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 35 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.

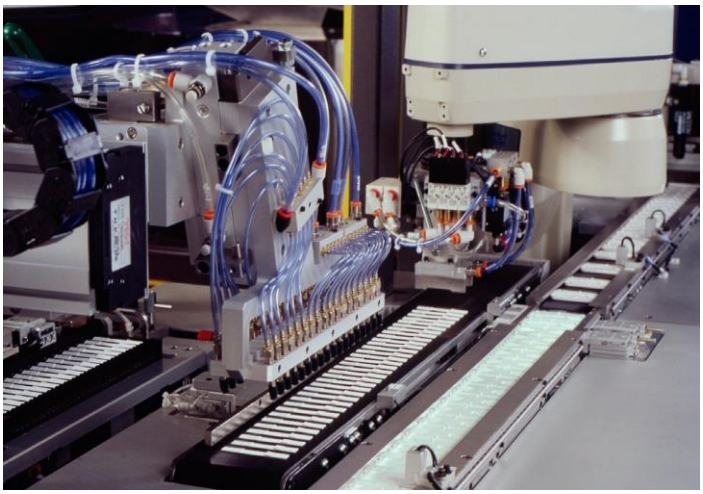
The Kinematic Automation *Matrix 2390* with dedicated MHS cutting and placing technology at 60 ppm in this configuration.

Speed and Reliability

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/t7uC2Vnucvo i*ntroduced by Kinematic in 2000*).

VGR systems are typically neither technician nor

maintenance friendly and may require high level resident expertise on every shift.



The QS5242 Cassette Assembly Platform designed and built by Kinematic utilizing robots pre-programmed for pick and place delivering 60 ppm.

Vision guided pick and place makes sense for feeding lateral flow housings when the geometry of the housing parts to be fed automatically cannot be processed with conventional dedicated mechanical high speed feeder systems such as vibratory or centrifugal bowls or when flexibility is required for multiple housing shapes. This is where commercially available or custom flex feeders (vision guided feeders) may be the only choice. However, to achieve rates approaching 60 ppm may require multiple flex feed systems.

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. Cutting and placing in one continuous motion without a strip exchange between the two processes is not only much more reliable but is proven technology at rates exceeding 8 strips per second. Strip width can be easily selectable with a configurable drive system and strip length is a simple mechanical adjustment. All for less than the cost of a vision guided robot functioning at a maximum rate of about 1 strip every two seconds.

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.

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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?

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

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.

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.

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Soliciting references for performance and service from suppliers being considered is perhaps the single most important step in the selection process.

I hope this article will serve to help potential decision makers to ask the right questions.

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