The case for efficient electronics manufacturing in the United States

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The tremendous decline in U.S. manufacturing in favor of foreign manufacturing in Mexico, Eastern Europe, and Asia has been fueled by the presumption that lower costs are achieved in those locales. Military and other government customers, however, would prefer U.S. manufacturing for reasons regarding security, confidentiality, and compliance.

The oft-cited rationale for foreign manufacturing is lower labor cost. Additional factors, such as proximity to source of component supply, less onerous government regulation, financial incentives, and costs of construction are also mentioned, but to a lesser degree. Taking China as an example, there is little argument that unskilled workers are in plentiful supply and cheap, but this labor sector comprises only one facet of manufacturing needs. If your product requires a significant amount of hand-touch labor, there may be real savings to be had, yet in many cases, automation significantly reduces and, at times, eliminates the need for unskilled workers and the financial benefits of this factor are significantly reduced.

Moreover, those companies that have done significant work in China know that while low-paid unskilled workers are plentiful, the same is not true of support engineers and other highly skilled professionals, whose salaries in recent years have increased substantially as U.S. companies compete for them. This segment of the work population is highly mobile, with workers continually changing jobs for small increases in pay. Not only is the economic benefit of lower professional salaries in decline but the disruption to a company's production is high as·there is an ongoing need to recruit and train replacement technicians and engineers.

To combat the resulting loss of institutional memory, the company must often resort to transplanting a significant domestic professional and management staff to maintain continuity of production, at great cost.

From an aerospace and defense contracting perspective, one of the greatest disadvantages to foreign manufacturing is lack of control The separation of primary design, mechanical, and process engineering resources from the factory floor on a real-time basis leads to inefficiency, delays in closing feedback loops, and cost. While attempts are made by many companies to re-locate engineering and technical resources to factories in China, generally only a few resources are made available at the local level and those only for temporary service to train foreign workers.

The balance of the interaction is significantly. impeded by 12-hour time differences, long delays for in person interaction, and language barriers. This problem can be exacerbated when manufacturing is outsourced to a contract manufacturer.

How can U.S. manufacturing compete?

U.S. manufacturing can compete with foreign manufacturing on cost by being smarter. By implementing smarter manufacturing processes, U.S. manufacturing becomes more flexible, produces product of higher quality at a lower cost, reacts to problems more quickly, and has tighter controls. Asian manufacturers are generally high-volume, low-mix factories. Military manufacturing is high mix, low volume, more sensitive to yield issues and process problems, and is more demanding of exacting quality. Cost savings in a high-mix, low-volume environment is not a strength of foreign manufacturers and this difference can lead to opportunities for smart U.S. manufacturers.

Automation requires foresight and planning. Instead of automating every task, or purchasing numerous odd form component placement machines to address specific assembly tasks, factories can use a modular approach. Standardized platforms allow for flexibility products and how to design equipment and the manufacturing environment. Each investment also requires a comprehensive return-on-investment analysis done jointly with sales and marketing teams. Not complete automation; smart automation.

At SynQor in Boxborough, Mass., close integration and collaboration of the design team with manufacturing and quality teams enables the design of products for manufacturability and deals with problems quickly. This process can get products into production more efficiently and yields the ability to institute product changes more rapidly. Flexibility is key to high mix manufacturing.

Manufacturing Software

Problems arise in manufacturing, and the solution often is to build intelligence into the manufacturing environment to identify problems in process and in real time-not in finished goods inventory. Home-grown manufacturing process management software can track components through the factory floor and enable operators and technicians to analyze real-time data, flag and isolate production units, and trace components back to individual component lots.

It helps contain non-conforming units immediately, and defective units can be re-routed to re-work without disruption to the flow environment. An investment in manufacturing software also means fewer people dealing with data collection and a higher level of accuracy in data analysis and record keeping- all of paramount importance to the military customer.

Investments in integration with third party SMT, ATE, AOI, and other test and measurement equipment enables faster implementation of machine programming and optimization. This provides more data for analysis and immediate feedback for continuous improvement. Finally, there is often potential to integrate manufacturing with ERP systems. Successful integration means less time planning and managing the factory.

Using the same production resources and equipment in the development of its new products enables development of tooling and programming during the product design phase that can then be used immediately for manufacturing. This reduces the time and cost to help new products make the transition into manufacturing.

Modular design topologies, component commonality, and design for manufacturability are key design concepts that affect the manufacturing environment and the cost of manufacturing. This requires direction from management and buy-in from the research and development engineers and the procurement department. You can't build everything in a cost-effective manufacturing operation. Be selective, and be smart.

Manufacturing Data

One way to compete effectively with high-volume foreign manufacturers is to apply non-military manufacturing data, as well as component usage, throughput, and node yields to the high-mix, low-volume military environment so long as core products are related. All manual entry of data can be eliminated by use of bar code scans, automated program downloads, and pick lists. The safekeeping of confidential information and compliance with regulatory restrictions, such as ITAR, is far more easily managed with the manufacturing facility and data in the U.S.

Many Asian manufacturers solve lead time problems by purchasing raw materials in large quantities and building finished goods inventory. This is a very expensive approach. A different approach is build to order. A robust supply chain and a well-designed manufacturing process with fast cycle times through the factory and high yields can produce short lead times and no need to build to stock. This also greatly reduces the level of raw materials needed on hand. Reducing raw material and finished goods means greater flexibility, less money tied up in inventory, and greater inventory turns. Having a global sourcing strategy means you don't need to relocate to China to be near your source of supply.

"Modular design topologies, component commonality, and design for manufacturability are key."

Why test, inspect, and rework in multiple iterations until you achieve high shipped quality when you can design quality in initially? There are up front and on-going costs but they pale in comparison to the hidden costs of repeated testing, inspection, and re-work-all of which increase the potential for field failures. Building in quality starts with design, continues with component selection, and ends with manufacturing processes. Keeping engineering community close at hand helps to respond quickly to problems and resolve issues to root cause. This can help engineers spend less time and money responding to quality issues and customer complaints and more time designing and selling products. Focus on the total cost of ownership, not just lower labor rates.

Optimize the factory

Lower costs involve more than paychecks to personnel; it also involves how best to run the factory. Incorporating manufacturing process design into product design reduces manufacturing costs. For example, SMT machine set up times can be reduced with optimized off-line setups and by dedicating technicians to product change-over. Sophisticated software developed in-house can help optimize the table set ups and sequencing of product through the factory. Redesigning the product flow from a linear configuration to a re-circulating configuration can make the most of production equipment, reduce the size of the assembly lines, and boost capacity within the factory area available.

Manufacturing in the U.S. can succeed on a cost-competitive basis with Asian or other foreign manufacturing and with significant additional benefits for aerospace and defense customers. The high mix, low volume manufacturing environment has significant challenges but none that can't be overcome' through automation, robust manufacturing processes and controls, standardization and modularity in products and equipment, and high quality process standards. Having . manufacturing lines close at hand to your design, mechanical and process engineers and technical personnel results in significant advantages such as tighter controls, greater flexibility and increased first-pass yield which leads to lower scrap rates and lower costs.