

The Next Step - When and What to Automate

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Over the past decade, *Lean Manufacturing* has been a major topic regarding the manufacturing strategies of progressive industrial companies. According to this approach, plants will initially move from traditional batch manufacturing to *Lean Manufacturing*, which is also known as *Just In Time Manufacturing* (JIT) or *Continuous Flow Manufacturing* (CFM). Many companies are taking the next step in a plan to move to an automated and integrated manufacturing facility. With this step, the plants invest capital in order to add automated processes and *Computer Integrated Manufacturing* (CIM) to their strategy. Within this strategy, the automation of material conversion, assembly operations, and quality control processes can achieve significant benefits.

When regarding assembly automation, the journey from *Lean Manufacturing* to *Integrated Manufacturing* is sound since this planned approach will eliminate the "waste" processes which otherwise would have been included in the automation. In addition, it is easier and better to automate a flow line of similar part families and similar processes than to attempt to mechanize islands of operations and hope there is some overall benefit. Does this mean that all automation projects should be put on hold until *Lean Manufacturing* is fully implemented? The answer is a definitive No! Although flow lines are a natural candidate for automation, there are many other places where automation would yield meaningful benefits and it would not make sense to delay the projects. This article will deal with the questions of when and what to automate.

When to Automate

The first thing that should be done when considering automation is to review the tactical issues. That is, what are you actually trying to accomplish by automating? Although special circumstances may offer a number of reasons to automate, the five primary reasons that dominate corporate tactical thinking are: reduce cost, improve quality, reduce inventory, improve response time, and improve ergonomics.

Each of these is summarized below:

Reduce Cost

When considering automation as a cost reduction, management traditionally focuses on direct labor. Reducing direct labor is the most obvious method of reducing costs; however, we must be careful when analyzing this scenario. The important thing to remember is that eliminating direct labor results in a cost reduction only when the actual headcount is lower than what would be required to produce the same volume manually. When automation does create an actual headcount reduction, that labor savings is usually specified as the entire cost reduction and other cost benefits are often overlooked.

One frequently overlooked cost saving is the reduction of indirect labor since automation will generally reduce the amount of material handling and orientation time required with manual operations. Reduction of in-process inventory is another significant cost savings that occurs when automation replaces batch operations. Finished goods inventory can often be reduced as well. Another cost benefit of automation is scrap reduction since an automated line will inspect for parts present and will often integrate functional testing. In addition, defective piece parts are rejected by automated stations. Finally, when there is an automated line instead of individual workstations, the cost for training can be effectively reduced when it is necessary to add personnel.

Improve Quality

There are a number of ways that automation will improve the quality of your products. Two methods that were previously mentioned are the inspection of parts present and the use of in-process testing. Any proper automation will verify the presence and position of a part after it has been placed into the assembly. Often the equipment will incorporate in-process testing to verify that the product is correct before sending it to the next operation. Another quality improvement is the elimination of piece part rejects. A defective or out-of-tolerance part will usually not pass through the tooling required to automatically feed and load it. This sorting of rejects will improve the quality of the finished goods, but it will also put pressure on the upstream operations to control the piece part quality.

Automation is often used to improve quality since machines can accomplish tasks that are difficult to do manually. For example, automation is frequently used to gauge and match components to achieve a more accurate fit than the primary processes will allow. When automation is used to test products, the parameters must be quantified and the products are accepted or rejected according to those parameters. This eliminates the subjective decision-making and potential for operator error, which is present when testing is done manually. In addition, it is relatively simple to maintain and document test results when utilizing automatic testers. The tester database can be utilized for SPC and Pareto Analysis in order to control root causes of failure.

Reduce Inventory

Automation reduces inventory in the exactly the same manner as *Lean Manufacturing*. Since product flows from station to station instead of sitting in bulk at each operation, the work-in-process inventory is dramatically reduced. In addition, the finished goods inventory can be reduced as automation allows you to make products when they are needed or Just In Time.

Improve Response Time

Response Time is related to *manufacturing cycle* time, which is the time from receipt of an order to shipment of the product. When manufacturing in batch through a number of manual operations, most of that time is spent with the products sitting in "buckets" waiting for value added work to be performed. Again, in a manner similar to *Lean Manufacturing*, automation will improve the response time as products flow from operation to operation. In addition, sub-assemblies can be integrated into the automation line in order to eliminate individual workstations. With the technology available today, flexible automation can further improve response time by processing small lot sizes or incorporating programmable changeovers.

Another way that automation can improve response time is by handling "surge" orders. When the automation project is developed, it should be planned to handle peak capacity. For example, if the equipment can produce the forecast annual quantity in two shifts, five days a week, a "surge" order can be run on third shift or on the weekend. Without the automation, people would have to be added and trained in order to handle the peak volumes.

Improve Ergonomics

The impact of ergonomics is continually increasing when considering automation. As people become aware of the problems associated with cumulative trauma disorders, vibration syndrome, fatigue, and so forth, they also become aware of the need to mechanize the operations that are causing these problems. Automation projects are often initiated when an operation is observed as "carpal tunnel waiting to happen." In most cases, the productivity gained by eliminating the difficult or repetitive operation will justify the expense of automation.

What to Automate

"When to Automate" outlines the primary benefits of automation, but what analysis should be done to indicate that an automation project makes sense in your plant? First, concentrate on the high-volume products. If you only have a few people involved in your annual production, it probably is not worth the effort to investigate automation. Second, look at products with a long product life cycle. If a product is going to be around for less than five years, and your automation project will take two years to implement, it is probably not worth the effort unless the equipment is reconfigurable. Other issues that indicate a potential for automation are excess material handling, operator dependent quality, and operations that are repetitive or difficult to do manually.

When the potential for automation is first recognized, there is a natural tendency to try to automate everything produced in order to increase volumes. This tendency has been the failure of many potentially sound automation projects. Exactly what products to include in the automation have to be analyzed carefully. The following are "rules of thumb" as to what you should consider running on your automation line and what you should leave as manual operations.

As a rule, consider the following for automation:

- Families of Parts - Parts that have the same or similar features.
- Group Technologies - Parts that have the same or very similar processes during manufacture.
- "80/20 Rule" - Parts which contribute to 80% of your volume and encompass only 20% of your part numbers.
- Flow Lines - Parts that have already been organized into a manufacturing line incorporating a continuous flow from operation to operation.
- Repeatable Operations - Parts that have a manufacturing process which is continually repeated.

As a rule, avoid the following when considering automation:

- "Cats & Dogs" - Parts which have different features or processes than the majority of your volume.
- Parts that are Difficult to Feed - Parts which:
 - will nest or tangle,
 - will overlap or shingle,
 - are flexible,
 - are delicate or fragile,
 - are sticky or magnetic,
 - are abrasive,
 - are too large or too small,
 - or, are too light.
- Parts that are Difficult to Orient - Parts which:
 - are oriented by non-geometric features,
 - are oriented by internal features,
 - or are oriented by external features which differ by less than ten percent.
- Parts that are Difficult to Insert - Parts which:
 - are not stable after insertion,
 - are difficult to align,
 - or require multi-directional insertion.
- Operations that are Difficult to Duplicate - Operations where an operator can accomplish the task much easier or quicker than a machine.
- Low Labor Content Operations - Operations where automation would not gain anything in the manufacturing process.

Please keep in mind that these are simply "rules of thumb." The automation being developed with the technology of today allows for a lot more flexibility than was available in the past. It is now relatively easy to mix automation with manual operations and the result will still be a continuous flow line. Therefore, parts or processes that do not lend themselves to automation can often be included in the line by utilizing an operator at that station. As with any significant manufacturing change, automation alternatives, and their respective benefits should be evaluated carefully before making the final decision.