QC / VERIFICATION

AND USING A ROBOT TO DO IT

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AGENDA

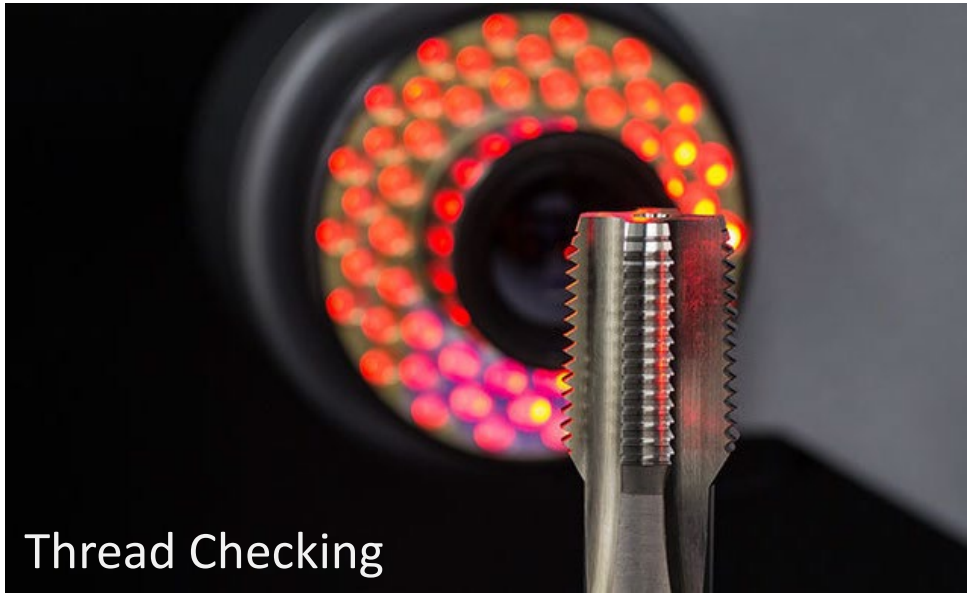
- What kind of QC?
- Application Elements
- Solution Elements
  - Camera
  - Robot
  - Software
  - Data storage/retrieval
- Potential Solutions
- Key Takeaways

What is QC?

In-Process Inspection

- Used to catch:
  - **Defective parts:** Are there known defects to look for?
  - **Process control:** Check for features or orientation of part before process starts
- Barcode reading/verification
  - **“Checking In”** parts to a process
  - Verifying labels in correct position and readable

Post-Process Inspection



Why Automate It?

- Quality Control is inescapable
  - Customers want quality
  - Medical / Semiconductor / Automotive / Aerospace
- Quality Control is Critical
  - Lots of inspection points in manufacturing process
  - Many processes require 100% inspection
- Consequences of either type of error can be high
  - Rejecting good parts
  - Failing to reject bad parts
- Consistency in the inspection process and data storage

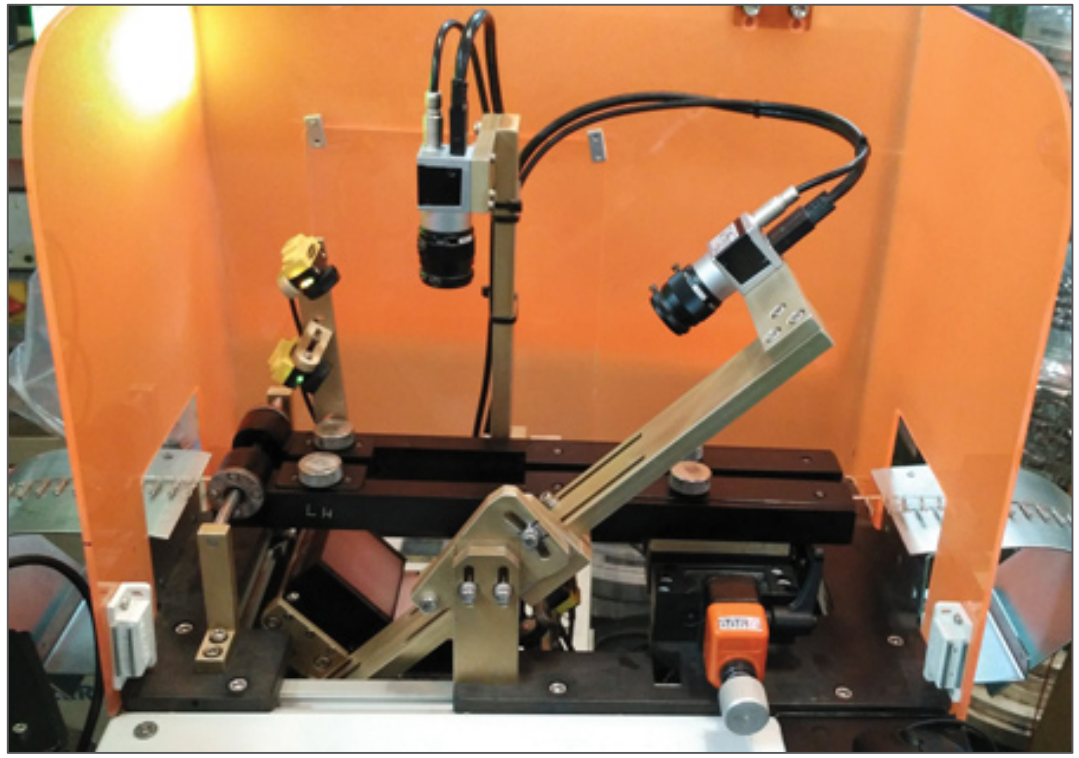
Why Automate it with a Robot?

- For multiple-point inspection in high-mix scenarios

- **Multiple Cameras** vs. Single Robot
  - Multiple cameras cannot reach into recesses for inspection
  - Need to be reconfigured for multiple SKUs

- If cycle time is very fast, use multiple camera system

- Single-point visual inspection is not too difficult



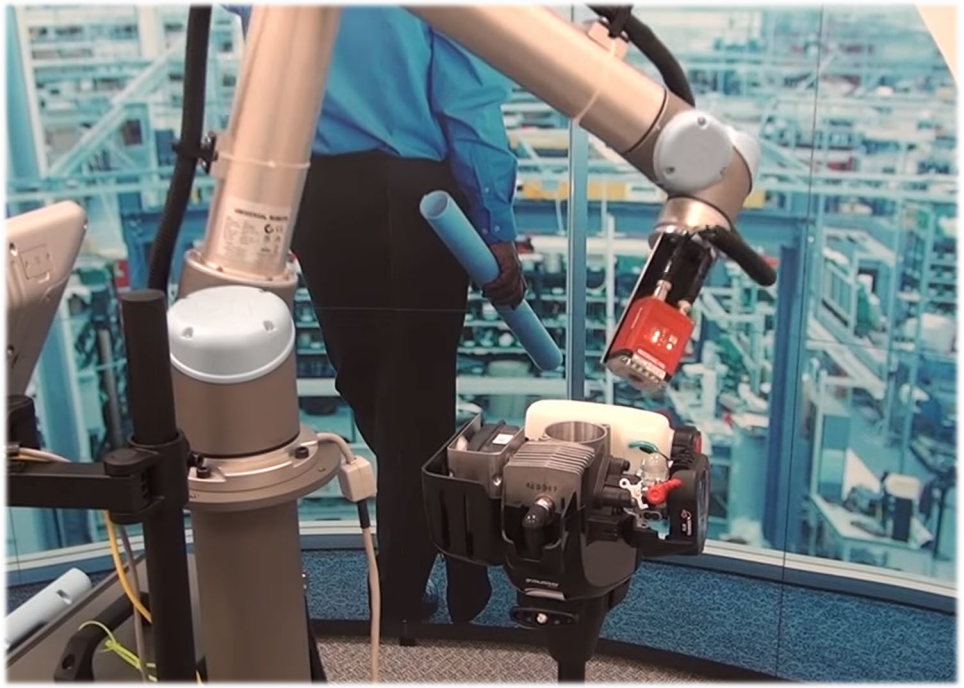
Changeover Time Can Be Significant!

Changeover Time	5 -10 min per batch
Working time per day (est.)	7 hours
Batch Processing Time	30 min
Batches per shift	(7hr * 60min) / 30min = 14
Operators per table	2
# of Inspection Stations	5
Total non-value-add **per shift**	(2 operators * 5 stations) * 5 min * 14 **= 700 min = 11.7 hrs** (2 operators * 5 stations) * 10 min * 14 **= 1400 min = 23.3 hrs**

Assuming Burn Rate of $25/hr…

$292 - $583 every shift

Adding a Robot



Single camera can be moved to multiple locations

Repeatability of Robot = less “fiddling” with focal lengths and other camera variables

One-time recipe setup eliminates changeover time

Robot allows flexibility in manipulating part vs. camera

Evaluating an Application

What Type of Inspection?

- Optical
  - Assembly Verification
  - Feature/Part Presence
  - Laser
- Physical
  - Thread Checking
  - Depth verification
- Post-inspection status
  - Accept
  - Reject
  - Is the part reworkable?

Cycle Time/Throughput Requirements

- Capture rate on camera

- Multiple fixtured cameras vs. robot-assisted

Camera Requirements

- Resolution (Spatial vs. Feature)
- FOV (X and Y)
- Working Distance
- Capture Rate
- Data Storage and Retrieval
- Protocols

$$Min.Resolution = \frac{FOV \times F_p}{R_f}$$

Field of View (X and Y)

# of pixels spanning smallest feature (ideally 4 or more)

Feature Resolution (size of smallest inspected feature)

Robot

- Collaborative = easiest to deploy
  - Don’t need additional guarding and line reconfiguration
- Reach and Pose
- Repeatability
- Payload not typically an issue
  - Heavy parts – put camera on robot
  - But remember – can also flip camera/part manipulation
- Communications
  - Can the robot and the camera be controlled via the same protocol?

Software

- …is the lynchpin of an effective robot+camera system
  - Defines the overall process and controls the actions of both subsystems
- Protocol – can the robot and camera talk easily?
  - Ethernet IP
  - TCP/IP
  - Profinet
  - Etc.
- Control Architecture – robot and camera

Data Storage and Retrieval

- What are your storage requirements?
  - ISO 9001 manufacturers typically have controls in place for records and QC
  - More specialized ISO certs have more in-depth requirements
    - 13485 – Medical Devices
    - 15489 – Records Management
    - etc.
- Need to inspect, but then **need to prove it was done**
- Integration with existing ERP?

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SOME PATHS FORWARD

Solutions Available

Proof of Concepts

- Forces a preliminary dive into your process requirements
  - Part presentation
  - Fixturing
  - Realistic cycle time?
- ALWAYS a good idea to sanity check sample parts against potential camera options
  - Particularly for tight tolerances on dimensions
  - Provide examples of controlled defects along with “good” parts

Turnkey Systems

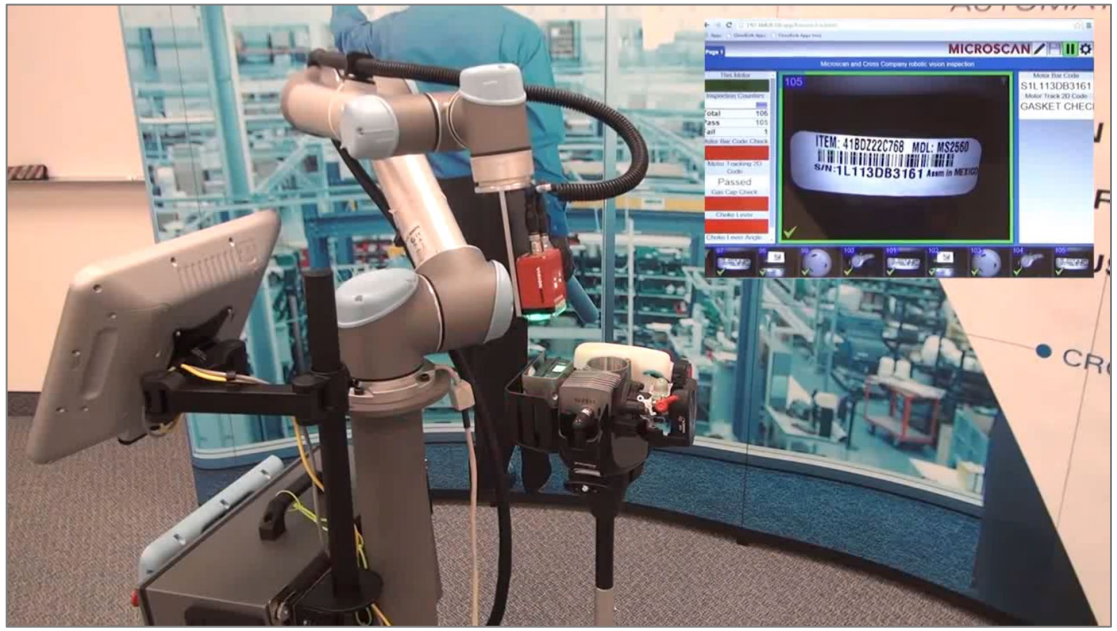
- May be the best way forward for:
  - Sophisticated dimensional inspection requirements
  - Rapid deployment requirement

- Fully configured or as a platform
  - Many providers exist for this

Customized System

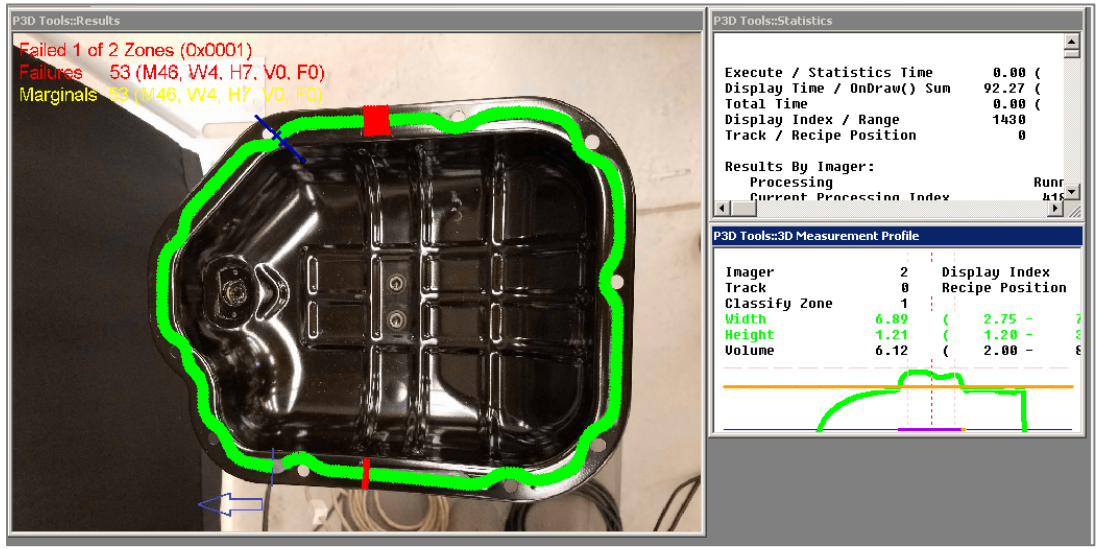
CrossRobotics UR Robot w/ Microscan

- Software interface for intuitive and easy operator training
- Easily create recipes that combine robot and camera actions
- Execute recipes by scanning barcode
- Can be used in both off-line and in-line scenarios
- Recipes and inspection results stored in and accessible from SQL database



CrossRobotics / Coherix Concept

- Coherix uses laser profiling to measure gasket bead
- Software Interface is all Coherix



Demo - Weedeater Assembly Verification

- Mid-stage inspection
- After recipe triggered by 1D barcode scan:
  - Read 2D barcode containing tracking number
  - Confirm cap installed on tank
  - Verify choke lever position

THANK YOU

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