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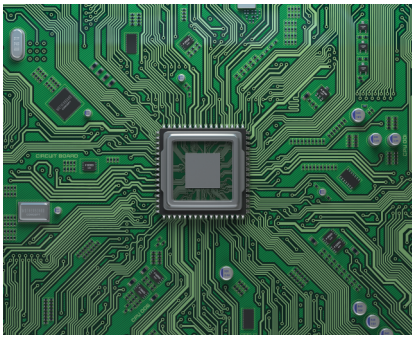
With All Due Respect, It's the Process, Stupid

■ The investment seeds planted by the Defense Department's science and technology enterprise created today's thriving commercial electronics, commercial aviation and commercial space industries.

As an example, in the 1980s, the department took the lead to address the then-Japanese threat and wisely invested close to $1 billion into the Very High Speed Integrated Circuit program.

As stated in the Sept. 30, 1990, "Very High Speed Integrated Circuits Final Report:" The "VHSIC Hardware Description Language and other design automation tools have broken through major integrated circuit complexity barriers and will decrease the cost and development time of modern electronic systems. The resulting achievements have helped to produce a new level of system design and fabrication — one that approaches an integrated 'concept to system' capability."

The program led to advances in integrated circuit materials, lithography, packaging, testing and algorithms, and created numerous computer-aided design tools. A well-known part of the program's contribution is VHDL, a hardware description language. And it created today's Silicon Valley.



That's the good news. However, that good news is historical. Since that time, both the Defense Department and commercial electronics companies have worked with the capabilities developed by the VHSIC program to develop "modern" electronics systems. However, because the department and defense industrial base have not been able to realize the potential of the VHSIC capabilities, they have fallen back to designing electronics using reliable, but heavy and power-hungry field programmable gate arrays, which are off-the-shelf silicon that can be programmed in the field.

Whereas, the commercial electronics industry has evolved those same capabilities to agilely, affordably and rapidly produce "first-pass success future-proofed" electronic systems — both hardware and software — with much faster performance.

How did we get here? From a macro — industry structure — and a micro — chip design process — viewpoint, we can glibly retort, "It's the process, stupid." The process for program formulation, compartmentalized and phased funding, separation of development, and sustainment funding are global contributors to the processes that govern the macro operation of the defense industrial base.

We believe there are a number of straightforward actions the government can take to address the lack of use of advanced-node semiconductor technology and the resultant erosion of workforce skill sets. For instance, targeted tax incentives can be an effective tool that yield short-term results.

At the micro level, down in the depths of semiconductor design, the established practices for chip design have remained relatively static in the defense industrial base, especially compared to those of their commercial counterparts. Under the shadows of the macro industry issues, chip design teams cloak themselves with historical practices and metrics that shield them from any possible reprisals. In fact, when these somewhat antiquated practices are followed, the teams are paid for failure as well as success. In fact, failure can often prolong the funding for a program.

Engineers are taught that to effectively solve a problem, one must identify the root cause. Only in that fashion will the developed solution truly solve the problem, not just address a symptom. For that reason, many engineers become quite effective at business. When working to achieve a goal, they apply the same engineering problem-solving skills that result in agile and scalable solution paths. Within innovative, growing companies that are working in highly competitive markets, these engineer skills are exercised on a daily basis.

Andy Grove's book, *Only the Paranoid Survive*, illustrates the executive and engineering mindset in such markets. Guy Kawasaki's book, *The Macintosh Way*, effectively illustrates the challenges faced and work ethic required to simultaneously create a game-changing product and a game-changing market.

Any reasonable person who contrasts the product develop-

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ment lessons from these two books to the product development issues highlighted in the "bible" of the defense industry, "Augustine's Laws," would recoil in horror.

From the Defense Department and the taxpayer viewpoints, this horror is well founded. The speed of development and affordable, quality, sustainable and modernizable products from the commercial electronics, commercial aviation, and the commercial space companies make a mockery of the processes and practices used for defense acquisition. The denials from the "guardians of the status quo," who reside within the department and within the now-irrelevant system engineering and technical assistance support contractors, seem to get louder with every commercial success.

When comparing the two processes, three items become immediately obvious. One is that the defense industrial base uses a serial hardware/software development process, whereas the commercial process is a sequential one.

The second is that the industrial base process is highly dependent on hardware prototype development, whereas the commercial process uses "virtual" prototyping.

And lastly, the commercial process consistently yields first-pass success, future-proofed electronic hardware.

When one considers that the engineers and designers in both industries are just as educated and have access to the same design tools, the root cause becomes obvious. The root cause is the process. Experience has shown that applying "empowerment," "agility" and "efficiency methods" to a broken process temporarily fixes some symptoms, but the root cause eventually overwhelms these temporary bandages.

The irony is that when the VHSIC capabilities were transitioned to both the defense industrial base and the commercial electronics industry, the development processes were the same. The defense world did not realize the potential of this revolutionary technology because they tried to make an efficient design and development process work within an inefficient acquisition system.

Here are a few major factors that drive the commercial electronics market. Desire to be first to market with "gotta-have," differentiated, affordable and profitable products; market intolerance to defective products; consolidation of the consumer electronics companies; market demand for "lifestyle" electronic systems; and electronic company desire to find new markets.

Arguably, the first two are the biggest drivers for the commercial companies to realize the potential of the VHSIC capabilities. These conditions have resulted in companies competing in the commercial electronics market investing a large percentage — in some cases 40 percent — of their annual sales in internal research and development, to shorten the "concept to system" development time for first-pass success, future-proofed products.

Large investments made in potential breakthrough technologies, especially those developed by teams to first determine if the technology is scalable, then to ensure that it's ready for transition to a product design. And the breakneck speed at which these first-pass success, future-proofed and affordable consumer electronic systems are developed is now taken for granted within the investment community and the general consumer market.

But the truly remarkable achievement is that the same commercial electronics product development process that consistently produces affordable and profitable first-pass success, future-proofed sustainable and modernizable products that are much more sophisticated than those developed by the Defense Department would meet the requirements of its acquisition process.

"Platform electronics and software must be designed for routine replacement instead of static configurations that last more than a decade."

Hence it is the current acquisition process that is the root cause as to why the Defense Department has not realized the potential of the VHSIC capabilities. Unfortunately, the "guardians of the status quo" that reside both within the department and the various support contractors fiercely guard that process. And they frequently throw false statements and claims to prevent the department from following the lead from the commercial electronics industry.

However, consistent high-quality commercial electronics products have gained the interest of both the Pentagon and Congress.

The following from the 2018 National Defense Strategy summary left no doubt as to the desired direction of defense electronics: "Prototyping and experimentation should be used prior to defining requirements and commercial off-the-shelf systems. Platform electronics and software must be designed for routine replacement instead of static configurations that last more than a decade."

To reinforce this point, the fiscal year 2019 National Defense Authorization Act has requested the Defense Department conduct a survey of the industrial base to include identifying individual current and future planned partnerships with commercial electronics design companies.

The seeds for change have been planted within the department. Thanks to efforts funded and managed by the undersecretary of defense for research and engineering and supported by Congress, the department is on track to rapidly become proficient in the use of commercial tools and will soon become expert in the common commercial electronics design of "emulate before you fabricate."

Soon, current and future acquisition programs will demand these same practices from the industrial base. These sown seeds will allow the Defense Department to reap the benefits of the VHSIC program — allowing warfighters to agilely and affordably keep their edge. ND

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