ROBOTIC WELDING AND PRACTICAL LEAN

Stacking the deck in your Favor
Promises realized or not?

Robotic welding, like other forms of automation, is rapidly evolving from its roots in high volume, low mix operations to becoming a game changer in high mix operations also.

However, it is very easy to severely dilute the nominal planned efficiency gains.

Why? Because efficiency is not just determined by the throughput of good units through one process, but also by actual productive uptime, cycle time, and costs throughout the entire value stream.

This session will focus on what drives these critical factors and how to use simple, but high impact Practical Lean tools to realize and sustain the gains that are available from your investment in robotic welding.
Simplified typical process stream: high mix metal fabrication

Lasers/punches → WIP → Press Brakes
Machining
Sawing, CTL
WIP buffer

Manual weld station 1 → 
Manual weld station n → WIP buffer

Cycle time determinant
Simplified typical waste areas: high mix metal fabrication

- Lasers/punches
- Press Brakes
- Machining
- Sawing, CTL
- Manual weld station 1
- Manual weld station n
- WIP piles
  Out-of-sequence scheduling

Downtime & quality

Large WIP piles
Out-of-sequence scheduling

Welding wastes

Out-of-sequence scheduling

Downtime & quality

WIP piles
Out-of-sequence scheduling

WIP

Buffer

Manual weld station 1

Manual weld station n

Buffer
Simplified typical process stream: high mix metal fabrication: robotic weld.

Cycle time determinant

Lasers/punches → WIP buffer → Press Brakes

Machining

Sawing, CTL

Manual weld station 1

Manual weld station n-m

Robotic weld station(s)
So, what improves?

- Absolutely better: robot vs. manual.
  - Costs per length of welds…when welding!
  - Less waste due to quality issues. Consistency.
  - Downtime due to absence.
  - Reduced variation in rates: reduced upstream buffer possible.

- IF:
  - Economic analysis was realistic and all-inclusive of costs of ownership, including:
    - Planned downtime for maintenance, trial programming, etc.
  - No overbuilding upstream to keep robotic station(s) running in order to maximize the efficiency of these stations.
Modern performance metrics

- Total value stream cost versus standard average or blended, or summed COGS output per unit time (week or month).
- On time delivery % and customer service metrics.
  - Complaints, disputes, etc.
- Cycle time average as measured by WIP and COGS.
  - Process WIP is the major determinant. It is also a symptom of costly inefficiencies.
- Costs of Quality (various measures).
  - Scrap and rework waste measures.
  - Returns % of ships.
  - First pass good.
- Asset utilization:
  - Inventory turns.
  - Value adding space vs. total space for production and support.
Maximizing the improvement

• Fix the upstream. The WIP buffers that exist before the weld stations are the major contributor to sluggish cycle times. The fact that they exist indicates inefficiencies and variation….much of which can be reduced dramatically even in high mix production.

• Find and fix the issues that contribute to welding being a high variation (and cost) constraint. Hint: they have nothing to do with the physical weld process.

• Always keep in mind that optimizing the whole does not imply optimizing each of the parts or even any one of the parts. Optimizing the efficiency and output per unit time of the robotic weld stations may in fact de-optimize the entire value stream. Always optimize the value stream as a whole without regard to whether any one process is optimized as far as output.
Fixing the upstream.

• Typical problems:
  • Downtime when machine is needed.
    • Information related: wrong, missing, unclear, etc. Downtime caused by searching, waiting, correcting.
    • Machine failure: major or series of minor requiring “tweaks”.
    • Changeover unrelated to physical set-up. Searching, waiting.
    • Physical set-up.
  • Quality:
    • Wrong information including program.
    • Poor training.
    • Bad material.
    • Damaged tools.
  • Over building and out-of sequence (to master schedule) production.

Fixing the upstream will reduce costs, reduce the WIP buffers dramatically, and ensure that the robotic weld stations downstream are utilized in such a manner that they contribute to optimizing the whole.
Weld stations waste

• Downtime:
  • Finding the right fixture.
  • Interpreting the drawing.
  • Part(s) missing.
  • Poor equipment maintenance.

• Quality:
  • Training and experience.
  • Fatigue: poor ergonomics.

*Note that the downtime issues that contribute to welding process inefficiencies have nothing to do with welding!*
Prescription: Practical Lean

- Information control, availability and integrity.
  - 5s/Visual workplace.
  - Documentation: clarity, appropriate for the process, correct, available.
  - In-sequence production to the master schedule. Visible to all.
- Uptime (OEE).
  - Quick change tooling.
  - Productive maintenance.
- Training/Cross-training/Continuous Improvement.
- One piece/sheet or small batch pull production. Pull from the constraint process. “Two bin” visual kanban and/or min/max supermarkets. Manage WIP by pull and by restricting the space for WIP.
Conclusion

• Robotic welding, like “robotic anything” can provide significant benefits to high mix shops as well as high volume manufacturers.

• But, the process does not operate as a stand-alone island. It is part of a value stream.

• To realize the maximum benefits available for robotic production, the same things must be done to optimize the value stream that would be done for non-robotic production. Otherwise, at best, robotic production would be a small island of efficiency in a sea of gross inefficiency. At worst, it could actually cause more inefficiency in the total value stream.