

How the **Factory Ecosystem** Positively Drives Exponential Value

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We have all learned that synergy means $2 + 2 = 5$. This is an old cliché but in today's factories the output must far exceed the accumulative performance of each machine to stay competitive. No machine or process is an island—they must form ecosystems. The trend towards extreme automation and the smart factory leads to ever more connectivity and interdependence.

Let's look at a few examples of the thermal process, which is close to my heart. This is arguably the least understood and the lowest priority in most factories. Most factories will use a manual profiler to spot-check their thermal processes once monthly, weekly or daily. The thinking is that the thermal process appears to be fine and does not need much attention. As electronics become ever smaller and more complex, the thermal process window keeps shrinking with a narrow margin of error.

The reflow profiler's prediction software can identify the optimal oven set points for each assembly and reduce NPI time. More advanced optimization will enable near-instant oven changeover time as well as reduced electricity use. This combination of spot check and optimization impacts the entire line as well as the utility bill.

Most engineers estimate that reflow contributes less than five percent of all SMT defects. Yet, when a production line is shut down due to a defect issue, much (expensive) downtime is wasted trying to determine whether the reflow process was the culprit. This is because reflow is a black box process, and therefore, an unknown, as only spot checks have been applied to determine its status. When a yield problem occurs, the manual profiler is sitting on a shelf somewhere. Adding a continuous monitoring system provides insight into the thermal process always, instantly verifying whether the reflow process was the defect culprit. If the profile was out of spec, the system

also will provide insight into what changed, enabling maintenance personnel to fix the problem faster. Not only will adding automatic profiling improve the reflow process, but the entire production line uptime will increase due to faster troubleshooting and elimination of manual tasks.

The average manufacturing engineer spends 40% of his/her time looking for equipment, personnel, information, etc. Again, profiling is a contributor. There are multiple profile tasks for multiple jobs over multiple ovens. The new industry trend of producing products in larger varieties builds further complexities. Centralizing all reflow (wave, select) data in a single database allows the engineer to manage and retrieve the exact data required with a few mouse clicks on any authorized PC or mobile device. Relevant data for each PCB produced becomes available in seconds.

Smart factories make good use of machine and process data to run their operations more effectively. Adding analytics to thermal process data enables a higher level of automation and productivity. For example, an intelligent database that learns the relationship between each assembly, process window and oven properties can eliminate or reduce the need for manual profiling. Entering a new PCB assembly length, width and weight into the software will produce a recommended optimal setup. Data analytics promises predictive process control and preventive maintenance to further enhance productivity and advancement towards the zero-defect goal. The data will not only be used to sub-optimize the thermal processes, but it can be shared with other machines and MES systems via the factory network to optimize multiple lines as well as the whole factory.

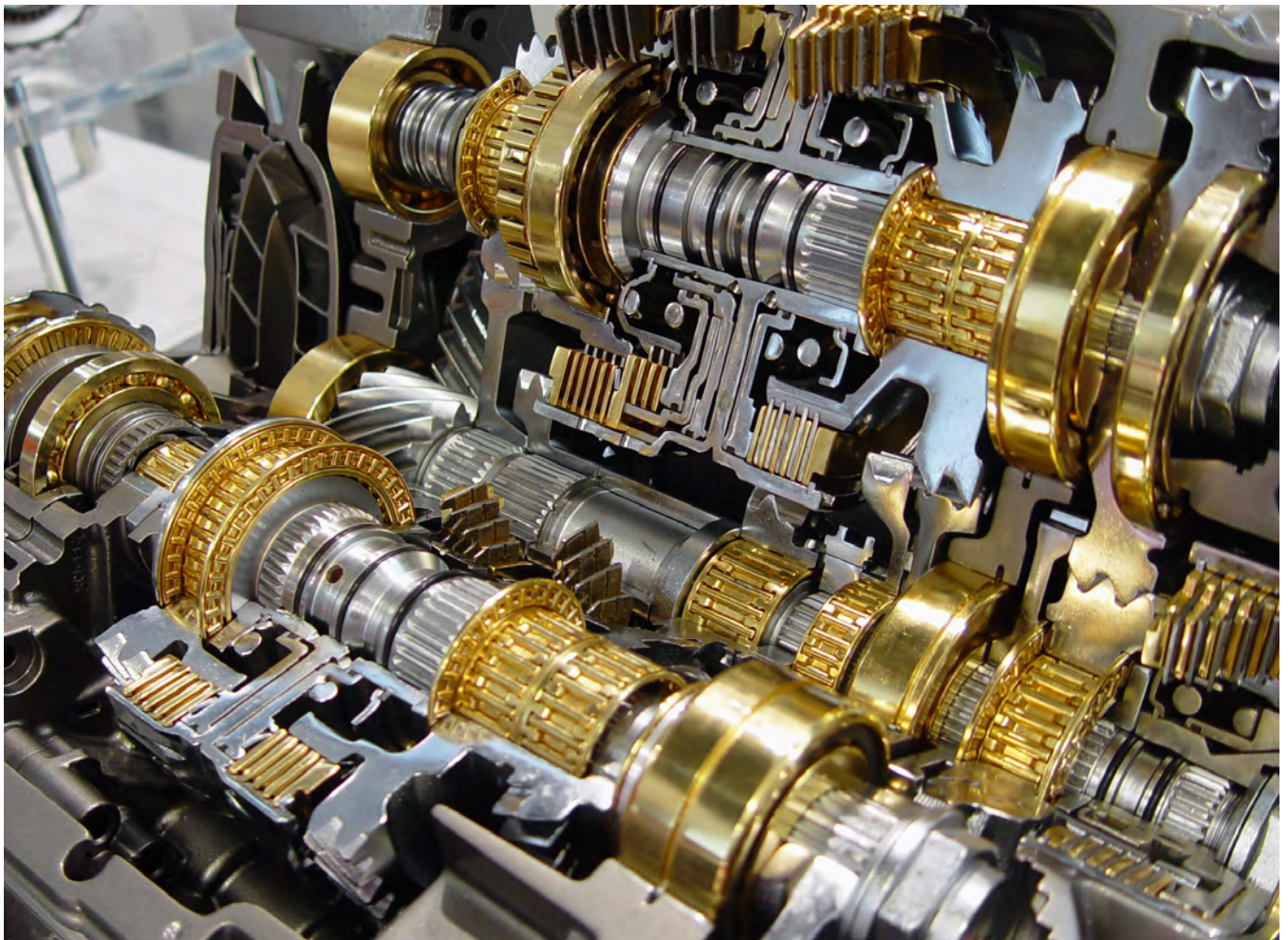


Figure 1: Several moving parts form an ecosystem.

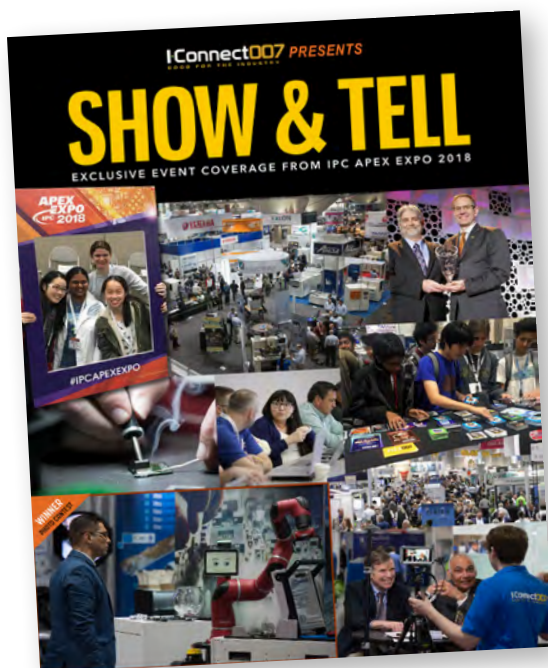
Each manual profiler, optimization software program, automatic profiler, central database model and data analytics offer significant individual value. But when they are combined, the value grows exponentially. A truly competitive operation can be built only when data is shared with other machines or the MES system. Productivity increases, cost decreases and consistent quality results. But interdependence and added value do not stop there. While engineers and technical managers are responsible for running a world-class factory, the salesforce and corporate executives are focused on promoting a competitive factory attractive to new (and current) clients. They are thinking about their factory's "uniqueness" and competitive advantages that can give them an edge in winning that next multi-million euro order. On top of a cost-effective operation, promoting capabilities that clients value such as process control, process transparency and process traceability down to individual PCBs, can mean the difference between winning or losing an order.

Electronic manufacturing is a capital-intensive business. A key part of engineering, management and purchasing's responsibilities is to acquire the right machines and software for their factories. There is significant money at stake, and there is pressure on factory performance in an intensely competitive low-margin industry. Reviewing each individual machine or software in isolation may lead to sub-optimization in an interdependent and interconnected environment. An ecosystem is more than the sum of each product's capabilities and benefits. Together they create exponential value that far surpasses the individual machine or process, it affects the entire factory and even deep into the non-technical aspects of a running a successful business. **SMT007**



Freddie Chan is the vice president of KIC.

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