Flexible Automation for Manufacturing in Heavy Industries

Matt Robinson
December 12, 2017
Agenda

• Introduction
• Drivers
• Limitations of Automation Today
• The Opportunity
  – Example Use Case
• Sustainability for Profitable Manufacturing
SwRI: Deep Sea to Deep Space

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

Alvin submersible

New Horizons, Pluto
A Manufacturing Footprint

Static, does not respond to volatility
The Product Challenge

- Disparate Products – with disparate components or parts in various states
The Market

- Constantly Changing
- Subject to Swings in volume and region
The Legacy Factory

- Factories by Product
- Lines by Model
- Existing Asset Base Drives Resistance to Change

<table>
<thead>
<tr>
<th>Location</th>
<th>Demand/Capacity</th>
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<tbody>
<tr>
<td>1</td>
<td>Utilized Capacity</td>
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<td>2</td>
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<td>5</td>
<td>Utilized Capacity</td>
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Variable Time is Money

- Talk of Automation in terms of volume of material processed
- In a Value Stream there is additional Time added to support the automation eroding value

Significant inefficiencies driven by limitations in legacy systems & processes

Though “85% of Weld Volume is Automated”, in the context of time 66% of time is manual activity to enable and compliment the automation
# Operations Support - Hidden Costs

## Cost Drivers that Challenge Period Cost Structure to Support Automation

<table>
<thead>
<tr>
<th>Program New Parts</th>
<th>Update/Create Programs for Engineering Changes</th>
<th>Modify Programs to Resolve Down Condition</th>
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<tbody>
<tr>
<td>- Asset Specific</td>
<td>- Involves Detail Program Review</td>
<td>- Input Variations</td>
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<tr>
<td>- Programs do not transfer or scale</td>
<td>- Programs are still asset specific</td>
<td>- Limited Range to Manage Change in Condition</td>
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<tr>
<td>- Creation of New Program is Cumbersome</td>
<td>- Validation ‘On the Fly’ – under supervision</td>
<td>- Desire to Meet Delivery Timelines</td>
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<tr>
<td>- Validation ‘On the Fly’ – under supervision</td>
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<td>- Difficult to manage in a PCN culture</td>
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Evolution of Automation

- Recent reports highlight evolution of automation
- Perception is that Manufacturing Work is nearer to complete automation
- For larger fabrication scenarios this work may be more appropriately defined as ‘Unpredictable Physical Work’
- This is where the development of ROS-Industrial plays a key role

Value Stream Optimization

- The automated solution is only as successful as its inputs, supporting process steps, reliability, and quality of output.
- Merging ROS-Industrial and the initiatives around Digital Manufacturing/IoT, improved efficiencies in operations can be realized.
A Practical Use Case – Edge and Surface Blending

- High Mix-Low Lot Factory Producing Customer Specified Products
- Legacy Assets with lots of work-arounds to meet demand
- Ineffective Utilization of Assets and People
  - Manual Rework Area not even accounted for in accounting cost structure

OEE of this Entire Area = 58%
Utilization of Each Employee = Average of 25%

2 Plate Cutting Operators
1 Crane Operator
1 Grind Area Operator

Parts Head to Fabrication Area

Only an Improvement of 10% OEE on cutting tables enabled elimination of one head-count in this area
Blending – A Stepping Stone, Why ROS-Industrial?

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

Target Adopter is a Low-Lot High Mix Manufacturing Site

Scan-N-Plan Foundation

Integrator Demonstration Robotic Blending Milestone 4

https://youtu.be/PWCpehyKnTY

Link: Robotic Blending Milestone 3
The Bigger ROS-I Picture
Closed Loop Agile Process

- CAD+Scan to Path
- Closed Loop QA
- Improved Order to Delivery
- Improved Product to Market
- Reduced Losses during Product Change
- Enables ability to apply novel optimization and deep learning techniques for dynamic continuous improvement

PLM – Model with Embedded Features – Modeled Welds; Machine Features

MRP and Work Orders/Execution Systems

Source: creaform3d.com

Organization’s manufacturing IP/Process Data

Source: AdvancedManufacturing.org

Process Data to Drive Optimization
Profitability through Flexibility

• Demonstrated Cases of Impact on Improved Utilization of Assets
  – New Capability on 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
Summary

• Heavy Industries significant need for capability & flexibility
• ROS-I has demonstrated capability for variation management and deploying advanced capability across range of assets
• ROS-I provides significant opportunity in the Digital realm for improved value stream optimization
• Robotic Integrators & Machine Tool builders are key to the sustainable deployment in factories
Questions?
Newest US 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
Contact Information

Matt Robinson
ROS-Industrial Consortium Manager - Americas
SwRI

Phone: 210-522-5823
Email: matt.robinson@swri.org

www.ROSindustrial.org