Intelligent Automation Decision Making for Lateral Flow Manufacturing

Vision Guided Robots vs. Mechanically Tooled Systems

With many hundreds of millions of lateral flow cassettes of varying shapes, sizes and uses being produced annually around the globe, it is no wonder that more manufacturers are moving away from labor-intensive manual assembly lines and into automated manufacturing. With automation comes higher efficiencies, higher quality and lower costs. However, depending on the application, some automated processes can be “over simplified” resulting in less than optimum return on investment.

The process of navigating through the maze of automation offerings can be a considerable challenge. Determining which option is not only best for the process but fits the production volume requirements, flexibility, reliability, maintenance capability and ROI can be a stressful exercise.

The following information and observations are intended to aid those decision makers tasked with this exercise.

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Vision Guided Robots

There appears to be a new perception in the lateral flow device assembly arena that the concept of vision guided robots (VGR) is somehow new and the wave of the future.

This concept has been around for decades, not only for lateral flow but in virtually every industry from microelectronics to automotive.

Kinematic Automation is a company that has been in the lateral flow cassette assembly and diagnostic strip automation industry for over 30 years. Kinematic and others have been utilizing vision guided robots for lateral flow device assembly systems for years.

Whether vision guided processes are used or not, adding vision to automate the quality processes is of great value to automation.

A vision guided assembly process offered as the only option by companies is likely due to the lack of experience in any other workable methodology for mechanical high speed (MHS), reliable cutting and placing of strips.

Good Dedicated MHS cutting and placing technology is faster, more robust, more reliable and more than competitive with VGR systems (ref http://kinematic.com/2390-video.html introduced by Kinematic in 2014). Reliable MHS offers better ROI for those manufacturers who need high volume production day after day, year after year for decades. Having built both VGR and MHS systems for many years, Kinematic is in a unique position to evaluate the differences.

VGR assembly is inherently slow. A rate of about 30 parts per minute is usually top speed. Higher speeds are certainly possible in robot applications where either the pick location or place location or both are pre-programmed and vision guiding is not part of the process (ref https://youtu.be/t7uC2Vnuco introduced by Kinematic in 2000).

VGR systems are typically neither technician nor
If you need additional speed from vision guided processes your choice is to use multiple VGR modules in the bottleneck areas to achieve that additional speed. The problem with that approach is twofold. The system becomes more costly but perhaps more important, as all manufactures know, the system OEE is inversely proportional to the number of in-line processes added.

"Unless it is absolutely and uniquely necessary, it never makes sense to cut strips, place them on a conveyor then pick them up again with a robot and place them into a housing."

**Flexibility**

The primary argument promoted by VGR advocates is flexibility. How valid is this argument compared to a well-designed flexible MHS system? There will be mechanical change-parts involved for both systems. Both robot pick-and-place end-effectors and high-speed end-effectors will require change out on a comparatively equal basis. The same is true for final cassette closure devices. One size does not fit all without compromising process requirements. Some adjustment of the housing conveying system may be required on occasion for both. The incoming strip material tracking system, be it card or web based, will need mechanical guiding adjustment for both.

**Serviceability**

From a machine builder's perspective this is an easy comparison, which relates directly to the same challenges the machine user would have. Simply put, to service a VGR assembly system requires a higher level technician. This technician in many cases may actually necessitate an Engineer or at the very least an expert not only in mechanics but very capable in vision and PLC programming. Unless the user has resident internal capability they will be forever dependent upon the availability of their machine supplier's resources.

**Validation**

Software validation is a comprehensive, expensive, tedious and mandatory exercise required of all lateral flow manufacturers. Once a system has been validated any program revisions or additions will also require validation efforts. For the most part, minor mechanical adjustments do not fall under this requirement.
### Where Do These Three Technologies Fit Best?

<table>
<thead>
<tr>
<th></th>
<th>Flexible Vision Guided Robots</th>
<th>Flexible Mechanical High Speed Cut-and-Place Automation</th>
<th>Dedicated Mechanical High Speed Cut-and-Place Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production Volume</strong></td>
<td>Low Volume (25 - 30 ppm)</td>
<td>Medium Volume (40 ppm)</td>
<td>High Volume (60 – 120+ ppm)</td>
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<tr>
<td><strong>Reliability</strong></td>
<td>Vision system calibration requirements and vision sensitivities such as lighting, optical clarity, and precise visualization of objects can be reliability issues.</td>
<td>More up-time and fewer issues due to better process stability and repeatability</td>
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<tr>
<td><strong>Flexibility for Multiple Products</strong></td>
<td>Modular components and vision can be programmed to recognize numerous parts and housings. Flexibility is achieved through software and mechanical adjustment.</td>
<td>Flexibility is achieved through mechanical adjustment.</td>
<td>Limited in product configurations</td>
</tr>
<tr>
<td><strong>Housing Feeding</strong></td>
<td>Flexible Feeders with Vision Guided Robots</td>
<td>Manual or Magazine Feeding</td>
<td>Vibratory or Centrifugal Bowl Feeding</td>
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<tr>
<td><strong>Service Personnel Required</strong></td>
<td>Troubleshooting and programming robot and vision software requires high-level resident technical support.</td>
<td>Only minimal level resident technical support required</td>
<td>Mid-level resident technical support required</td>
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<tr>
<td><strong>Validation</strong></td>
<td>Software-intensive systems are challenging and cumbersome to validate both initially and for future changes.</td>
<td>More traditional validation efforts are required for automated processes.</td>
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<tr>
<td><strong>Floor Space / Size</strong></td>
<td>Comparable Footprints</td>
<td>Larger footprint</td>
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**ROI: Price/Performance**

Risk mitigation, experience, industry knowledge and most of all testimonials from current assembly systems users in the lateral flow arena are key factors when considering new automation. For most manufacturers however, the ROI element of their decision making matrix is perhaps the most important factor when considering either VGR or MHS. At the end of the day how much good product is produced and what is the comparative cost associated per unit will be a prominent factor.

“If the automation choice is less than successful the ramifications can be devastating for both company and career.”

The decision making process for a piece of new automation is always a complicated one. In most instances the decision maker is under enormous pressure to get it right. If successful, the company benefits as well as the career of the decision maker within that company. If the automation choice is less than successful the ramifications can be devastating for both company and career.

I hope this article helps potential decision makers to ask the right questions and to consider the history of their potential automation choices by soliciting recommendations for performance and service from lateral flow cassette assembly system users.

-Ted Meigs