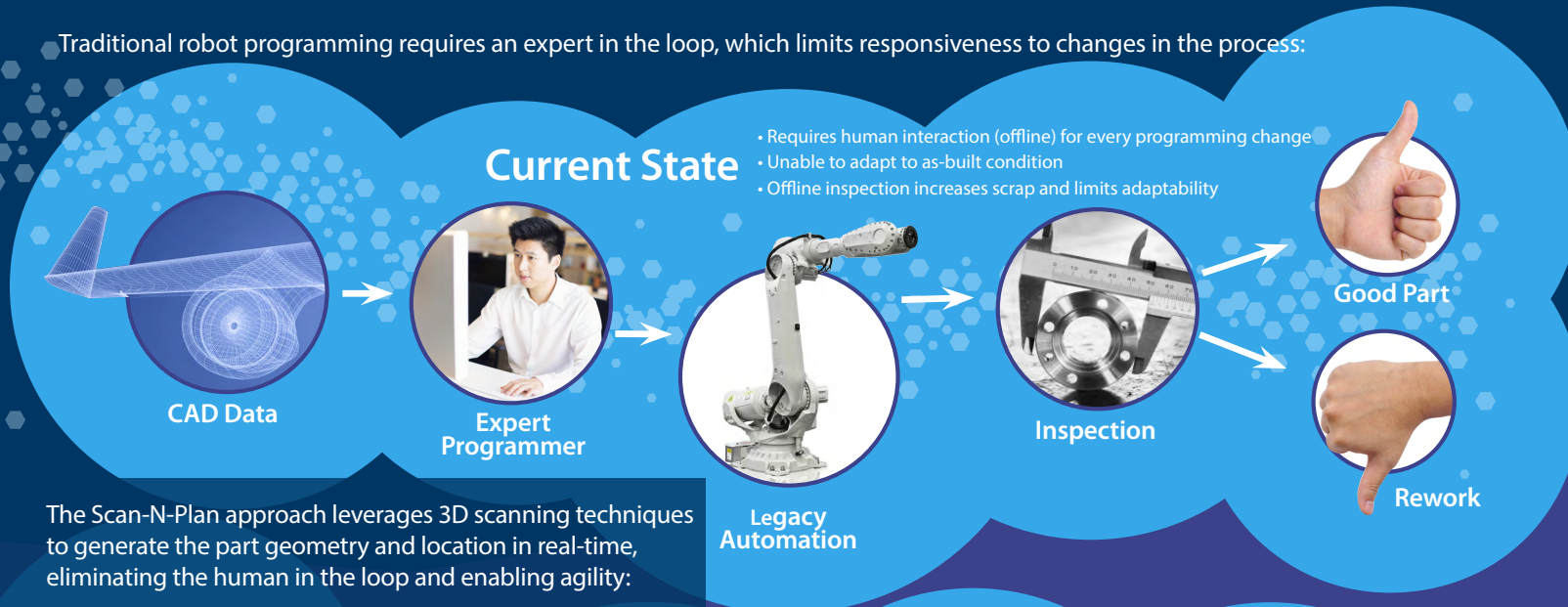# Scan-N-Plan™

*rosindustrial.org/scan-n-plan*

Scan-N-Plan technologies are a suite of tools that enable real-time process planning and robot trajectory planning from 3D scan data. Traditional industrial robot programming is performed using either on-line teaching techniques or off-line programming with a simulated version of the robot and workpiece. The Scan-N-Plan approach overcomes limitations in traditional robot programming for applications that:
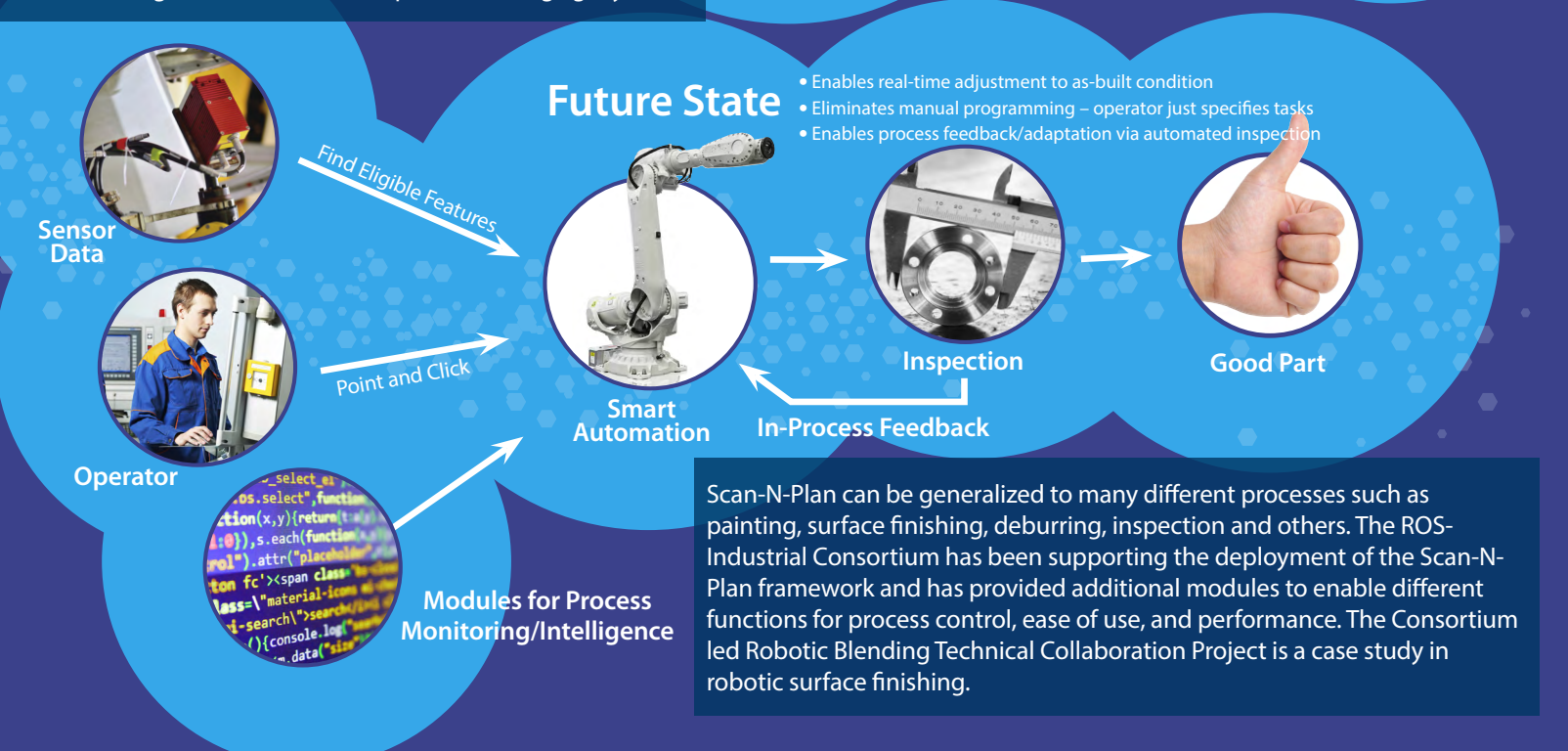
- Have highly variable part mixes such that hand programming is impractical
- Do not have CAD part models available
- Include flexible or deformable parts such that pre-programming is impossible
- Have part-to-part variability that is difficult to accommodate with static programming
- Require flexible part fixturing or no fixturing at all

These applications are representative of adaptable and flexible operations that require dynamic response to changes in the parts or their presentation - all with minimal to no human intervention. In addition, the dynamic nature of the trajectory generation permits real-time adaptation based on process feedback.

Traditional robot programming requires an expert in the loop, which limits responsiveness to changes in the process:

## Current State

- Requires human interaction (offline) for every programming change
- Unable to adapt to as-built condition
- Offline inspection increases scrap and limits adaptability



**CAD Data** → **Expert Programmer** → **Legacy Automation** → **Inspection** → **Good Part** / **Rework**

The Scan-N-Plan approach leverages 3D scanning techniques to generate the part geometry and location in real-time, eliminating the human in the loop and enabling agility:

## Future State

- Enables real-time adjustment to as-built condition
- Eliminates manual programming – operator just specifies tasks
- Enables process feedback/adaptation via automated inspection



**Sensor Data** — *Find Eligible Features* → **Smart Automation**
**Operator** — *Point and Click* → **Smart Automation**
**Modules for Process Monitoring/Intelligence** → **Smart Automation**
**Smart Automation** → **Inspection** → **Good Part**
**In-Process Feedback**

Scan-N-Plan can be generalized to many different processes such as painting, surface finishing, deburring, inspection and others. The ROS-Industrial Consortium has been supporting the deployment of the Scan-N-Plan framework and has provided additional modules to enable different functions for process control, ease of use, and performance. The Consortium led Robotic Blending Technical Collaboration Project is a case study in robotic surface finishing.

# Scan-N-Plan for Robotic Blending Focused Technical Projects & Advanced Deployments

Many metal fabrication processes including casting, machining, and welding produce parts with surface finish defects but automation of these has proven challenging, due to lack of volume, CAD data, or programming expertise. Solutions have been desired that combine the flexibility of a manual process with the repeatability and safety of robotic systems.

The ROS-Industrial Consortium has undertaken a multi-phase Focused Technical Project to develop open-source Scan-N-Plan software for Robotic Blending. The results from milestone 4 of the project and beyond are shown below.
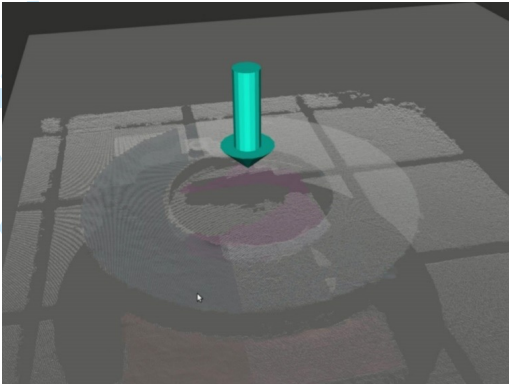


*In seconds, CAD-free recognition of flat or contoured surfaces that are eligible to process. Additional capabilities enable alignment to provided CAD.*
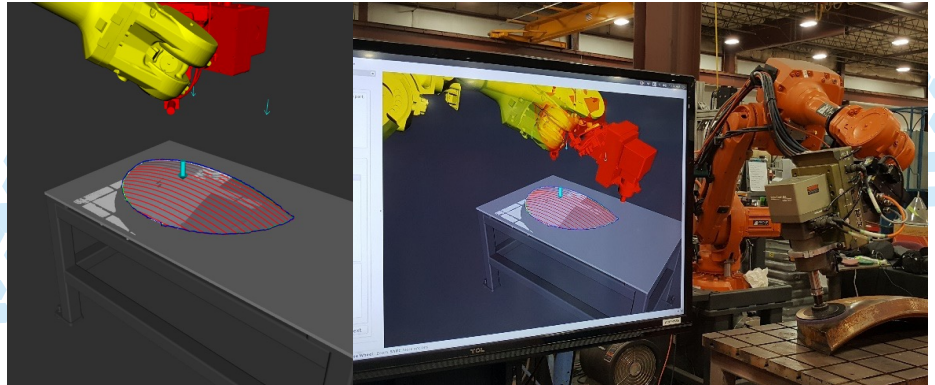


*In less than a second, the software computes collision free paths to process each selected surface (left). After preview of motion planning the system then executes motion paths (right).*

Additional features and elements have been added to expand on the Scan-N-Plan framework that include richer tool path planning capabilities, in process quality monitoring, and the deployment on mobile platforms extending into processes such as sanding, painting, and inspection.



*After blending, system executes a QA scan with a high resolution sensor and displays results as well as defect correction tool paths.*
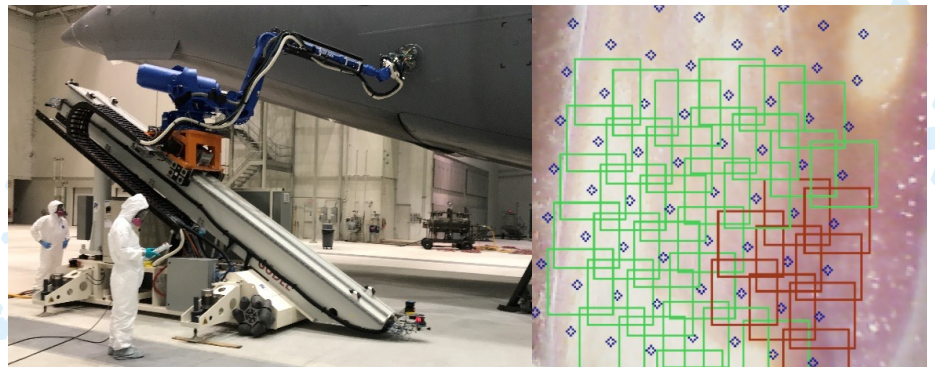


*Mobile based Scan-N-Plan system (left), Realtime classification of progress for sanding (right).*

Since this work the Scan-N-Plan framework has been demonstrated on mobile platforms, performing coatings, and executing processes on composite materials with real time process monitoring. A collaborative follow-on project to extend these capabilities further and enable more efficient deployment is forthcoming. You can learn more about Scan-N-Plan and learn about resources available by visiting *rosindustrial.org/scan-n-plan*



*https://rosindustrial.org/scan-n-plan*

## ⁞⁞⁞ROS industrial consortium americas
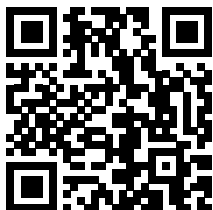
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