

# OEE is Key in Packaging Automation

Many Manufacturers Investing Heavily to Improve OEE, but Why and How?

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## Overview



Today's CPG manufacturer is faced with a number of difficult challenges. The manufacturer's ability to drive the cost per packaged unit down while maintaining the flexibility to innovate and integrate new packaging solutions is crucial to the ultimate success and profitability of their product. An engineering team's ability to take a packaging concept devised by marketing and implement it quickly (using existing machinery without sacrificing product run rate) can mean the difference between success and failure of a product.

New requirements from retail outlets of consumer products are driving new packaging innovations from manufacturers. Retailers are evolving, resulting in the need for more customized solutions. In order to compete in today's highly competitive marketplace, retailers have been forced to reduce back room space and as a result, costly overhead. On-hand inventory needs to move from the retailer's loading dock to their shelves as quickly and efficiently as possible. Retail-Ready packaging and customized pallets containing different varieties of product are examples of solutions that help the retailer remain competitive.

The requirements of today's consumer are also driving innovation from the CPG manufacturer. Buying tendencies vary based on the age, social and economical status of the consumer. A 17-year old is not likely to purchase toothpaste that is marketed for a senior citizen even though the actual product may be identical for both consumers. Manufacturers sometimes package the same product three or four different ways, each targeting a very specific consumer market segment. Consumers spanning multiple age groups and segments are demanding organic products that have much shorter shelf lives. This ultimately increases the importance of getting the product from the manufacturing line to the consumer as quickly as possible. Many consumers demand packaging materials that are sustainable and eco-friendly. These types of materials can be thinner, softer, and more fragile which creates new challenges for the CPG manufacturer.

In order to succeed in the current consumer market, manufacturers must address all of these requirements while maintaining a reasonable cost point for their product. Advances in automation over the past 25 years have allowed manufacturers to become very proficient at mass production of a particular product. The introduction of new customization requirements has had a significant effect on the overall production efficiency. As a result, many manufacturers are investing heavily to improve the OEE of their entire packaging line. OEE is a quantitative measurement of Overall Equipment Effectiveness that takes all of the following into account:

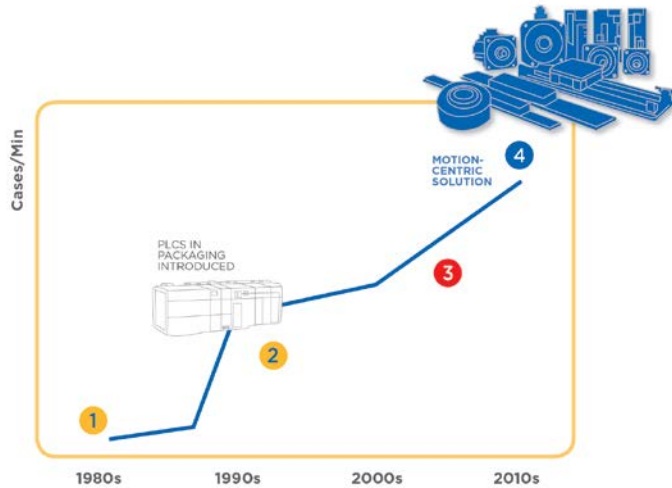
- Performance – the ratio of actual run rate / ideal run rate
- Quality – the ratio of good units / total units
- Machine Availability – the ratio of operating time / planned production time

This OEE calculation can be used as a snapshot of the effectiveness of an entire packaging line.



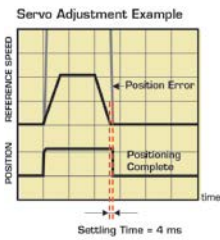
## Traditional Approach

The traditional approach for optimizing OEE on a packaging line consists of using a PLC based model from a single source automation supplier. This approach focuses heavily on maintenance in an attempt to limit downtime. An alternate and potentially more successful approach is based on a motion-centric model with a focus on productive outcome. The key is to not only focus on keeping the machine running, which directly affects the Machine Availability variable in OEE, but to address all of the OEE variables with a motion-centric solution that is flexible enough to allow for new packaging innovations.



- 1 PRIOR TO AUTOMATION**  
Chip packaging was done manually. Demand increased. End users added more people to keep up with demand.
- 2 THE FIRST WAVE OF AUTOMATION**  
Until they had to automate, these first machines were very mechanical and had PLC control. Attention quickly turned to maintenance. In order to reduce costs, components like the PLC were standardized.
- 3 THE PROBLEM**  
Maintenance focus produced on average a 45-50% OEE across the CPG industry
- 4 THE SOLUTION**  
Packagers are driving toward OEE targets of 85-90% with higher throughput and faster changeover using the motion-centric solution

## Performance



### Benefit of Reduced Settling Time

#### Pick and Place Example with 50 ms Settling Time

Axis Length	Move	Settle	Move	Settle	Time Per Part	Parts Per Minute	Parts Per Hour	Price Per Part	Revenue Per Hour
X = 200 mm	0.5 s	0.05 s	0.5 s	0.05 s	-	-	-	-	-
Z = 100 mm	0.2 s	0.05 s	0.2 s	0.05 s	-	-	-	-	-
<b>Total</b>	<b>0.7 s</b>	<b>0.1 s</b>	<b>0.7 s</b>	<b>0.1 s</b>	<b>1.6 s</b>	<b>37.5</b>	<b>2250</b>	<b>\$0.1</b>	<b>\$225.00</b>

#### Pick and Place Example with 4 ms Settling Time

Axis Length	Move	Settle	Move	Settle	Time Per Part	Parts Per Minute	Parts Per Hour	Price Per Part	Revenue Per Hour
X = 200 mm	0.5 s	0.004 s	0.5 s	0.004 s	-	-	-	-	-
Z = 100 mm	0.2 s	0.004 s	0.2 s	0.004 s	-	-	-	-	-
<b>Total</b>	<b>0.7 s</b>	<b>0.008 s</b>	<b>0.7 s</b>	<b>0.008 s</b>	<b>1.416 s</b>	<b>42.37</b>	<b>2542</b>	<b>\$0.1</b>	<b>\$254.24</b>

Revenue Per Hour	\$29.24
16 Hours	\$467.84
6 Days	\$2,807.04
<b>50 Weeks / Year</b>	<b>\$140,352.00</b>

Performance of a packaging line is often dependent on the motion control solution. The throughput of the packaging line is a critical piece of the overall line performance. The throughput of each individual process can be impacted by the capability of the specific motion control solution chosen. Some of the more sophisticated motion control electronics employ advanced servo algorithms that assist in

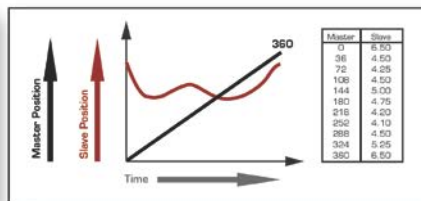
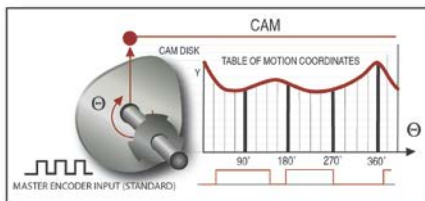
decreasing settling time of discrete machine movements. Even a small decrease in the settling time of each discrete machine movement in a production cycle can result in a significant reduction in overall production cycle time. Ultimately this leads to more units being shipped per hour and a lower overall cost per unit.



The efficiency of machine changeovers also affects the overall throughput and consequently the overall performance of a packaging line. Machine changeovers are dramatically simplified through the use of robotics. Typical processes at the end of the manufacturing line (picking, packing and palletizing) tend to have a lot of variability due to differences in customer requirements. Industrial robots are inherently designed for flexibility and are a perfect fit for these types of applications. By eliminating rigid automation equipment in favor of customizable robotics, the manufacturer has a virtually limitless array of application solutions at its disposal. Optimal performance is attained via the quick changeover capability of robotics.

## Quality

Yaskawa America has developed a variety of reusable code libraries, called application toolboxes, for its controllers. These toolboxes can be imported into user programs as a User Library to form the foundation of a complete, customized solution. They also save time for developers who would otherwise have to start programming from scratch. An onboard OPC server can be used to stream large data arrays for thousands of individual recipes to the controller via HTTP communications. This allows the CPG manufacturer to effectively manage thousands of product SKU's. These large data arrays, each consisting of thousands of points, are managed by camming and kinematic toolboxes that are specific to typical packaging applications. These toolboxes streamline the implementation of complex machine move profiles with a resultant motion path that is extremely smooth and efficient. Ultimately, this results in higher throughput and reduced wear on mechanical components on the machine. This functionality contributes to both the overall quality of the packaged product as well as decreased overall cost per unit.



## Machine Availability

Machine availability can be greatly improved simply by the specification of machine components that do not fail. Yaskawa recently performed an internal study to determine the out of box failure rate over a period of time where 100,000 motors were shipped. Some motor manufacturers set failure rate goals around 0.5% (which in this case would be 500 motors). Of the 100,000 motors that Yaskawa shipped, 7 came back for warranty repair.



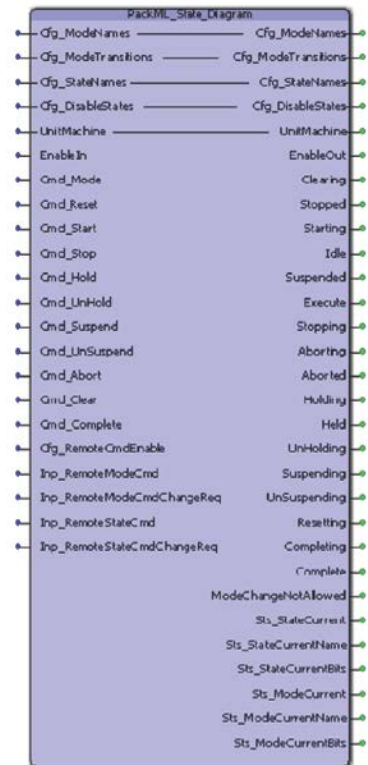
The flexibility of the automation solution can also impact machine availability. As discussed above, custom packaging requirements and shorter manufacturing runs are becoming the norm for today's CPG manufacturer. Changeover time between production runs can significantly impact overall line efficiency. Industrial robots lend themselves to this type of required flexibility. They have the ability to move from one job to another with only a program change. Mechanical adjustment and machine reconfiguration can be almost completely avoided in this scenario.

Giving the production manager the ability to monitor his or her production line from anywhere at any time can be a key contributor to increased uptime. Machine controllers with an integrated web server offer access to real time status and diagnostics from any device that can access the internet. This provides the user the ability to load modifications or enhancements to a machine's control program (from the machine builder or integrator) without having to purchase and control any development software.



Many automation products are now equipped with built in preventative maintenance tools. Variable frequency drives are designed with *life monitors* that proactively provide the maintenance team with information that will help avoid downtime. The drive sends out notifications and warnings when consumable components like cooling fans, DC bus capacitors, inrush relays, and IGBTs are nearing the end of their predicted lifespan so that they can be replaced prior to failure during operation.

Monitoring all of the individual variables that makeup the OEE calculation in a consistent and repeatable manner can sometimes be as important as the work done to improve the manufacturing process. Among the application toolboxes Yaskawa has developed is the PackML toolbox, which is designed to help packaging end users manage and measure the effectiveness of their packaging line. This development consists of a PackML project template and toolbox containing core code for using the PackML machine state diagram. Using this globally standardized machine code architecture helps the end user reduce the amount of time and expense involved in integrating machines from different suppliers into a cohesive production line. Utilization of the PackML toolbox also simplifies the process of data collection for the measurement of OEE.





## The Result

Most often the OEE bottleneck is directly related to the automation solution that has been implemented on the packaging machine or line. This automation bottleneck can not only impede the end user's ability to increase the effectiveness of the manufacturing line, it can also limit the end user's ability to implement new and innovative packaging designs. Therefore, it is extremely important to work with an automation supplier that has experience working with packaging end users to solve OEE bottlenecks. For more information on Yaskawa's products, tools, and engineering capabilities please visit [www.yaskawa.com](http://www.yaskawa.com).

