

Chip War

reviewed by Col Christian Cabaniss, USMC (Ret)

In the age of AI, it is often said that data is the new oil. Yet the real limitation we face isn't the availability of data but of processing power." In *Chip War*, Chris Miller argues, "Semiconductors have defined the world we live, determining the shape of international politics, the structure of the world economy, and the balance of military power." He clearly articulates in this work how little most U.S. political and military leaders understand about the complex challenges and market forces that drove the world chip economy into its present state. As he states up front, the dream of decoupling the tech sectors of China and the United States, which has been mentioned in numerous Congressional hearings this year, will likely run up against the Scylla and Charybdis of the ultra-efficient international chip network. He also clearly articulates that this network, unlike most of the globalized supply chains we have come to exist upon, is dependent on just a handful of firms in just a few countries, perhaps the most important of which is in Taiwan. You can hear the echoes of this challenge today in the terms "de-risking," "on-shoring," and "friend shoring" used by so many political and industry leaders. The generality-laden discussions in our Nation's capital may not always capture the real challenges that must be overcome to change today's market onto a path more to our liking.

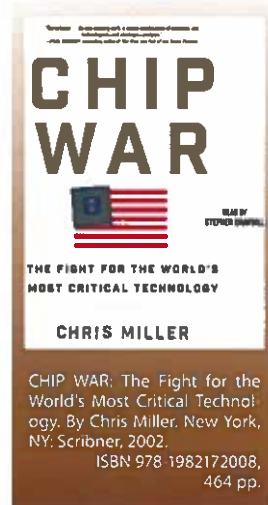
While it may have seemed like science fiction at the time, some at the end of World War II had begun to consider the possibility that it may be possible to make machines "think" by solving math problems. What started with mechanical gears such as those used in a World War II bomb sight capable of only a few calculations was soon replaced by vacuum tubes. The electric current running through

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the tube could be switched on and off producing any number by binary counting and capable of executing many types of computations. The book tracks the development of a better switch than the glass vacuum tube into the semiconductors that are per-

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vasive across every aspect of the world economy today. Through a detailed analysis of the process from idea to product, Miller spells out the pursuit of the market as critical to sustaining the research and development necessary to make Moore's Law a reality. Benefiting immensely from the Space Race of the 1960s, the industry's initial customer, the U.S. Government, drove continued innovation that brought the chip industry into contact with other elements of the economy that could have scarcely been imagined at the beginning. While the U.S. approach to chip development clearly defeated its communist opponent who was trying to copy U.S.



efforts, the solutions utilized in that part of the race to include technology transfers laid the groundwork for the competition we face today, especially with China.

The author details that the 1980s were a "hellish decade for the entire US semiconductor sector." While the United States sat atop the industry, it faced cut-throat competition from Japan. The post-World War II aim of turning Japan into a democratic capitalist nation had perhaps worked too well. With access to government support and cheap capital, Japanese firms launched a relentless struggle for market share in the memory chip market. The efforts of U.S. companies to reduce costs in a world of high inflation, rising U.S. labor costs, and repeated energy crises to succeed in that struggle for market share with Japan enabled the rise of others within the Asian market. The partnerships and subsidies between industry and government in many of the Asian nations so critical to their pursuit of market share could not be easily reproduced in the U.S. economy. Perhaps,

the most difficult statistic to take is that today "90 percent of all memory chips, 75 percent of all processor (logic) chips, and 80 percent of all of the silicon wafers are produced in East Asia," even though those responsible for the semiconductor and the entire semiconductor industry started in the United States.

The worldwide chip industry that has developed from that initial struggle in the 1970s and 1980s has seen U.S. firms continue to dominate high-end chip design, as well as critical aspects of the chip machinery required for the manufacturing process, even as the fabrication plants have moved further to the East. While many are aware that most high-end advanced fabrication is accomplished by Taiwan Semiconductor Manufacturing Company, few are aware that the Dutch Company ASML completely dominates the lithography processes essential to high chip fabrication.

From its earliest days as a sponsor of chip development, the DOD looked to capitalize on the emerging technology in this industry to create offsets. While initially developed to counter the Soviet threat in Europe, these new capabilities were on full display in Operation DESERT STORM. The arrival of Silicon Valley entrepreneur and future Secretary of Defense, William Perry, led to what we know today as "Assault Breaker." As the industry has expanded into the commercial market and away from the government, government leaders have found it "harder and harder to shape the future of the chip industry." As the author points out, the CEO of Apple has a greater influence on the chip industry than any Pentagon Official.

This book is important for Marines for at least three reasons. First,

it provides an exceptional example of competition in practice between allies, partners, and opponents. Clearly, the DOD has limited influence in the semiconductor market that has adapted itself to global demands. Many of our allies and partners may actually be economic competitors. This being the case, we must work on expanding alliances and partnerships where we can as part of a whole of government effort while acknowledging the limits of the possible. It is important to note that "China is staggeringly dependent on foreign technology, almost all of which is controlled by China's geopolitical rivals." That being said, governments or companies looking to increase market share or in need of financing may not be thinking about the long term, which could give China a powerful lever to induce chip firms to transfer technology.

As Miller offers, "The future of war will be defined by computing power. The US military is no longer the unchallenged leader." With that in mind, the book demonstrates the challenge of taking an idea and turning it into reality which will be critical as acquisition professionals attempt to work with industry to operationalize emerging technologies into capabilities on the battlefield. While Thomas Kuhn may have suggested something similar in his description of the differences between discovery and invention, the author's description of the translation of Moore's Law into reality as a triumph of manufacturing, supply chains, and marketing is appropriate. This is a lesson for senior leaders as they evaluate technology and its potential for military application in the short, mid, and longer term. As the author clearly articulates, the resourcing requirements for chip development just for research and development are far beyond a single service or even the DOD as a whole. As weapons systems become autonomous, their computing requirements will only grow. For example, DARPA's budget is a couple of billion dollars a year. In comparison, the design alone of a leading-edge chip can cost several hundred million dollars,

which is beyond the capability of all but a few companies. In comparison to DARPA's budget, Taiwan Semiconductor Manufacturing Company spent over \$5 billion on research and development while ASML spent over \$3.8 billion—both reflected double-digit increases from previous years.

Finally, the semiconductor industry lies at the intersection of all the warfighting capabilities at every echelon of command, so the funding must be spent wisely. While we have tended toward advocate-driven solutions for the last few decades, it is clear only an integrated approach will prepare us to succeed in the future as all senior leaders will need a much greater understanding of how evolving global supply chains both shape and are being shaped by technology development. This industry touches all facets of service capability development and will shape future force design. Only an integrated approach to understanding the range of possibilities will create the opportunity to maximize the return on our investments.

As the author says, a "triad of data, algorithmics, and computing power is needed to harness AI." While well-meaning professionals will argue the rising importance of information to warfare, we must ensure the widest number of leaders across the service have a clearer understanding of how the Service's application of the "triad" will both enable and leverage the broader Joint Force. While this book may be short on policy solutions perhaps because the issues are so complex and cut across our entire economy, it does provide the reader with a much greater appreciation of how we got here and where we may be going. That is perhaps its greatest value, providing an understanding of the current state. While framing the current paradigm on chip development, the work does provide an approach to enable the greater whole of government action to move this complex system toward a trajectory that provides greater benefit to ourselves, our allies, and partners.

