SMT OEE

Cracking the Code of Micro-Stops: A Game-Changer for SMT Productivity

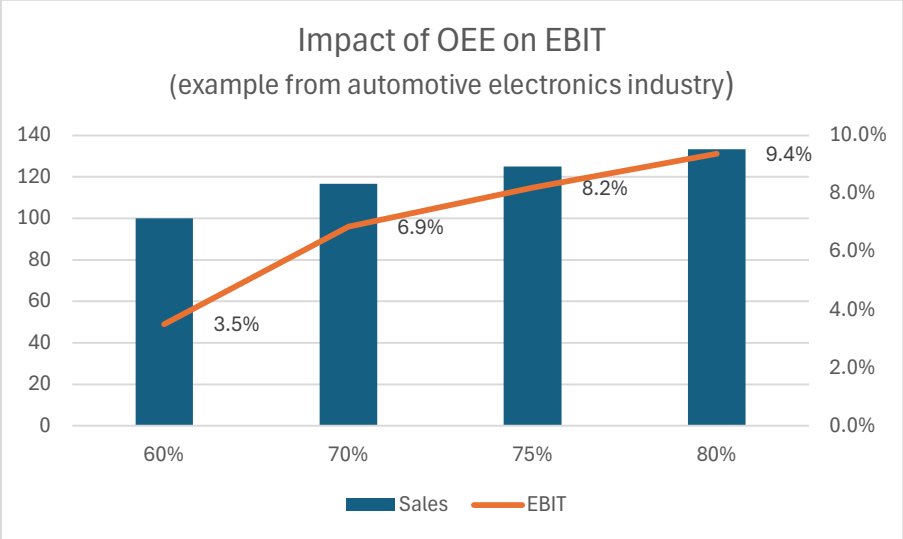
Swarna Kamal Banerjee

SMT OEE and impact on business performance

The highest value addition in the manufacturing of electronic products usually happens in the SMT (Surface Mount Technology) process where electronic components are assembled on bare PCBs (Printed Circuit Boards).

SMT lines are made up of a series of highly automated machines performing complex operations (solder paste printing, component placement, optical inspections etc.) at high speed. The capital expenditure for one SMT line is in the range of 2 to 3 million USD, sometimes even higher. Typically, these lines feed multiple final assembly and test lines and can therefore impact the efficiency of the whole plant. The complexity of SMT lines make them prone to losses caused by breakdowns, changeovers and micro-stops (also known as Chokote). Micro-stops are intermittent short duration stops that often account for a surprisingly high share of total losses.

In SMT process, OEE (Overall Equipment Effectiveness) of 80 to 85% is considered good. However, achieving 80 to 85% OEE is a formidable task.



OEE has a high impact on profitability. The above example from the automotive electronics industry shows the impact of OEE on EBIT. ***Improving OEE from 60% to 70% can improve EBIT by approx. 3.5% and improving OEE from 60% to 80% can improve EBIT by as much as 6%***.

In addition to the impact on profit, non-achievement of planned OEE levels result in extended working hours, missed shipment schedules with associated high costs incurred in overtime and expedited freight. In some cases, this can even result in supply disruptions and severe customer dissatisfaction.

It should be obvious that continuous monitoring and improvement of OEE is a powerful lever for improving business performance.

The challenge of OEE improvement

Industry has been focusing on breakdown and changeover reduction to improve OEE. Investments in improving maintenance management systems and training of maintenance crew have helped in reducing breakdowns over

time. Recently there has been noticeable activity in Predictive Maintenance technology, Remote Monitoring and Troubleshooting to reduce breakdowns further.

Lean Manufacturing methodologies have helped in streamlining changeover processes resulting in optimized changeover times. Despite these advances, achieving acceptable levels of OEE (~ 85%) remains a hard problem. Part of this can be explained by the low level of attention paid to micro-stops.

The table below shows typical performance levels observed in SMT processes.

	Target	Recorded Performance		Percentage Improvement Potential
		Good	Poor	
OEE	>85%	80%	60%	20%
Breakdown	<5%	5%	10%	5%
Changeovers	<5%	5%	10%	5%
Micro-stops	<5%	5%	20%	15%

Micro-Stops

There has been considerably less investment made in finding solutions to reduce micro-stops, typically the largest contributor to a sub-optimal OEE. The probable reason for this is the fact that micro-stops are almost 'invisible'.

Breakdowns on the other hand are easily visible as they cause a major disruption of manufacturing. Single instances can have a significant impact on

production output. These events are recorded and reported. Metrics like MTBF (Mean Time between Failure) and MTTR (Mean Time to Repair) are tracked by most organizations.

Changeovers are also very visible as they are planned and every instance results in several minutes of downtime.

Performance losses due to micro-stops on the other hand are not very visible and therefore not well understood. SMT lines (and in general any transfer line) are made up of many automated high-speed machines connected in series. Such machines are prone to intermittent issues and short stops when any one of the multiple conditions necessary to proceed safely to the next step of operation is not fulfilled. Misfeeds from component feeders, nozzle clogging, vision system errors, conveyor jams are only a few examples. The duration of such micro-stops is typically between a few seconds to several mins. Thus, each instance of micro-stop does not impact production output significantly.

Micro-stops happen at relatively high frequency in SMT lines and need quick troubleshooting by line operators. The operators' focus therefore is on troubleshooting. Troubleshooting can involve actions like quick inspection and confirmation to proceed, component feeder adjustments, error message resolution, etc. The priority is to get the line up-and-running as fast as possible. Operators may need to move from one issue to the next in quick succession making the task of recording a micro-stop and their causes utterly infeasible.

The above are key to why micro-stops are rarely recorded and analyzed. Almost not 'noticed' by management and considered as 'part of the process'. Something that one has to live with.

But the cumulative effect of micro-stops during a run, shift or day can be quite high. Depending on the maturity of the plant, the complexity of the products and the experience and skill level of operators, ***loss of production from micro-stops can range from a 10 to 20% (sometimes even higher)***. This is akin to death by a thousand cuts.

As a result, 10 to 20% of the overall losses are 'hidden'. Not measured, not reported, not analyzed and not acted upon. In many cases such losses are carefully buried under inflated standard cycle times or are wrongly accounted for under other causes to reduce this unexplained category of losses to levels that do not trigger alarm bells.

Attempts at manually recording micro-stops are mostly ineffective. Accuracy of manually collected data is poor, and the sustenance of such manual processes is a major challenge.

The emergence of Data Science and AI (thereby opening up a powerful set of tools to analyze data and extract meaningful insights) and IIoT (the ability to collect complete and accurate manufacturing data) presents us with the means to significantly reduce micro-stops to boost profits.