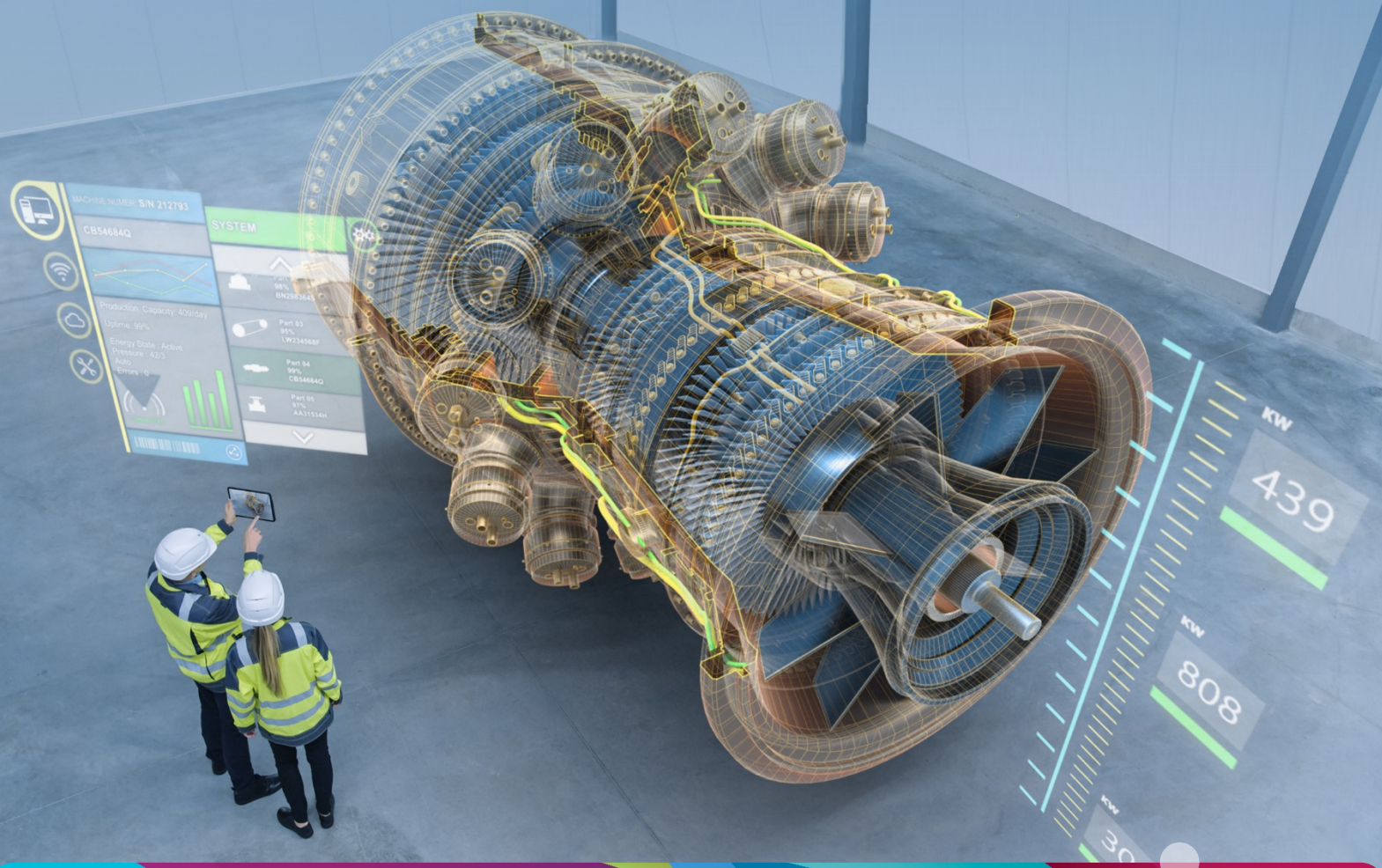


DIGITIZATION OF SHOP FLOOR ASSEMBLY PROCESS WITH ILLUSTRATIVE GRAPHICAL PLANNING

Enhancing production line efficiency and reducing lead times in aircraft assembly through digitization, minimizing manual errors, and eliminating paper-based processes for a streamlined and error-free shop floor experience.



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Abstract

The Assembly process planning in the **aircraft industry** presents several unique challenges due to its complexity, precision requirements, and regulatory constraints. Key obstacles include: managing thousands of specialized components, ensuring high precision to meet safety standards, and adhering to strict regulatory compliance. Cyient leverages its expertise to digitize the assembly process using 3D illustrative graphics, enhancing production efficiency & quality in aircraft assembly.

Introduction

The aircraft final assembly line (FAL) is pivotal in integrating mechanical, electrical & electronics & electromechanical systems to build the complete aircraft. This process involves assembling components such as aft, aid & rear fuselage, wing structures, ailerons, tail fin & interiors. Despite its importance, the FAL faces several challenges:



Complexity of Components

Thousands of highly specialized parts require meticulous planning to ensure compatibility and functionality.



Precision and Quality Control

Any delay in precision can compromise safety, necessitating rigorous quality control measures.



Regulatory Compliance

The industry's stringent standards (e.g., FAA, EASA) demand detailed documentation and traceability.



Supply Chain Coordination

Timely delivery and consistent quality of components across a global supply chain is critical.



Skilled Labor Shortages

Training and retaining a skilled workforce for precise assembly tasks remains a significant challenge.



Technological Integration

Adoption of advanced technologies like automation, robotics, and digital twins faces resistance and requires careful implementation.



Cost Management

Balancing quality with cost constraints is essential, especially in low-volume production.



Design Changes

Aircraft designs often evolve during development, requiring quick adjustments in assembly planning. These changes can disrupt established workflows and necessitate retraining.



Environmental Considerations

Timely delivery and consistent quality of components across a global supply chain is critical.



Logistics and Space Utilization

Effective facility planning and logistics are crucial to optimize space and resources.

Digitization of Assembly Operations Using 3D Illustrations

The shop floor requires mechanics & operators to understand technical specifications for assembling the latest aircraft configurations. Traditional instructions written in SAP-PP & other tools often fall short of bridging the knowledge gap. To address this, Cyient introduced 3D digitization using the 3D Via Composer tool. This innovative approach enables clear graphical representation of assembly operations, making complex tasks easier to understand and execute across industries, such as Engineering, Manufacturing & Aftermarket services.

High-Level Solution

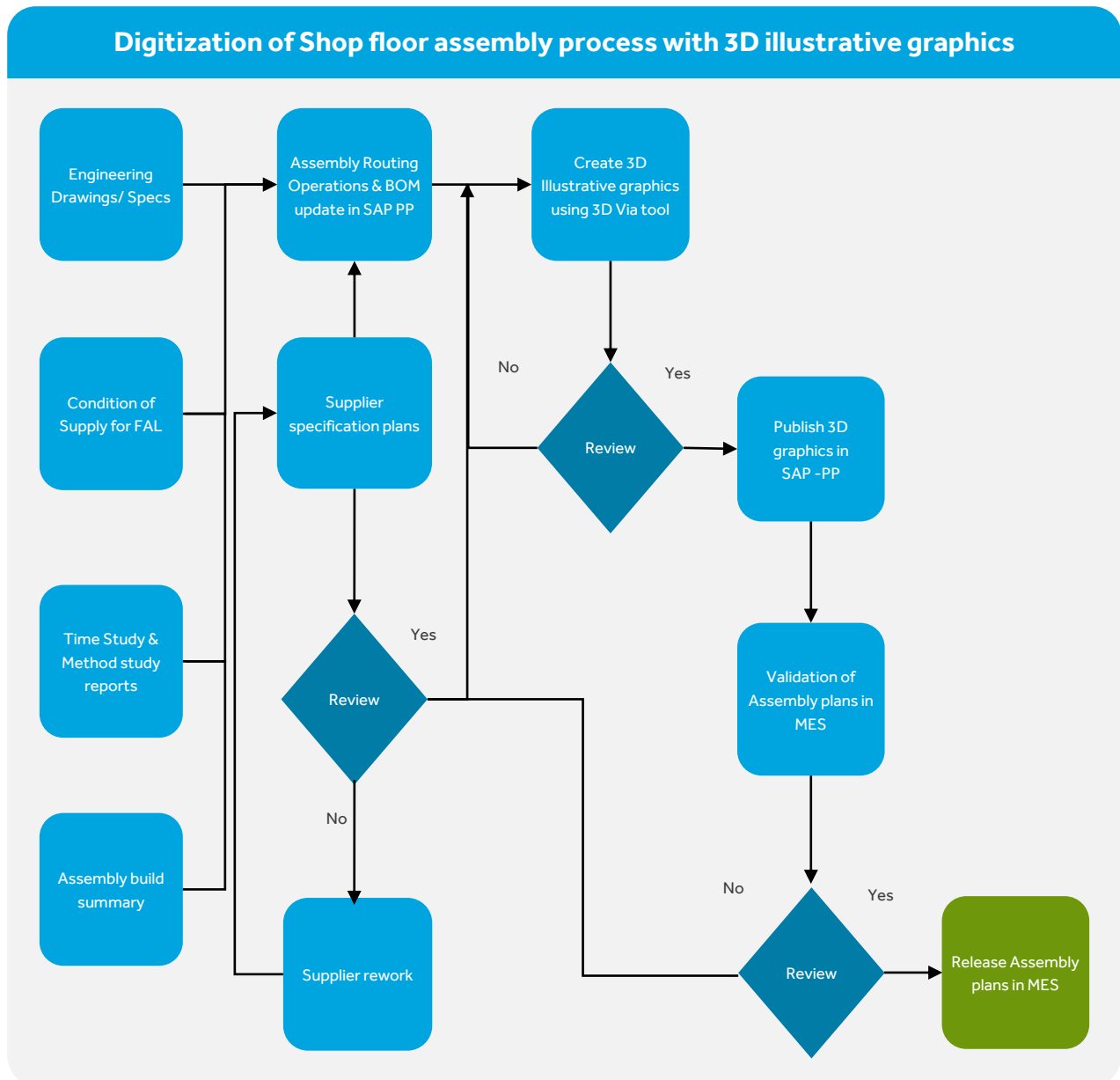


Figure 1. Digitization of Assembly Process planning - Process flow steps



Case study:

Productivity Improvement and Cost Reduction with 3D Illustrations

Project Overview: Cyient supported a 19-seater business jet program, managing activities from design and stress analysis to assembly process planning and quality assurance. One critical task was verifying sealant application for the wing structure before shipment to the final assembly line.

Challenges

Apply coatings (brush coat and dome sealant) across 52 bays (~6,000 fasteners) per engineering requirements.

Manage engineering changes and non-incorporated requirements (NIEO).

Conduct thorough quality inspections to validate sealant applications.

Solution

Technical Review and Graphics Development

Conducted a thorough technical review of installation drawings to identify brush and dome coat sealant requirements.

Reviewed applicable NIEOs (Non-Incorporated Engineering Orders) and incorporated engineering changes into the graphics.

3D Graphics Creation

Developed new assembly plans in SAP-PP specifically for sealant operations.

Created 3D bay graphics using the 3D Via Composer tool, with annotations and symbols for different sealants to eliminate deviations and rework.

Integration with Systems

Published 3D graphics in SAP-PP, integrated with the MES tool on the shop floor, enabling seamless digitization of the assembly process.

Enabled mechanics to access graphics on tablets, saving time and ensuring accurate execution of tasks like drilling, riveting, and torquing.

Support for Quality Assurance

Collaborated with the quality control team to streamline inspection processes, using 3D graphics for faster buy-off decisions.

Training Enhancements

Created animations for tasks such as flap and spar assembly, providing step-by-step instructions to train mechanics and suppliers effectively.

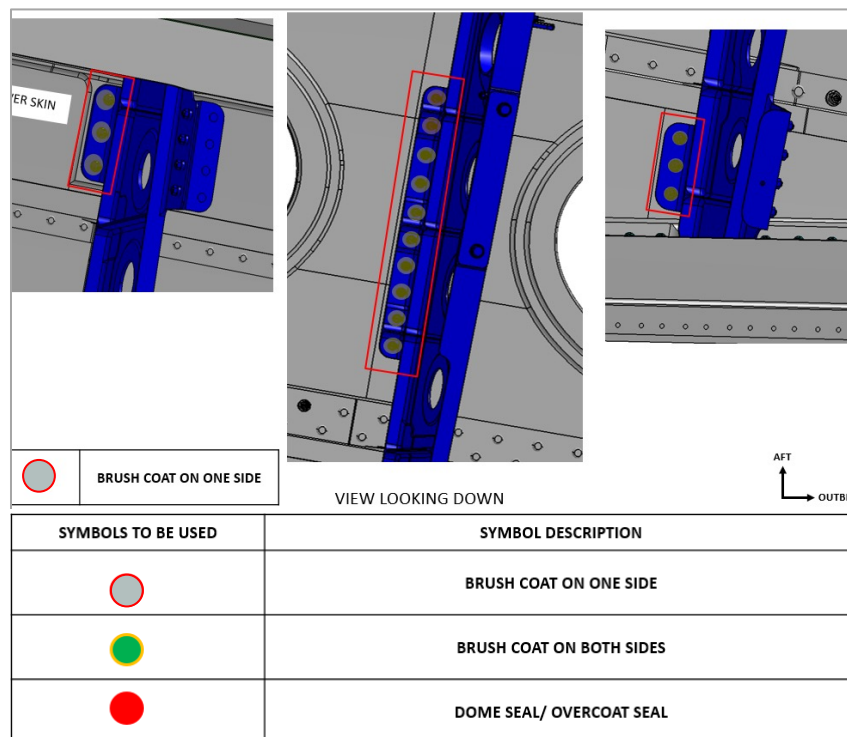


Figure 2. Bay Sealant 3D graphics

Benefits/ Results

The use of 3D Bay sealant graphics by shop floor mechanics resulted in approximately 30% cycle time savings and eliminated the need for re-validation against engineering data.

3D bay graphics enabled the quality team to efficiently verify and validate sealants applications as per engineering drawing requirements, significantly reducing waiting time for buy-off decisions.

Bay sealant maps for wing assembly enhanced shipment delivery schedules and minimized turn-backs and quality issues from the final assembly line, improving productivity & eliminating wasted time in understanding sealant applications.

The Cyient team created approximately 10,000 3D graphics, showcasing extensive experience in assembling build planning and 3D graphics development for various aircraft programs.

Step-by-step animations for tasks like flap, spar, and skin assembly were developed, capturing the entire sequence of operations required to build aircraft assemblies. These animations are also used to train new mechanics and suppliers effectively.

The 3D graphics developed by the Cyient team significantly improved the understanding of assembly process for mechanics and streamlined the buy-off process for quality inspectors.

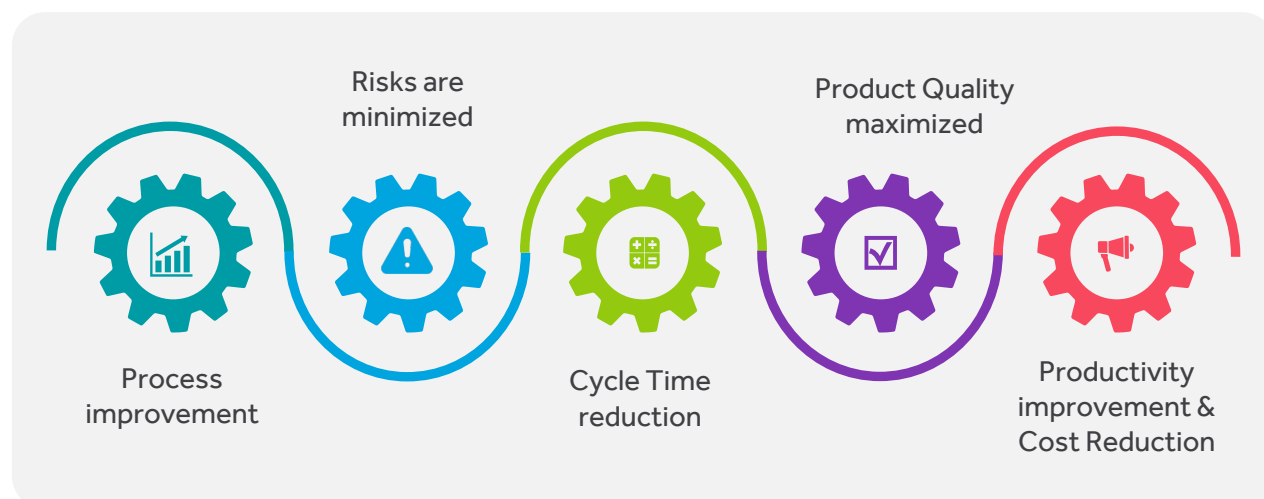


Figure 3. Case study benefits in production line

Integration of Graphics – SAP-PP & MES Production Systems

A robust database of engineering specifications and technical documentation is critical for building aircraft structures & assemblies. Tools like SAP-PP ensure the maintenance of real-time technical data, enabling operations teams to build the latest shipset configurations. SAP-PP was used to develop the assembly routing plans, bill of materials (BOMs), work orders for approximately 2,500+ plans across 11 assembly stations.

The Cyient team developed approximately 10,000 3D graphics, attaching them to routing plans in SAP-PP. The graphics were published and regularly updated to align with the latest shipset configuration requirements.

The Manufacturing and Execution System (MES) is a customized tool designed for the detailed execution of production plans. It ensures that the work orders are completed on time, tracks production progress, and schedules/monitors operator activities effectively on the shop floor.

The integration of SAP-PP, 3D Via Composer, and MES tools ensures a comprehensive approach to managing assembly processes, enhancing efficiency, reducing costs, and ensuring quality compliance.

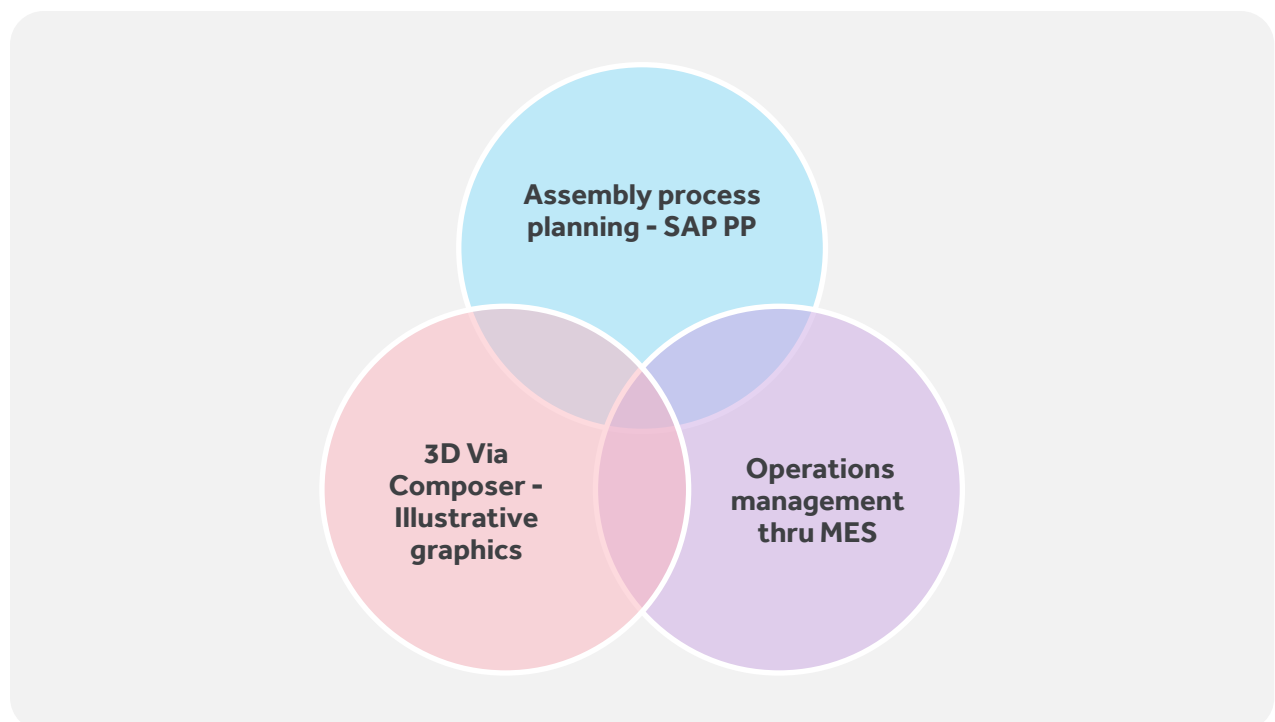


Figure 4. Integration of SAP-PP, 3D Via composer & MES system

Conclusion

Cyient's 3D digitization of assembly processes has improved productivity by 30% and reduced lead times in aircraft production. By creating approximately 10,000 3D graphics, Cyient has empowered mechanics and quality inspectors with intuitive tools for efficient assembly and inspection. The integration of ERP and MES systems further amplifies operational efficiency, cost savings, and decision-making.

About the Author



Sreenivas Katte is an experienced manufacturing engineer with over 24 years of expertise specializing in manufacturing & assembly process planning within the aerospace industry. He possesses extensive experience in machining processes, fabrication technologies, welding techniques for various material specification and hands-on experience with special treatment processes for aerospace components.

Sreenivas has demonstrated proficiency in shipside support of aircraft assembly build processes, providing critical production team support. His experience includes PPAP, FAIR & quality control & assurance procedures. He also has a strong background in new product development, supplier coordination & providing technical assistance for outsourced parts.



About Cyient

Cyient (Estd: 1991, NSE: CYIENT) partners with over 300 customers, including 40% of the top 100 global innovators of 2023, to deliver intelligent engineering and technology solutions for creating a digital, autonomous, and sustainable future. As a company, Cyient is committed to designing a culturally inclusive, socially responsible, and environmentally sustainable Tomorrow Together with our stakeholders.

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