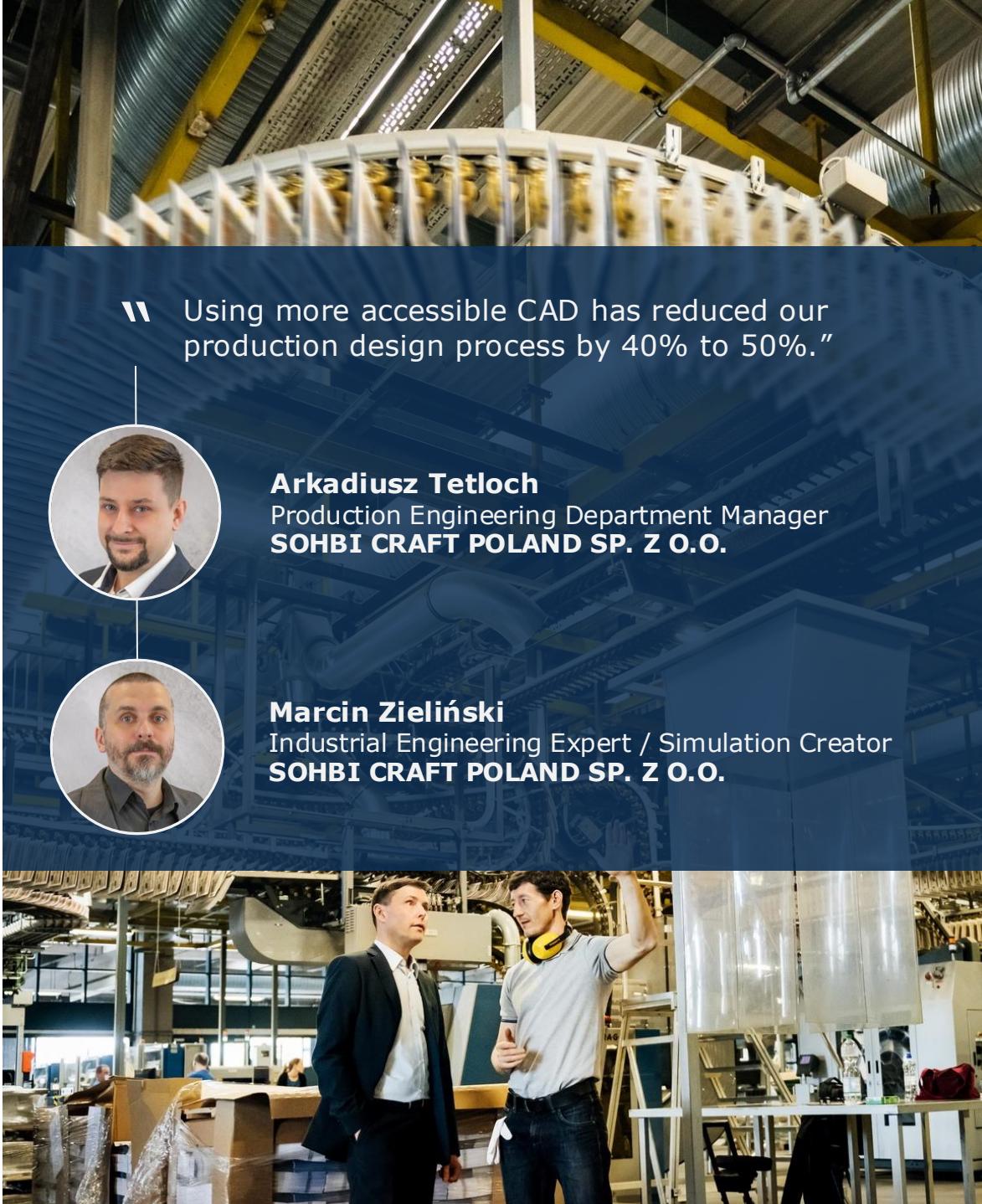
This report explores how accessible 3D CAD can help operations support staff communicate more effectively, resulting in:

- Faster validation and optimization of production line layouts
- Accelerated tooling, jigs, and fixture design

- Increased opportunities for continuous improvement
- More efficient production readiness reviews
- Improved business agility

Create a Competitive Advantage

Today, competition is so fierce that every step during the product development lifecycle can impact competitiveness. Success depends not only on how companies design products, but also on how efficiently they transfer those designs to production. When broader teams communicate and collaborate in 3D, they can shorten development cycles, improve quality, and cut costs, keeping manufacturers agile in today's volatile market.



“Using more accessible CAD has reduced our production design process by 40% to 50%.”

Arkadiusz Tetloch

Production Engineering Department Manager
SOHBI CRAFT POLAND SP. Z O.O.

Marcin Zieliński

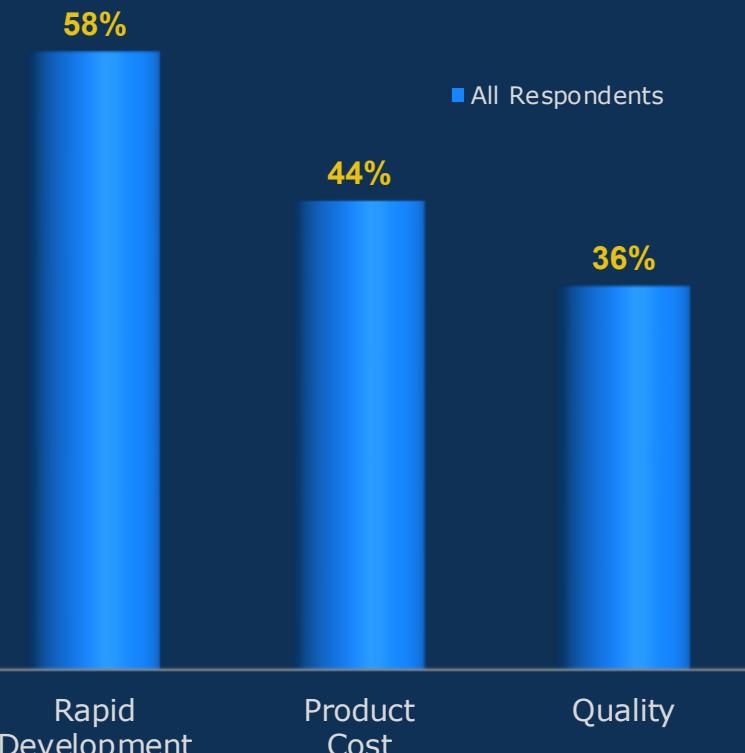
Industrial Engineering Expert / Simulation Creator
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Business Pressures on Manufacturing

Improving Competitiveness

To stand out in today's competitive landscape, which includes traditional rivals, new market entrants, offshore competitors, and vertically integrated firms,¹ decision-makers must focus on speed, cost, and quality as core drivers of product success and profitability (see graph below).²

MOST IMPORTANT PRODUCT DEVELOPMENT SUCCESS AND PROFITABILITY SUCCESS DRIVERS



Time to Market

First to market offers a decisive advantage. Companies that launch earlier can capture market share, establish visibility, and set the competitive standard. Faster release cycles also extend the window for recouping development investments and optimizing profitability before the product is superseded by a competitive offering or its next iteration. Delays shrink this window and increase financial risk.

Managing Cost

Cost control is equally critical. As products become more complex and materials and labor costs fluctuate, companies must manage production expenses to sustain margins. Efficient processes while effectively using resources help companies compete on price without eroding profitability.

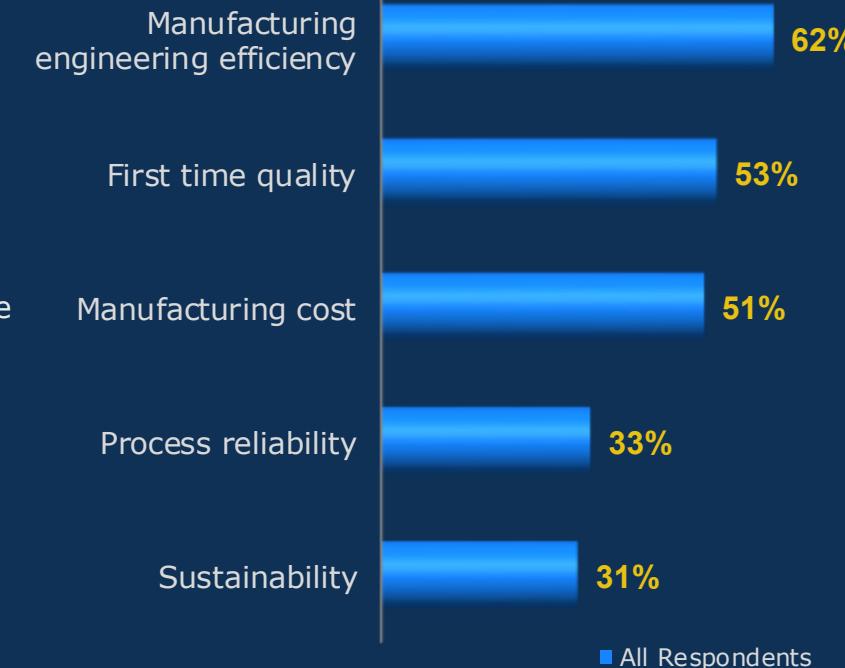
Quality

Quality strengthens brand reputation and builds customer loyalty. In competitive markets, it can be a differentiator that justifies premium pricing and protects long-term profitability.

Operations Support Staff

Simultaneously meeting speed, cost, and quality goals is challenging, as each must be optimized without compromising the others. Operations support staff directly influence these objectives (see graph on right).³ Yet, as products and systems grow more complex, planning becomes more demanding. Teams must coordinate across disciplines and locations, and even minor

MANUFACTURING PLANNING ASPECTS THAT MOST IMPACT PRODUCT SUCCESS AND PROFITABILITY



misunderstandings can cause costly delays or rework.

Given their influence on product success, companies should empower these teams to work as efficiently as possible while supporting cost and quality goals. To do this, let's examine the process challenges operations support staff should overcome.

Poor Communication Undermines Goals

Process Challenges

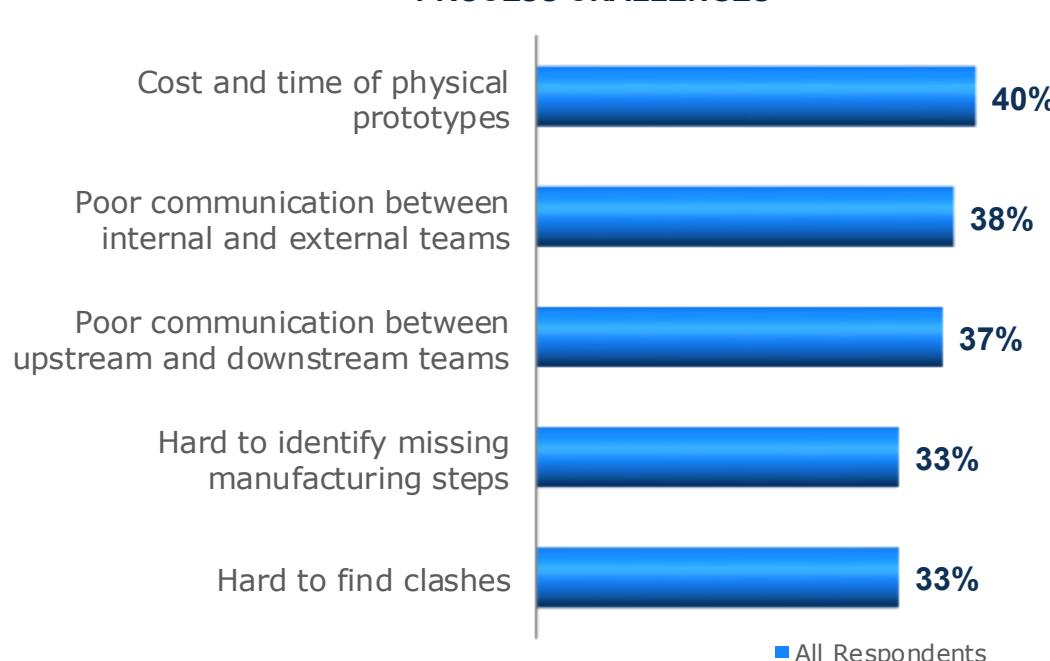
While operations support staff directly impact product success, they encounter persistent process challenges that hinder their effectiveness (see graph).⁴

Prototypes

A common issue involves the time and cost of physical prototypes. Prototyping remains essential for

verification; however, when teams rely heavily on physical builds, the process becomes both expensive and time-consuming. Each physical prototype adds cost and inefficiencies that affect time to market and profit margins. Teams that use virtual environments more extensively can reduce iterations, save time, and lower costs.

PROCESS CHALLENGES



Poor Communication

The data also shows that poor communication within internal and external teams, as well as between upstream and downstream groups, creates challenges. These problems result in delays, misunderstandings, and costly rework.

These communication barriers are often at the root of downstream inefficiencies. Many companies struggle to identify missing steps during the planning phase or to detect clashes in layouts and fixtures before production begins. Catching those issues late, especially after they reach the shop floor, can lead to schedule disruptions, waste, and unnecessary cost.

Together, these challenges demonstrate the need for more effective ways to communicate and visualize design information. The following section examines the role 3D CAD plays in addressing these issues.



"The biggest challenge our accessible CAD solved for us is definitely communication. Anytime that I can put something visually in front of someone, it can remove days of miscommunication and going back and forth trying to explain and resolve issues."



Josh Schober
Engineering Lab Technician
WURTEC



"From my side, the difficulty is with the limited process design time. We cannot take more time. We have to get everything done within the time they give us."

Senior Engineer
AUTOMOTIVE COMPANY

The Role of CAD in Manufacturing Planning

3D CAD

CAD is a critical tool for modern engineering. It allows engineers to create precise digital models that document design intent. For most, 3D models offer significant advantages over 2D. 3D models make it easier to visualize parts and assemblies from any angle, helping users quickly identify design issues and understand spatial relationships, without the specialized training required to interpret 2D drawings. Additionally, 3D models support better collaboration by providing a shared view for teams to discuss changes. These capabilities make 3D models an effective foundation for downstream processes such as manufacturing planning.

Manufacturing Planning

In manufacturing planning, CAD supports a wide range of activities. Teams use it to design jigs, fixtures, and tooling, plan production lines, verify clearances, and optimize workflow layouts. By assessing various production scenarios, teams can identify bottlenecks, test ergonomics, verify safety requirements, and validate feasibility before investing in costly prototypes. CAD also aligns upstream product design and downstream manufacturing, which improves quality and reduces waste.

CAD Challenges

Although CAD's value is clear, its full potential can be constrained by accessibility. Traditional CAD systems are optimized for professional design engineers who use them daily. CAD's complexity, training requirements, and licensing models can make it less practical for those who use it less frequently, such as operations support staff, including production planners, quality engineers, and manufacturing engineers. Instead, these essential stakeholders often find themselves relying on design engineers to complete CAD work, or alternatively, making do with less effective means, such as screenshots, static 2D drawings, or incomplete data. This restricted access creates bottlenecks and communication barriers since every change requires routing back through design engineers.

By expanding 3D CAD throughout manufacturing, all contributors can more effectively engage and collaborate, fostering a streamlined workflow that reduces cycle times, lowers cost, and avoids missed opportunities for improvement.

“ Previously, we relied on 2D drawings, which were difficult to read and modify. Now with more accessible CAD, we can quickly visualize the whole process and check for problems.”

Arkadiusz Tetloch

Production Engineering Department Manager
SOHBI CRAFT POLAND SP. Z O.O.

Marcin Zieliński

Industrial Engineering Expert / Simulation Creator
SOHBI CRAFT POLAND SP. Z O.O.

“ We used to share the production design in a presentation. Now we can share the 3D model, and they can validate it virtually. It has significantly reduced validation time for us.”

Senior Engineer
AUTOMOTIVE COMPANY

What Is More Accessible CAD?

Improved Communication and Collaboration

As discussed in the previous section, limited access to CAD tools can be a challenge for manufacturing planning. More accessible CAD addresses this by opening the 3D environment to a broader range of contributors, enabling direct interaction with digital models and fostering a shared understanding.

Accessible CAD is not meant to replace engineering-grade systems; it complements them. With an intuitive user interface and workflow, accessible CAD can enable planners, quality engineers, and shop floor teams to engage with design data confidently and independently.

More Accessible CAD

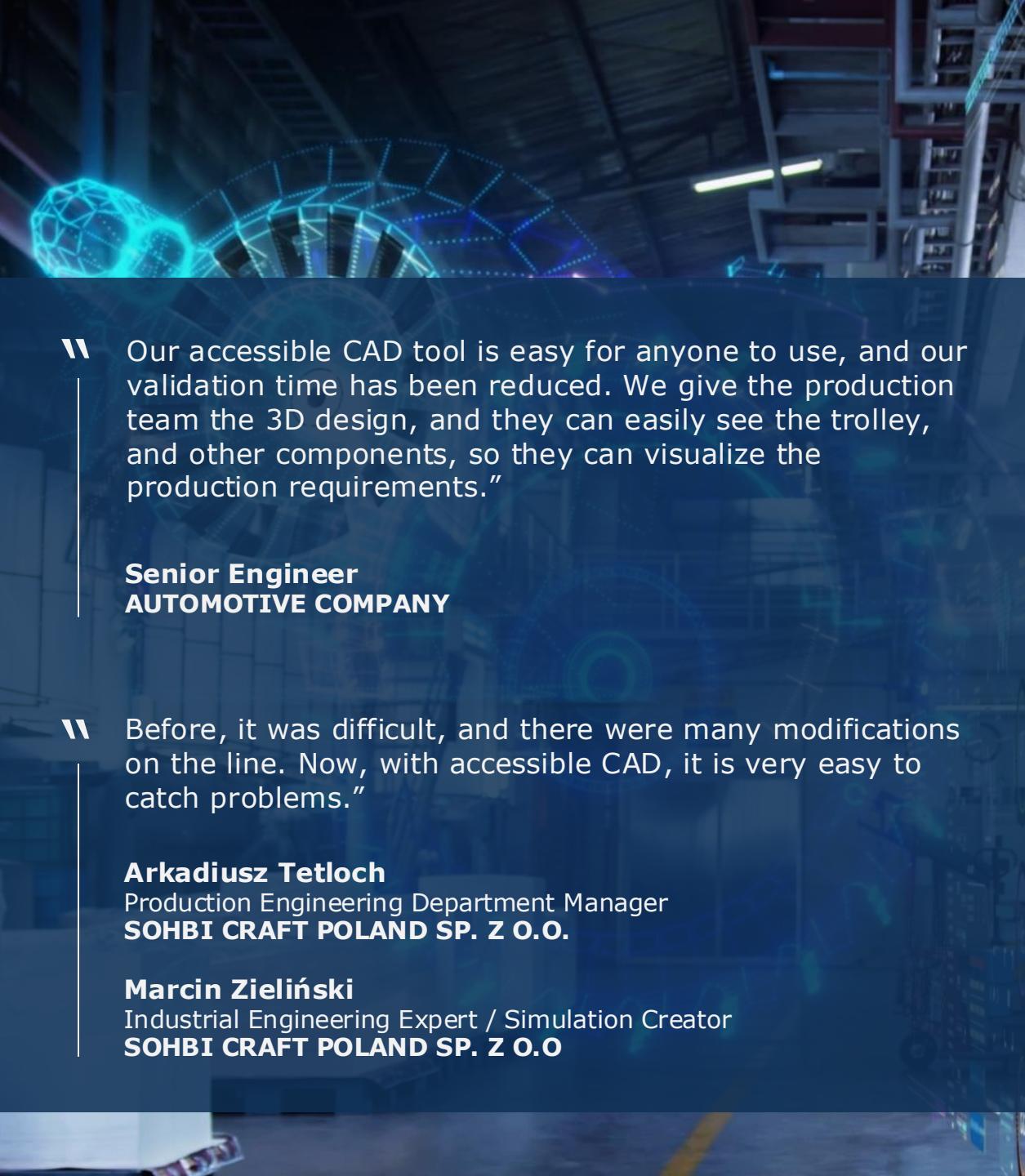
Qualities that define more accessible CAD include:

- **Lower learning curve:** Enables production planners, quality engineers, and shop floor teams to create and interact with 3D models confidently, without extensive training.

- **Multi-device compatibility:** Supports desktops, laptops, and tablets, so design data is available where and when it's needed.
- **Access without replacement:** Keeps the engineering CAD as the authoritative source for design creation, while empowering others to contribute directly to manufacturing planning.

In short, accessible CAD bridges communication gaps that have been behind some of the top challenges facing operations support staff. It makes it easier for everyone to visualize and understand the same information, leading to greater efficiency. By reducing reliance on a small group of CAD specialists, organizations can respond more quickly to changes, leverage the expertise of production staff, and improve cross-functional communication.

We will now explore some of the use cases where accessible CAD can help.



“ Our accessible CAD tool is easy for anyone to use, and our validation time has been reduced. We give the production team the 3D design, and they can easily see the trolley, and other components, so they can visualize the production requirements.”

**Senior Engineer
AUTOMOTIVE COMPANY**

“ Before, it was difficult, and there were many modifications on the line. Now, with accessible CAD, it is very easy to catch problems.”

Arkadiusz Tetloch
Production Engineering Department Manager
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Production Line Planning

Importance of Visualization

Effective production line planning requires precise coordination across engineering, production, and operations teams. Every decision, from equipment placement and material flow to ergonomics and worker safety, affects production speed, cost, and quality. Yet, in many organizations, the communication needed to achieve this coordination is less than ideal.

Misunderstandings about clearances, tooling needs, or assembly motion may surface only after equipment is installed or production begins, when changes are significantly more expensive.

Optimize Early

More accessible CAD solves this problem by making 3D line visualization a shared communication tool. Operations support staff can review layouts directly, explore how parts move through workstations, and identify risks early, without waiting for engineering support. This insight helps detect interferences, test ergonomics, and validate equipment positioning before anything is built. Mobile devices can extend flexibility by enabling virtual adjustments from the shop floor.

Options for AR

Some manufacturers also extend this capability through augmented reality (AR).

By overlaying 3D CAD models onto physical spaces, teams can validate scale, operator reach, and safety clearances in context. This practical visualization ensures that decisions are based on accurate spatial understanding, rather than guesswork or interpretation. Operators can also provide input and suggest improvements to optimize workflows.

Another advantage is collaboration. Remote teams can join the same virtual workspace to evaluate proposed layouts, reducing the need for travel and accelerating decision-making. For example, seeing fixtures in AR can make it easier to spot small but critical adjustments early. Frontline operators can also provide direct feedback during planning. The result is faster, more informed decision-making. Teams can then spend more time refining production efficiency.

Business Impact

By improving communication through accessible 3D models, manufacturers can plan their production lines with greater confidence and accuracy. They can catch potential issues before they become costly, accelerate layout validation, and reduce the number of mockups required. The impact reaches beyond efficiency; it helps ensure that the line is designed right the first time, supporting the broader business goals of speed, cost control, and quality performance.

It used to be very difficult to get people involved. Now, with our new tool, we can be creative. If we want to try out another layout, we can easily rearrange the equipment models until we've optimized the workflow. We can involve operators who are most involved in the production process since they understand the process best, and they can provide input and share their ideas."

Arkadiusz Tetloch

Production Engineering Department Manager
SOHBI CRAFT POLAND SP. Z O.O.

Marcin Zieliński

Industrial Engineering Expert / Simulation Creator
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With our tool, we can take our product directly to the production line and validate it with augmented reality."

Senior Engineer

AUTOMOTIVE COMPANY

Tooling, Jigs, and Fixtures Design

Supporting Repeatability

Designing jigs, fixtures, and other custom tools is a critical part of preparing a production line. They are essential for holding, positioning, and guiding parts during manufacturing processes and testing.

Factors such as workpiece location, clamping forces, material selection, and ease of loading/unloading must be considered to prevent distortion and ensure safety and ergonomics. Getting the design right ensures accuracy, repeatability, and safety during production, assembly, and testing.

Bottlenecks

When this work is limited to only those skilled in expert CAD tools, it limits opportunities for optimization, which can lead to longer cycle times. The cumulative impact of longer cycle times can result in significantly higher production costs.

This gap often leads to inefficiencies. When CAD tools are limited to a small group of engineers, production staff must request drawings or model updates for even minor changes, such as shifting a clamp, adjusting a tolerance, or resizing a fixture. These requests compete with higher engineering priorities, delaying production readiness and reducing flexibility on the shop floor.

Collaboration by Extending Access

By extending CAD access to operations support staff, fixture design becomes more collaborative and iterative. Tooling teams can quickly test ideas, visualize clearances, and validate fit with real geometry, all before cutting material. This early visibility helps identify potential interferences or ergonomic issues that might otherwise surface only during production, assembly, or test.

Accessible CAD tools make fixture and jig design a shared process rather than a serial handoff. This accelerates time-to-production, reduces rework, and ensures tooling supports both product quality and operator efficiency from the start. By enabling technicians and tooling designers to engage directly with digital models, manufacturers can bridge the gap between product design and production, where every small improvement in setup translates into measurable gains in throughput and consistency.



W We used to have to rely on another team to design some pieces of equipment for us. Of course, they had their own responsibilities and were always busy, so we couldn't really rely on them, as it took a long time. Often, we couldn't wait for them to finish, so we would just go ahead without it and modify the equipment, but there were always lots of problems. Now, we can avoid all of that."

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Design and Production Readiness Reviews

Bridging Engineering and Operations

Design and production readiness reviews are critical to ensure designs can move smoothly from concept to production. While design reviews focus on product engineering and ensuring the product design is right, involving manufacturing can be very useful in catching manufacturability issues. Production readiness reviews, also known as manufacturing readiness reviews, ensure that the manufacturing process, tooling, facilities, and workforce are prepared to produce a product at scale. For both, success depends on clear communication between engineering and operations teams.

Lack of Clarity

During reviews, operations support staff often rely on static visuals, such as PowerPoint slides, screenshots, or PDFs, to communicate complex 3D designs. These can be much harder to interpret and assess workflows, tool access, ergonomics, safety, and other concerns. Misunderstandings can then trigger multiple follow-up loops to clarify intent, slowing decision-making and delaying production readiness.

Real-time Updates

Accessible CAD changes the dynamic. Instead of reviewing static slides, teams can collaborate directly using 3D CAD during the review, rotating models, zooming in, and making edits in real-time, streamlining communication. More team members can get involved and offer input, brainstorm together, and iterate quickly. This reduces the number of post-review iterations and supports more optimized production workflows in a shorter timeframe.

Some teams also enhance reviews using AR to visualize tooling layouts in context. This capability helps reviewers assess real-world fit and reach without building physical prototypes, accelerating validation and improving production readiness confidence. This is another way to solicit feedback from more team members, creating more opportunities to catch problems while they are still quick and easy to fix.

“Validation time for process planning has been reduced for us due to more accessible CAD.”

**Senior Engineer
AUTOMOTIVE COMPANY**

“We can catch more problems now. We can involve more people, such as technicians and other departments like sales or quality, who typically don't participate in production planning. By involving those who understand the process the best, they can share their input to improve the workflow.”

Arkadiusz Tetloch
Production Engineering Department Manager
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Process Continuous Improvement

Missed Opportunities

Continuous improvement is a defining characteristic of high-performing manufacturing organizations. Yet for many companies, the process of identifying, testing, and implementing incremental improvements is slowed by communication barriers. Operations support staff often recognize small adjustments that could reduce setup time, improve ergonomics, or streamline workflows. However, translating those ideas into formal updates can take days or weeks, if they even invest the effort into making the changes.

Many small but valuable fixture enhancements, such as adding a clamp point or adjusting a clearance, do not get implemented because the overhead of a formal CAD request outweighs the perceived benefit. Over time, these missed opportunities accumulate into inefficiencies that hurt productivity.

Quick Iterations

Accessible CAD removes that barrier by giving operations teams the ability to visualize and communicate directly in 3D. Instead of relying on screenshots, sketches, or verbal descriptions, staff can model their ideas, making proposed changes clear and reducing

misinterpretation. This can lead to ongoing continuous improvement.

Production teams can propose and implement adjustments to tooling or assembly setups directly, reducing the time required to test and validate process changes. Minor improvements that previously required routing through a specialized CAD user can now be implemented in hours rather than days. Lowering the barrier to updating setups encourages small, incremental optimizations that might otherwise be skipped. Over time, these accumulate into measurable efficiency gains and a culture of proactive process improvement.

Improved Morale

This immediate feedback loop not only accelerates improvement cycles but also encourages greater participation. When operations staff can contribute ideas and validate them quickly, they become active partners in optimization rather than passive recipients of process changes. This also improves employee morale as they can feel good about contributing, making a difference, and improving the process for everyone. As many manufacturers struggle with labor and skill shortages, keeping existing staff happy is critical.



Using accessible CAD as a communication tool to advance my position has been a great benefit to me personally and for my position. I can demonstrate that I possess skills beyond being a technician. In one case, we were able to go from an idea to a tested modification in a week's time, rather than the two months of iterations that would have been required previously. It saves us so much time and cost."

Josh Schober
Engineering Lab Technician
WURTEC

Supporting Business Agility

Today's Market Volatility

Today's market conditions have created much uncertainty. Fluctuating material costs, unpredictable supplier performance, global events, and changing customer demands all place pressure on production teams to respond quickly and decisively. The ability to adapt without compromising quality or profitability has become a defining measure of operational resilience.

Flexibility

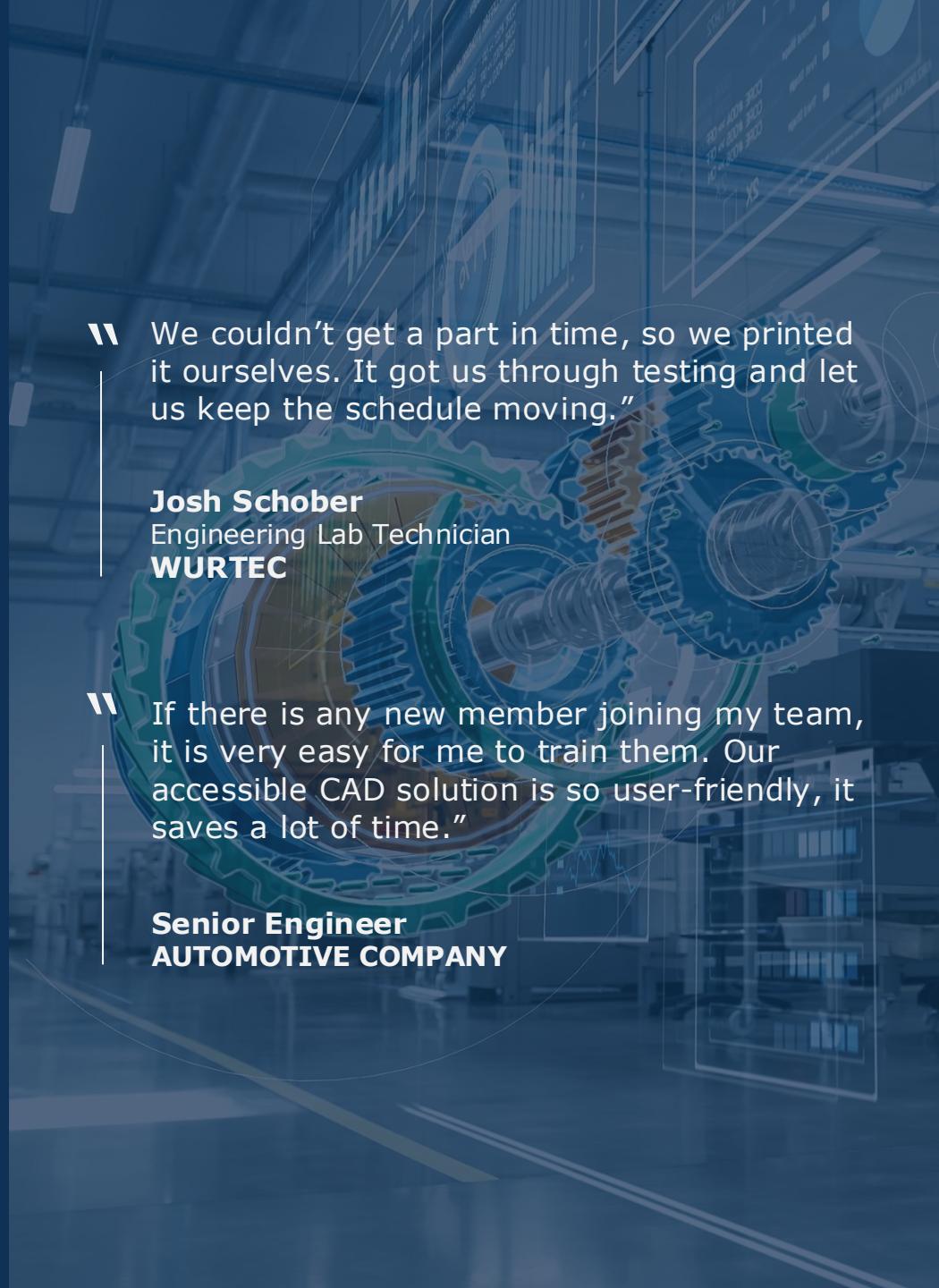
Flexibility to adapt to market changes requires the ability to rapidly implement changes. When manufacturing teams can visualize and modify 3D models directly, they can evaluate alternate production methods, adjust tolerances for different materials, or validate substitutions without waiting for a full engineering change cycle. The result is faster decision-making and greater control over cost and timing.

Accessible CAD tools can help operational teams evaluate the downstream impact of changes, whether it's a supplier substitution, an equipment constraint, or a design revision. They make it possible to simulate new workflows, check for interferences, and assess manufacturability before changes reach the production floor.

In an environment where material shortages or price spikes can occur overnight, this can be an invaluable capability. Those that can make informed trade-offs quickly, balancing cost, quality, and delivery without excessive disruption are more likely to succeed.

Evolve with Changing Needs

Empowering operations and manufacturing support staff with the ability to explore and implement alternative solutions strengthens organizational agility. It ensures that decisions about how to build a product can evolve as business conditions change, helping manufacturers maintain continuity, manage cost, and stay competitive when the unexpected happens. Further, if staffing levels need to change, it is easier to bring on new help since the learning curve is low, and they can be productive in a short time.



“ We couldn't get a part in time, so we printed it ourselves. It got us through testing and let us keep the schedule moving.”

Josh Schober
Engineering Lab Technician
WURTEC

“ If there is any new member joining my team, it is very easy for me to train them. Our accessible CAD solution is so user-friendly, it saves a lot of time.”

Senior Engineer
AUTOMOTIVE COMPANY

Recommendations

Recommendations and Next Steps

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations:

- **Improve communication for Manufacturing Planning:** Transition from screenshots and marked-up drawings to model-based communication, which reduces errors and rework.
- **Empower manufacturing planners with direct 3D CAD access:** Provide planners, quality engineers, and shop floor teams with tools to design, view, interrogate, and update 3D CAD models without relying on specialist CAD experts.
- **Look at accessible CAD for production line planning:** Empower teams to evaluate ideas and optimize workflows with accessible CAD.
- **Consider accessible CAD for fixture and jig design:** Use easy-to-learn CAD tools to accelerate the design and refinement of production aids, helping to reduce cycle times and improve manufacturability.
- **Enable continuous improvement:** Lower the overhead required to implement small changes, allowing incremental process optimizations to yield long-term efficiency gains.

- **Capture shop floor input:** Enable faster implementation of shop floor insights by allowing direct incorporation of adjustments into 3D models, creating opportunities to improve production efficiency.
- **Leverage CAD during review meetings:** Foster cross-functional collaboration and build stronger alignment across planning, production, and quality functions with improved communication using 3D models.
- **Consider AR/VR for improved visualization and assessment:** Bringing 3D CAD models into an immersive environment enables teams to validate fixtures, tooling, and workflows at full scale, identify ergonomic or accessibility issues early, and improve collaboration among distributed teams.

“Because we can see everything in 3D now, it's very easy to assess the cost for any given line.”

Arkadiusz Tetloch

Production Engineering Department Manager
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Acknowledgements



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About the Author

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Michelle graduated magna cum laude with an MBA from Babson College and earned a BS in Mechanical Engineering, with distinction, from Worcester Polytechnic Institute. She is an experienced researcher and author, having benchmarked over 7000 product development professionals and published over 90 reports on product development best practices.

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