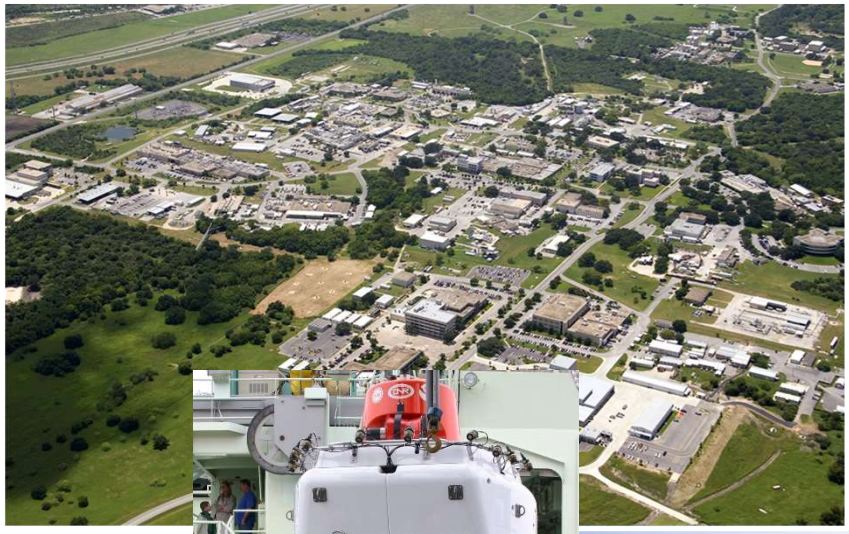
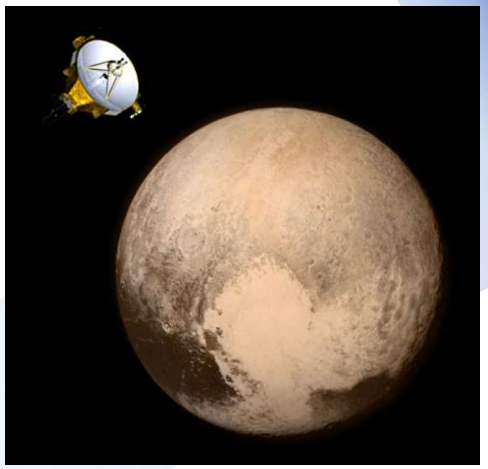
ROS-Industrial – Growth, Global, Value

SOUTHWEST RESEARCH INSTITUTE

SwRI: Deep Sea to Deep Space



Alvin submersible

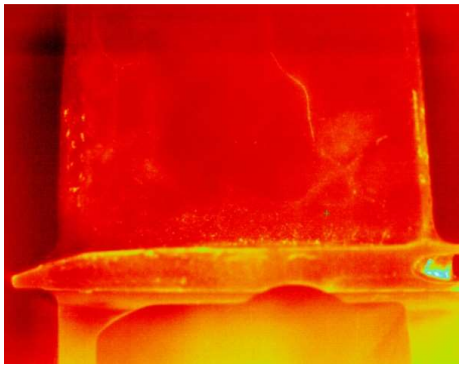


New Horizons, Pluto

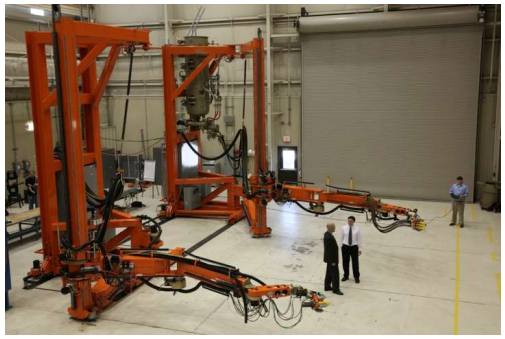
SwRI Characteristics

- Est. 1947
- San Antonio, Texas, USA
- Independent, Not for profit
- Applied RDT&E Services
- Natural Science and Eng.
- FY 2016 Revenue: $560M

Robotics and Automation Engineering



Machine Vision and Perception



Custom Robotics

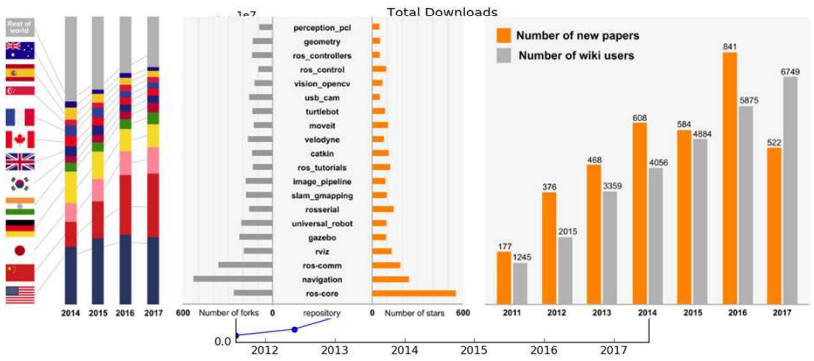
System Integration

Industrial Automation and Controls

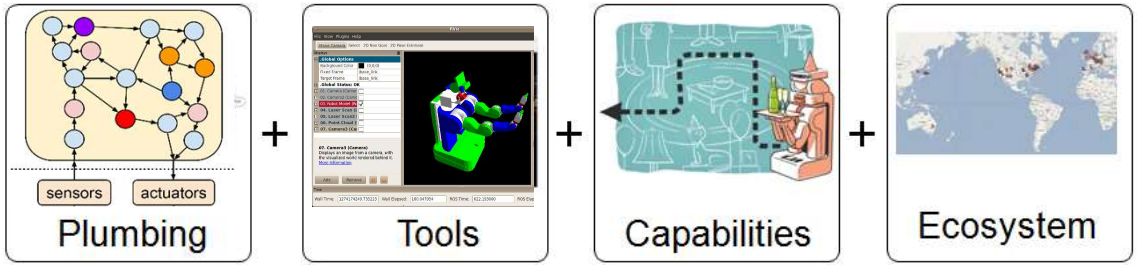
ROS industrial

Advanced Robotic Software

ROS: Robot Operating System



- Open source (BSD)
- Established to keep robotics researchers from "re-inventing the wheel"
- Maintained by OSRF – 10 years strong!
- Reusable software components
- >1,000,000 users downloaded/mo. [1]



1. http://download.ros.org/downloads/metrics/metrics-report-2017-07.pdf

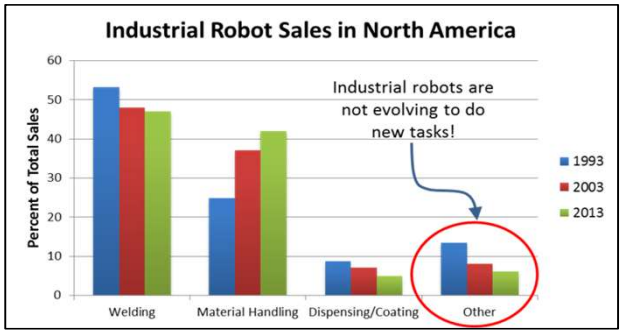
Why ROS?

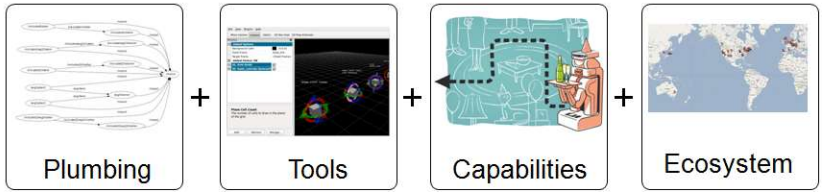
- Research Robotics
  - Reinvention of the Wheel
  - Little Commonality
  - Short Lifespan
  - Inability to Compare Results

ROS Solves These

- Open source (BSD)
- Created by Willow Garage
- Maintained by Open Source Robotics Foundation (OSRF)

"We've automated all the easy stuff"





ROS-I Timeline

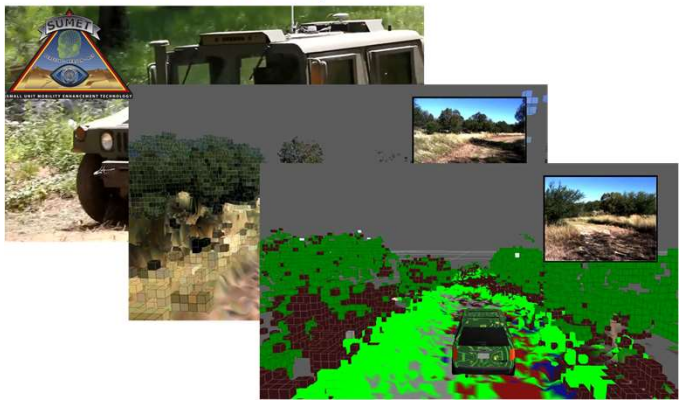
2010
SwRI Adopts ROS

2011
ROS-I Inception

2012
ROS-I Repo Launch

2013-2016
RIC Launch & Growth

SwRI Unmanned Ground Systems



ROS-I Timeline

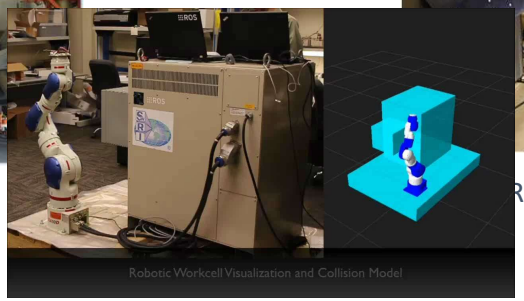
2010
SwRI Adopts ROS

2011
ROS-I Inception

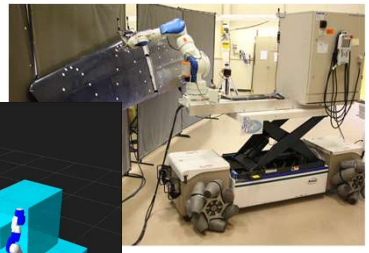
2012
ROS-I Repo Launch

2013-2016
RIC Launch & Growth

Robotics Automated Coating Stripping Sys.



Robotic Workcell Visualization



R ROAM Mobile Robot

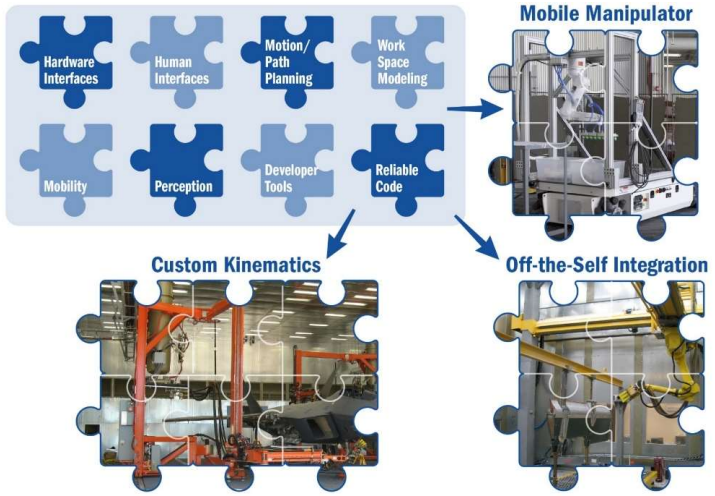
ROS-I Timeline

2010
SwRI Adopts ROS

2011
ROS-I Inception

2012
ROS-I Repo Launch

2013-2016
RIC Launch & Growth



ROS-I Timeline

2010
SwRI Adopts ROS

2011
ROS-I Inception

2012
ROS-I Repo Launch

2013-2016
RIC Launch & Growth

Networking & Strategy Events

2013 RIC Kickoff Meeting

2014 – RIC-EU Launch

2016 – RIC-AP Launch

ROS: Robot Operating System

Notable Users

ROS


BMW


ClearPath Robotics


Erle Robotics

Fetch Robotics


Intermodalics


PAL Robotics


Rethink Robotics


Savioke


SwRI

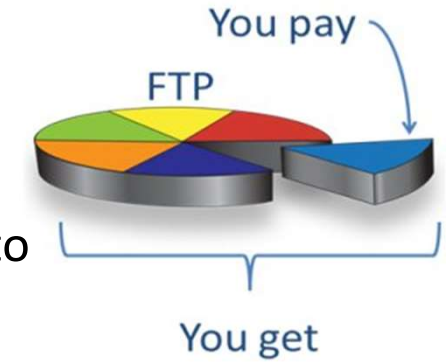

Willow Garage


Yujin Robot

Why a Consortium to Support ROS-I

- Provide Direction
- Enable Investment to Accelerate Development
- Education
- Efficient Pipeline from University to Factory End-Users
- Global Leverage with Regional Focus

Focused Technical Projects



Networking & Strategy Events

2013 RIC Kickoff Meeting

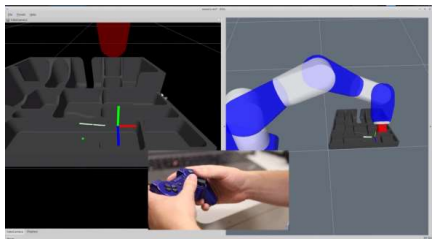
Consortium Training Classes

Consortium Benefits

- Foster Growth of Flexible Manufacturing Automation
- Education
  - ROS-I training
  - Website/blog
  - Wiki tutorials/docs
  - Videos
- Networking
  - Mailing lists
  - Meetings
  - Site visits
  - Tradeshows
- Tech Support
- Input to Roadmap
- Software Releases
- Focused Technical Projects

2018: RIC Global Members

2018: ROS-I



Human Interfaces

Calibration

Industrial 3D Sensors

Bridges

PROFINET INDUSTRIAL ETHERNET

EtherCAT

EtherNet/IP

CANopen

Hardware Interfaces

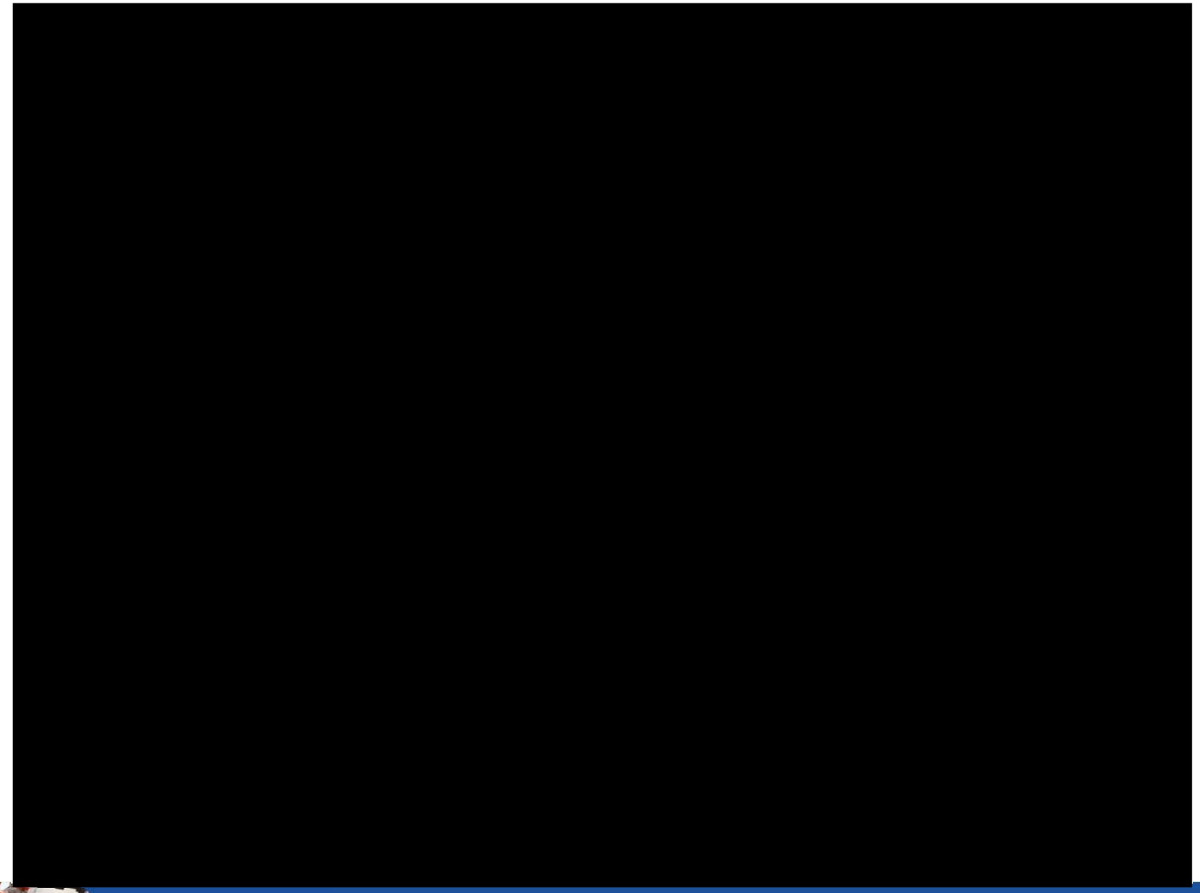
Creator ROS Plug-in

ROS CADTools

Developer Tools

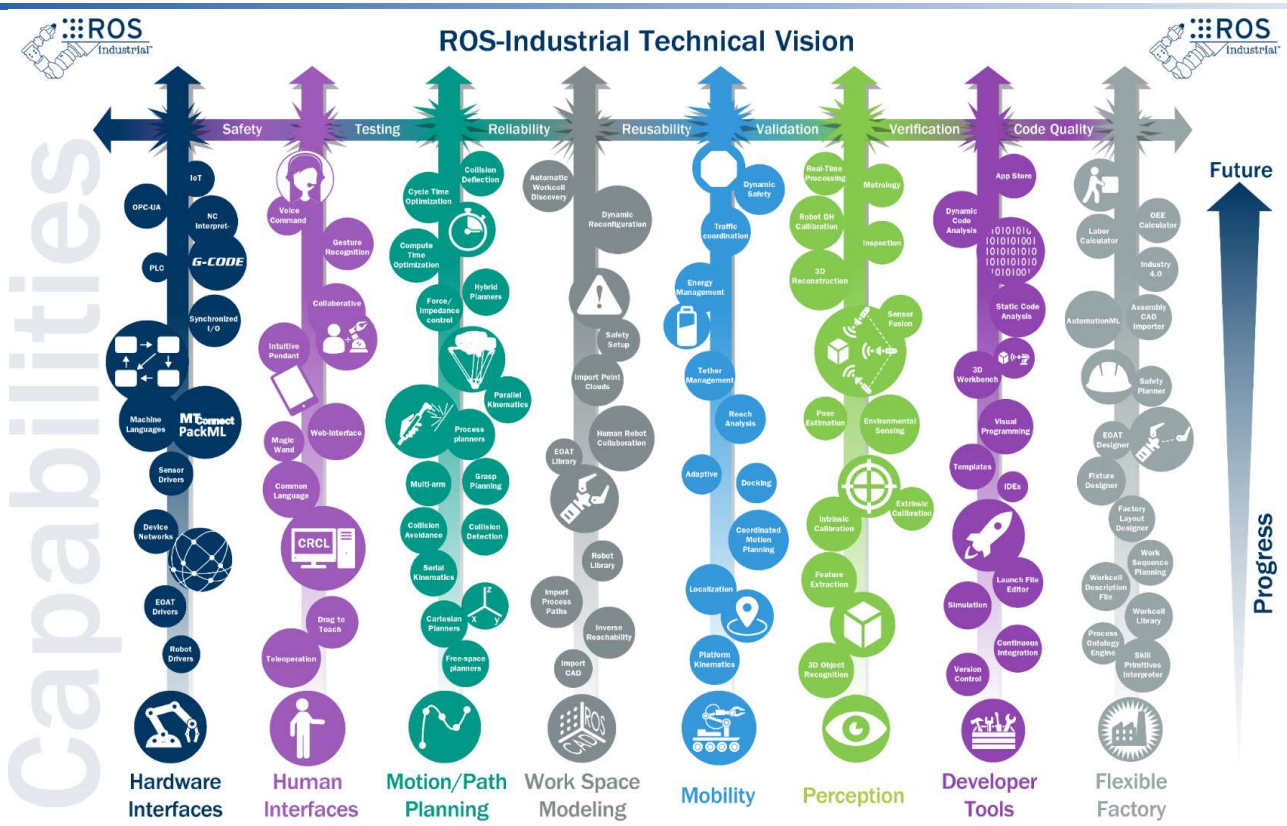
Applications

What Can ROS-I Do?



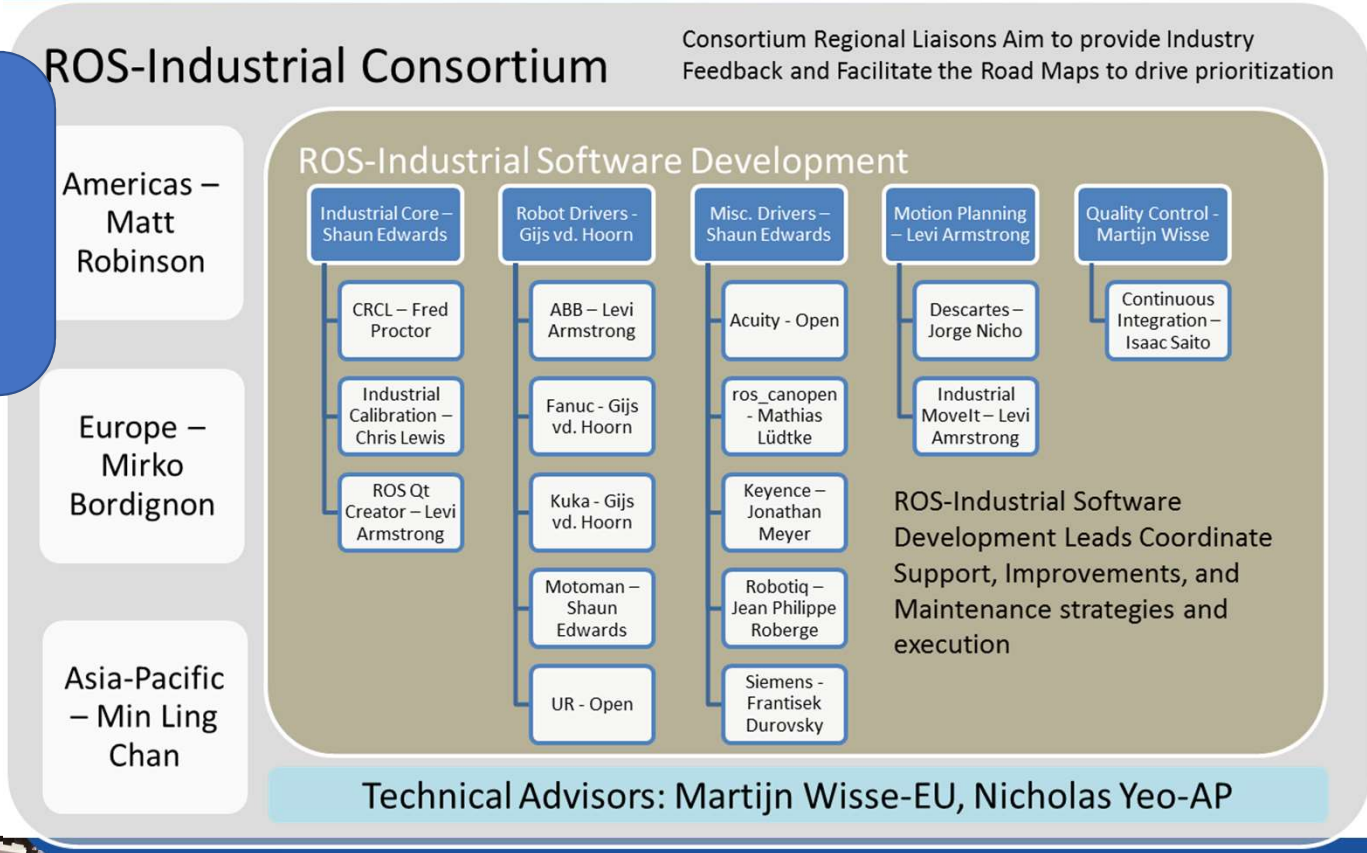
https://youtu.be/IxTJ473MY3Y

Trajectory


ROS-Industrial Technical Vision
Capabilities
Safety
Testing
Reliability
Reusability
Validation
Verification
Code Quality
Future
Progress
Hardware Interfaces
Human Interfaces
Motion/Path Planning
Work Space Modeling
Mobility
Perception
Developer Tools
Flexible Factory

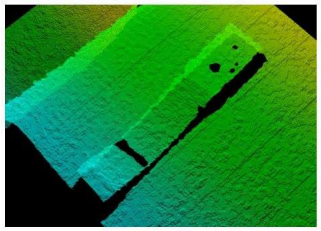
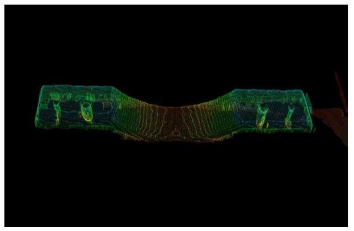
Supporting Organization

New Strategic Initiatives
OEM Engagement
Community Engagement
Drop and Go Capability
Support & Maintenance Working Group
Preferred Access

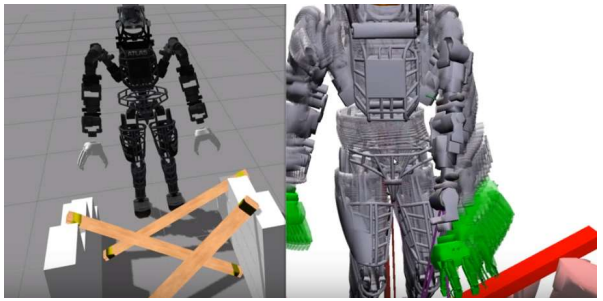


SwRI ROS-I Team Recent Developments

- Intelligent Part Reconstruction
  - TSDF + Next Best View (NBV) implementation for creation of meshes on featureless or highly spectral parts
  - Targeting path planning for aerospace parts
  - Improved detail and efficiency in creation of meshes with greater level of detail
  - In state of development pending external investment to complete into a state for open source

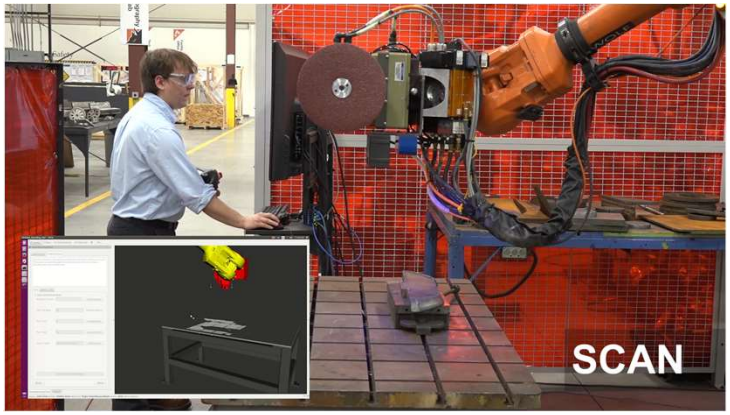
Before & After on Machined Aluminum



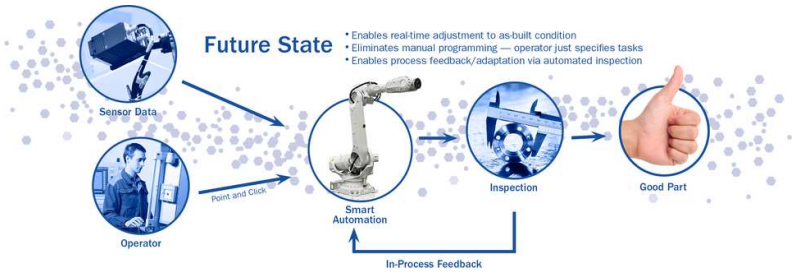
Trajopt in Gazebo

- Trajopt Integration
  - Cal Berkeley Trajectory Optimization for Motion Planning
  - Currently in OpenRave
  - Developed for DARPA for Humanoid Motion Planning
  - Being integrated into ROS to be leveraged on industrial manipulators utilizing MoveIt! collision libraries
  - Plan is to open source upon completion and testing

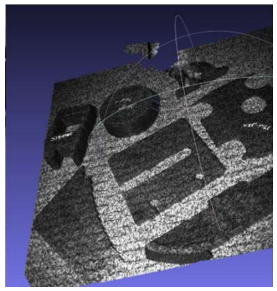
Blending – A Stepping Stone to Intelligent Agility



Scan-N-Plan Foundation



Tech Demonstration of Robotic Blending Milestone 4
https://youtu.be/PWCpehyKnTY



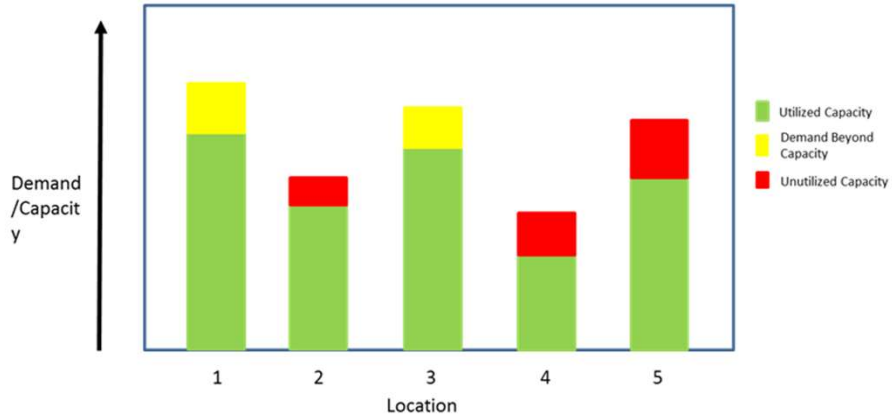
Target Adopter is a Low-Lot High Mix Manufacturing Site

Opportunity 73% ROI based on overall part processing area efficiency improvements via reduction in variable labor

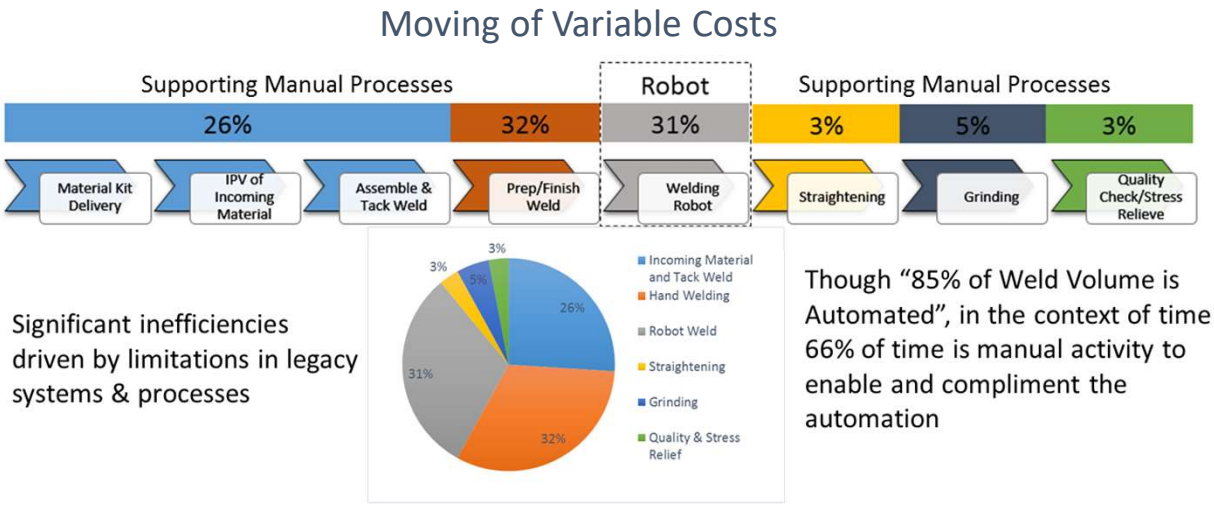
Attacking End-User Opportunities

- Factories by Product
- Lines by Model

Underutilized Resources



Attacking End-User Opportunities



Attacking End-User Opportunities

Legacy Automation Support Costs

Cost Drivers that Challenge Period Cost Structure to Support Automation

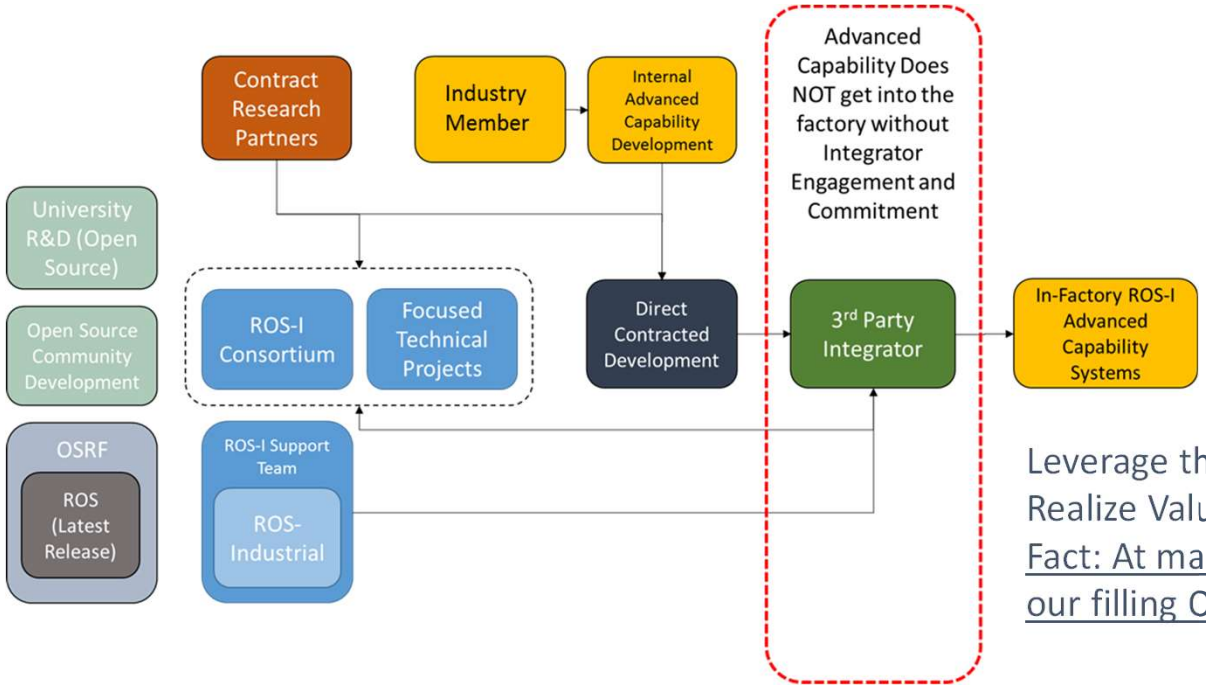
Program New Parts	Update/Create Programs for Engineering Changes	Modify Programs to Resolve Down Condition
• Asset Specific • Programs do not transfer or scale • Creation of New Program is Cumbersome • Validation 'On the Fly' – under supervision	• Involves Detail Program Review • Programs are still asset specific • Validation 'On the Fly' – under supervision	• Input Variations • Limited Range to Manage Change in Condition • Desire to Meet Delivery Timelines • Difficult to manage in a PCN culture

Profitability through Flexibility

- Demonstrated Cases of Impact on Improved Utilization of Assets
  - New Capability in Legacy Assets
  - Increased Flexibility
- Reduction in Non-Value/Low-Value Added Variable Labor
  - Often high risk jobs
  - Typically tasks subject to over-processing/little control
- Flexibility to be able to shift production closer to Market as demand shifts geographically
- Reduced overhead to support due to greater capability in variation management

Near-Term Key to Sustaining

- Integrator or “Solution Provider” Deployment Model



Leverage the Integrator to Deliver Capability and Realize Value Sooner

Fact: At many Industry Sites, Integrator Personnel our filling Operational Support Roles

Benefits of Open Source

- Cost
- Crowd power
- Customizability
- Flexibility
- Interoperability
- Reliability
  - Code review
  - Free testing
- Security!
- Try before you buy

http://logoary.com/open-source-software-logos.htm

Newest Institute in Robotics

Some objectives of the new institute:

- Supporting advanced robotics capabilities for manufacturing
- Standardizing interfaces for cross-platform compatibility
- Modularizing and scaling components to larger systems
- Enabling a collaborative development environment
- Developing the workforce through training curriculum and hands-on classes
- Transferring technology via open-source license
- Providing affordability for small and medium enterprises

http://www.arminstitute.org/

Resources

- ROS-Industrial
  - Home: rosindustrial.org
  - Documentation: wiki.ros.org/industrial
  - Code: https://github.com/ros-industrial
  - Training: rosindustrial.org/training
- Upcoming Events
  - ROS-I Americas Training – April 10-12
  - Register! https://rosindustrial.org/events/2018/04/10/ric-americas-spring-ros-i-training

Contact Information

Matt Robinson

SwRI

Phone: 210-522-5823

Email:matt.robinson@swri.org

www.ROSindustrial.org