NOVEMBER 2015

SEMICONDUCTORS PRACTICE

A new world under construction: China and semiconductors

The ongoing transformation of the Chinese semiconductor sector requires all parties to raise their game.

Christopher Thomas

Business in China has become a top-of-mind issue for semiconductor executives and investors over the past year. While traditionally an important consumption market for chips, three related factors have now made it more important for companies to understand the opportunity and proactively refresh their China strategies. First, the government is actively attempting to reshape the domestic semiconductor market and assist local companies in becoming national champions. Second, Chinese consumers and companies are becoming increasingly important to the growth of the global semiconductor market. Third, Chinese capital—from both government and private sources—is actively pursuing merger, acquisition, investment, and partnership opportunities worldwide.

These changes raise important questions for Chinese and multinational companies. How can they continue to capture growth in China? Do market and policy changes require new capabilities or approaches? And how can local and international players form mutually beneficial partnerships?

The factors behind China's increasing prominence

It's worth examining in detail the political, economic, and financial-market factors behind China's growing role in the global semiconductor industry, as they may shape the market for years to come.

A supportive government

In June 2014, the State Council of China released the National Guidelines for Development and

Promotion of the Integrated Circuit (IC) Industry, its long-awaited policy for improving the country's semiconductor sector (see sidebar, "China's national guidelines for the development and promotion of the IC industry"). The new guidelines lay out ambitious targets for industry revenues, production volume, and technological advances. While they do not represent the Chinese government's first attempt to support the indigenous semiconductor industry, they differ from previous policies in three important ways:

- The government's investment is 40 times higher than previous targets, with a five-year investment target of about $19 billion. Overall, the government hopes that the industry will receive about $100 billion to $150 billion from all sources, including state-owned enterprises and other investors.
- There is a greater focus on creating segment winners, or national champions, through M&A and other consolidating moves.

China's national guidelines for the development and promotion of the IC industry

China's 2014 policy for expanding the local semiconductor industry sets ambitious targets through 2030, with specific goals for various horizons, as shown in the exhibit below.

China has set ambitious targets for the local semiconductor industry.

By 2015	By 2020	By 2030
Integrated-circuit (IC) industry overall revenue (design, manufacturing, packaging, and testing) exceeds 350 billion yuan (about $55 billion)	Compound annual growth rate of revenues ≥20%	World-class IC industry value chain
Volume production of 32- and 28-nm[1] chips	Volume production of 16/14-nm chips	A set of leading companies considered tier 1 players in the global semiconductor market
Wireless and telecom IC design capabilities approach world-class level	World-class IC design in applications such as wireless, telecommunications, cloud computing, Internet of Things, and big data	
>30% of total packaging and testing revenues come from middle- to high-end products	World-class packaging and testing technology	
45- to 65-nm semiconductor equipment in production; 12-inch silicon wafers and other key materials in production	Integration of key equipment and consumables from China into the global supply chain	
	Development of an advanced, safe, and secure IC industry value chain	

[1] Nanometer.

Source: McKinsey analysis

- The government is adopting a more market-based investment approach by giving local private-equity firms responsibility for allocating public funds—a bold experiment designed to improve the likelihood of success.

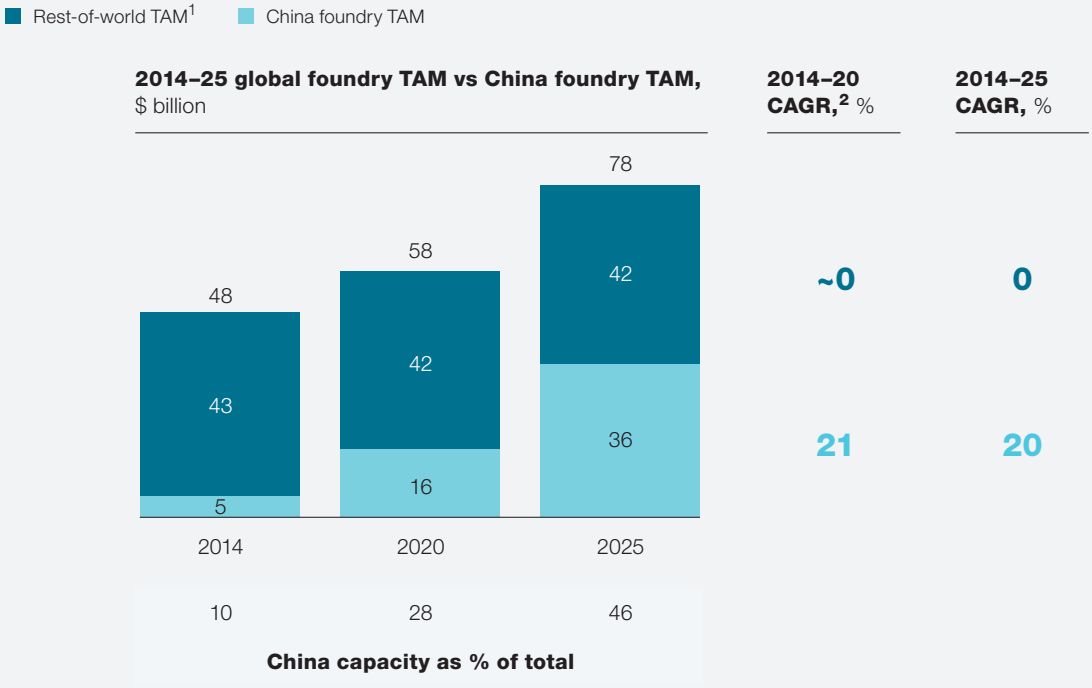
Since the release of the guidelines, the government has become even more ambitious about semiconductors. In May 2015, for instance, the State Council announced the "Made in China 2025" policy, which focuses on building indigenous capabilities in high-end precision manufacturing, with semiconductors as the first priority segment. The goal of this policy is to have China increase its self-sufficiency rate for integrated circuits to 40 percent by 2020 and to 70 percent by 2025. While the definition of self-sufficiency is unclear and there are no guarantees of hitting policy objectives, these targets clearly indicate that the government has ambitious aspirations. Consider the digital-foundry segment. If Chinese manufacturers were to hit the 2025 self-sufficiency goals the government has laid out for this segment, roughly all incremental foundry capacity installed globally over the next ten years would have to be in China (Exhibit 1).

Surging demand

Semiconductor consumption in China continues to outpace the overall market, rising by 9 percent in 2014 to reach about $160 billion, or 50 percent of the global total. Chinese fabless companies and Chinese branches of fabless multinationals saw even greater

Exhibit 1

To meet the 'Made in China 2025' targets, all incremental foundry capacity globally would have to be in China over the next ten years.



[1]Total available market.
[2]Compound annual growth rate.

Source: IHS Application Market Forecast Tool 2015; McKinsey analysis

growth in 2014, with sales rising 20 percent. The fast growth of China-based customers, especially in the mobile space, helped fuel this rise. For instance, leading Chinese smartphone brands (such as Huawei, Lenovo, Meizu, and Xiaomi) increased their global market share from 15 percent in the fourth quarter of 2013 to 27 percent in the second quarter of 2015. Like China's overall economy, its mobile market has cooled considerably, however, with 2015 smartphone consumption flat year on year, after rising fivefold since 2010.

This slowdown, which is mirroring a global cooling of the smartphone market, is winnowing out weaker original-equipment manufacturers (OEMs), increasing price-based competition, and creating uncertainty about long-term growth prospects for mobile devices and the semiconductors they contain.

Increased capital activity

In the 18 months from the launch of the 2014 policy to the writing of this article, six Chinese government-investment vehicles, with approximately $32 billion under management, had been announced—the Sino IC National Fund, as well as city investment vehicles for Beijing, Hefei, Shanghai, Wuhan, and Xiamen. These funds may receive additional capital: for instance, the Xiamen investment vehicle received $47 million during the first phase of funding and has a target size of about $157 million. The six funds have already invested in various Chinese players, including AMEC, JCET, Sanan, SMIC, and Spreadtrum.

China-based corporate and financial investors are looking outward and have recently announced roughly $15 billion in controlling or minority investments in ten global semiconductor companies across the value chain. Although this was a dramatic increase over the previous year's activity, it still represents only about 15 percent of the $100 billion in semiconductor M&A deals announced globally since the government's 2014 policy was made public. In the same time frame, the global industry invested nearly $80 billion in capital spending and R&D—about 20 times what local Chinese semiconductor companies did.

Global players have also made increasing commitments to the China market over the past year, including greater efforts to collaborate with local players. Consider just a few recent moves:

- Qualcomm announced that it will partner with SMIC on 28-nanometer products and 14-nanometer process-technology development.
- UMC is collaborating with the Xiamen government and FuJian Electronics and Information Group on a $6.2 billion investment in a foundry.
- Intel invested $1.5 billion in a subsidiary of Tsinghua Unigroup, which owns RDA and Spreadtrum, two of the largest fabless-design companies.

Building Chinese champions

The semiconductor industry is global, with products rarely customized for specific regions. There are no Taiwanese packages, South Korean memory chips, or Japanese industrial semiconductors—these products all serve a global clientele. The search for Chinese champions is thus something of a misnomer; it would be more appropriate to say that domestic companies should aim to become global champions with roots in China.

Global leadership matters to Chinese players because of the efficiencies derived from scale and experience. In fact, McKinsey research shows that the top one or two semiconductor players, by industry segment, earn 100 percent of total economic profit, while their competitors lose money. Furthermore, no profitable leader confines its market to a single geography—they are global players. Given these patterns, it is important for

companies to strive for one of the top two global positions over time.

For Chinese companies, achieving this status requires three fundamental shifts. The first is a significant increase in technical skills and global-management capabilities. The second involves adopting a technology-leader mind-set. The third required shift is encouraging the development of patient financial capital willing to invest over long horizons and through business cycles.

Enhancing capabilities

To become international champions, Chinese companies must build the capabilities needed to run far more complex businesses. Following the example of leading semiconductor multinationals, they must also invest years in developing relationships and extending competencies beyond their home borders. Although many emerging Chinese semiconductor leaders have made strides in this direction, there is much room for improvement. For instance, domestic companies need to create global sales and customer-service teams to win business abroad. They will also likely need to manage multiple R&D facilities, with centers of competency spread around the world.

Companies involved in deal making must master the art of M&A. Rather than just buying companies, they must drive synergies and improvements from acquired targets. And as Chinese players search for growth in new areas, such as the Internet of Things, they will need to enhance their capabilities beyond silicon, investing in areas such as software development, ecosystem management, solutions selling, and reference designs.

Several areas of capability building require special attention, with talent management topping the list. Recruiting, training, and retaining the best (and often scarce) global talent is difficult, especially in hardware architectures, firmware, and applications. The situation may be even more challenging in China, since the most experienced semiconductor talent is typically based in other regions. In cases where talent is brought into a company through acquisition, effective postmerger management is essential—for instance, the systematic integration of new teams with existing Chinese teams, or of new engineering tools and flows with existing ones.

Chinese players also need to strengthen their development, management, and protection of intellectual property (IP). First, they should develop a systematic approach to identifying, choosing, and executing an IP strategy. This will require each company to have a well-thought-out IP road map separate from its product offerings. The road map should clarify which intellectual property needs to be proprietary and developed in-house and which can be sourced from partners or IP suppliers. Second, Chinese semiconductor companies should encourage the continued strengthening of their country's IP regime, both to protect their own innovations and to develop an environment in which multinationals are willing to undertake IP and R&D partnerships with Chinese players.

Finally, Chinese companies will need to master all aspects of postmerger integration (not just the talent-related ones mentioned above) in both a domestic and a global context. Historically, outcomes of M&A in the high-tech sector have been quite variable. Well-managed mergers that leverage the strengths of both parties have created substantial value, while poorly integrated acquisitions tend to have disastrous results. Since employee retention is critical to success, Chinese leaders must strive to develop an esprit de corps and a spirit of collaboration. Controlling product and project fragmentation is also essential, as McKinsey research suggests that spreading semiconductor R&D efforts across multiple sites leads to an average efficiency loss of more than 10 percent.

Companies that can build strong, unified teams from multiple cultures and geographic locations—and effectively focus those teams on the right programs—will emerge as winners. The bar is higher than normal for Chinese-driven deals in the semiconductor space, since most of these efforts aspire to transfer technology from global clusters to China. Synergies have typically been more difficult to realize from R&D and IP transfers than from go-to-market or manufacturing operations.

Adopting a technology leader's mind-set

Technology innovation and leadership matter in semiconductors, to companies competing on both the lagging and leading edge of process technology. By choice and necessity, Chinese companies now generally focus their efforts on mature technologies, modifying and removing cost from innovations developed by others. (There are, of course, exceptions, such as HiSilicon, which is making baseband chips at roughly the same technology cadence as market-share leaders). While mature products can generate profits because of their lower risk and investment requirements, they alone are not sufficient to transform a company into one of the top two in its segment.

McKinsey has surveyed Chinese companies that purchase semiconductors about their key buying factors. Similar to their global counterparts, they consistently cite product performance and leading technologies as their primary consideration when purchasing. As a result, the leading suppliers to these companies continue to be vendors that define and deliver leading technologies across multiple areas, including circuit design, product integration, and production processes, as well as "above chip" features such as firmware, reference designs, and software.

Chinese players cannot rely solely on technology transfers and acquisitions as a means to promote indigenous technology leadership. Export controls and other limits on purchasing "crown jewel" technology make many desired team, IP, or company acquisitions impossible. Furthermore, much cutting-edge knowledge is tacit and impossible to transfer through contracts or other means. And perhaps most critically, technology development never stops. Even after technology is purchased by or transferred into a Chinese company, competitors in other countries will be improving and pushing innovations forward, requiring the Chinese company to do the same. For all these reasons, Chinese companies will need to become leaders at internally developing, commercializing, and scaling the science and engineering breakthroughs required to become suppliers that take a sustainable leading share in a market segment.

Running a company that leads in technology is different from running a follower. The shift will likely require Chinese companies to change their business and investment models and their engineering mind-set. The shift should occur in a deliberate, measured fashion, allowing the country's players to keep a strong foundation in their existing businesses even as they strive for technological leadership and invest in innovation.

With so much at stake, Chinese companies cannot take an ad hoc approach to building the required new capabilities, key performance indicators, and processes. They must develop a systematic road map of improvements, tying together business opportunities, technology trends, capability requirements, and skill-building initiatives into one cohesive plan. It will be paramount to align diverse stakeholders, including the government, investors, and potential global partners, to support this plan. Goals should be set by global benchmarking to reflect where competition is today and where it will be in the future.

Chinese companies have a large task ahead, given their talent and capability gaps, the high bar for global

leadership, and the need for the country's global champions to be the top one or two players in their segments. The more segments and technologies in which China attempts to be number one, the more diffuse industry and government efforts will be. The more companies that attempt to become the Chinese champion for a certain segment, the more the best talent will be spread across too many teams. And the more investment vehicles that chase after the best global and local acquisition targets, the higher the prices that will be paid. However, a top-down approach that limits competition may stifle innovation and trap talent in the wrong roles. Therefore, the government, investors, and business leaders should seek the right balance.

Ensuring investors are willing to provide patient capital

Although enhanced capabilities are the most important factor separating winners from losers, patient capital is also essential. Under its new policy, the Chinese government is having local private-equity firms manage its investments in the semiconductor industry, since earlier bureaucrat-led efforts did not produce the desired results. As these firms make decisions about funding, they will adhere to the government's goals and objectives—but also strive to meet market rates of investment return.

The ability of these investors to continue funding during economic or industry downturns is important. The semiconductor sector's unique capital requirements may complicate these efforts, however. First, the industry has long development cycles and high business cyclicality. Second, its returns are lower than average. Most private-equity players have a hurdle rate—or minimum expected return on investment—of 8 percent. Semiconductor companies have, in aggregate, earned lower returns on equity than that over the past 40 years. In fact, many segments have experienced down cycles when returns were negative for several years straight.

Finally, the semiconductor sector's horizon for generating profits is typically longer than average, especially in the process and manufacturing segments. Payback times of 5, 10, or 15 years are typical. Investing steadily and intelligently through the entire cycle and the long term will be a challenge for financial investors with multiple options for their capital.

Investor challenges will be particularly acute for acquisitions. There is a healthy market for well-performing semiconductor companies and assets, so private-equity funds will be competing with corporate investors with lower cost of capital and the ability to generate synergies from acquisitions. As a result, corporate investors could pay higher prices for the same assets.

Multinationals in China: Moving ahead thoughtfully

Non-Chinese multinationals have a different set of objectives and constraints when doing business in China. Since most already have global capabilities, they are likely to focus on maximizing their Chinese market share and developing strategies to compete with emerging Chinese players.

Many multinationals—even those with long experience in China—have a fragmented view of the situation on the ground. Local country leadership, the CEO, and the heads of business units and global functions may all hold different perspectives based on their own experiences, priorities, and the business or functional lens through which they observe China. These different perspectives emerge during the development of detailed strategies for China and often stall progress. To rectify this issue, multinationals should invest in building a common and aligned fact base to accelerate decision making. As part of this process, corporate leaders should try to reach agreement on the answers to various questions, including those in Exhibit 2.

Exhibit 2 **Multinational companies must ask strategic questions when determining their China strategy.**

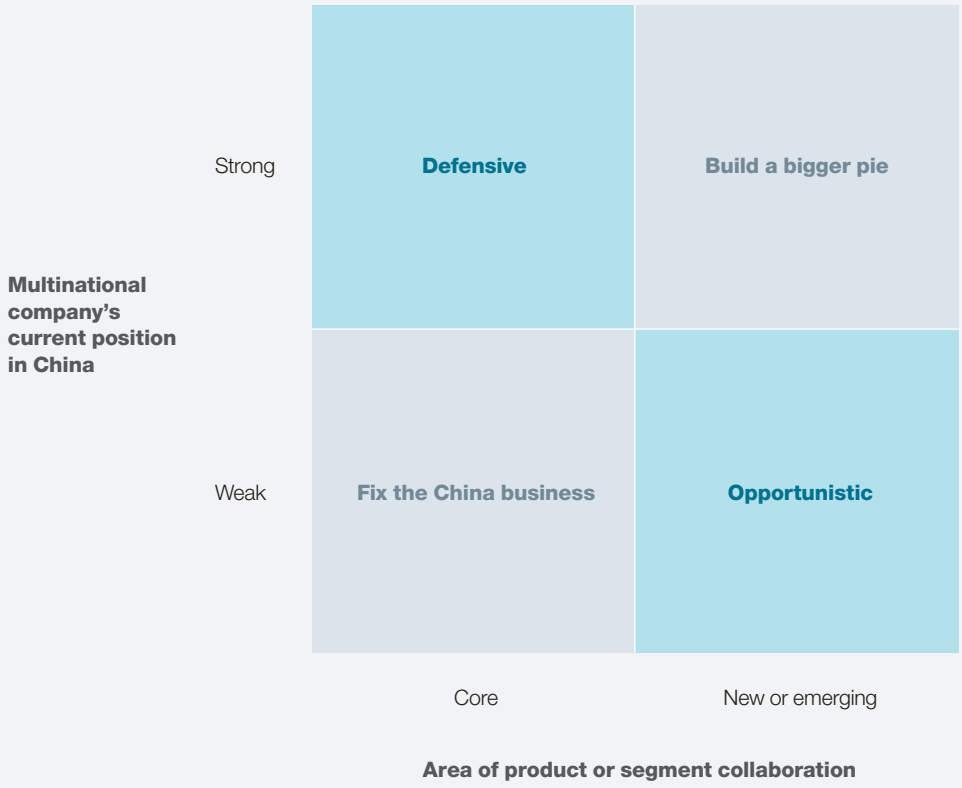
How important is it to win in China?	Are we winning today in China?	How local do we need to be to win in China?	How does our "localness" stack up against the competition, and will it meet the government's expectations?
Where does China rank among revenue and profit priorities? Is it a must win, an important battleground, or a nice to have? Is it worth addressing difficult trade-offs between engaging in China and pursuing other opportunities? How does the global economy affect the specific segments where multinational companies compete?	How does performance in China stack up against performance globally? Is the company growing as fast as the competition, Chinese customers, or Chinese end markets? How do customers grade the company against the competition on global factors such as product performance and local factors such as technical support?	What are the key buying factors for customers, and which of these require a strong local presence? What does a local presence entail (eg, technical support, product road map, equity participation by Chinese players)? How do these buying factors vary by segment or by customer type (eg, are there relevant differences between state-owned enterprises and private companies)?	What is the balance between what a multinational company receives from China, such as revenues and subsidies, and what the company contributes to China, in the form of taxes, local employment, intellectual property, and other benefits? How do government stakeholders view a multinational company's contribution to the Chinese industry and to China overall?

Source: McKinsey analysis

Indeed, companies have debunked internal myths about winning in China by answering these questions. For instance, one multinational believed that Chinese customers want to buy from local companies and therefore thought it needed to develop a large joint-venture R&D center in the country. However, structured interviews with customers showed that their preferences varied by tier. Smaller ones with simpler technical needs desired local suppliers, while larger customers aspiring to an international presence wanted global, non-Chinese suppliers with local customer-service teams. Another company was certain that a Chinese competitor offered much less expensive products because it was comfortable with lower margins. But a product-teardown analysis proved that the competitor likely had higher gross margins than the multinational because it had a simpler, de-featured product design for the lower-priced segments where Chinese OEMs competed.

An aligned fact base also simplifies the debate about alternative approaches to improving performance in China, since it helps leaders propose solutions that truly resolve problems. For instance, companies may be looking for tactical improvement in China, such as faster technical support or localized reference designs. In such cases, the solutions may be a simple matter of greater investment and improved on-the-ground execution. In more complicated situations, such as when the government requires local ownership to obtain important R&D subsidies or certain tenders, multinationals may need more comprehensive solutions that involve forming partnerships with Chinese companies. If partnerships are required, multinationals and

Exhibit 3 **Multinational companies should base partnership objectives both on their current position in China and their product-line goals.**



Source: McKinsey analysis

domestic companies must develop the elusive but desirable "win-win" partnership structure.

Forming partnerships that work

Outside the semiconductor sector, multinationals have long made deals in China, essentially by trading technology for market access and capital. This approach is now front and center for global semiconductor companies.

Multinationals may encounter many challenges forming partnerships. For instance, they need to find sustainable, lasting business value for both themselves and their partners when defining the terms of a deal. Complications may also arise when integrating Chinese and non-Chinese teams and operations. But multinational companies can mitigate many potential issues by pursuing partnerships systematically rather than making ad hoc decisions. This may be difficult under the circumstances, since many multinationals are approached by multiple Chinese investors, government entities, or corporations with ideas. In such situations, multinationals should actively pursue a comprehensive partnership strategy, rather than simply responding to entreaties. A few best practices have emerged.

Define explicit objectives

Multinationals can pursue many different types of partnerships. If they have a strong position in China, their efforts represent a defensive stance; if their China position trails their global status, a partnership is an opportunity to capture additional value. Similarly, some multinationals may want partnerships that support all business operations, while others may want assistance only with a single business unit or product. Multinationals should take a broader approach, evaluating the ways Chinese capital and support can further their objectives outside China. The simplified framework in Exhibit 3 suggests possible types of partnerships based on a company's current market position and its product areas of focus.

Assess Chinese partners based on specific objectives

China's business landscape is diverse, and the universe of potential partners is broad, from pure-play private IC companies to state-owned industrial conglomerates. In addition, deals will likely involve interaction with multiple government agencies. Each of these entities brings different capabilities, relationships, and objectives to the table. The fit between partners will vary based on deal objectives. For instance, a go-to-market partnership designed to increase local market share may prioritize engaging distributors, while a manufacturing effort would prioritize partners with extensive on-the-ground production experience. Multinationals should develop goal-specific, objective criteria to evaluate and prioritize potential partners.

Rank the benefits of different engagement archetypes for each potential partner

Partnerships can differ in multiple ways—business scope, geographic reach, IP and R&D collaboration, or the split of roles, responsibilities, and ownership. They can generally be classified into one of several archetypes, such as contractual relationships between distributors and suppliers or full R&D and manufacturing joint ventures with dual control. For each archetype, a multinational should objectively identify the benefits for itself and the partner, identifying zones of mutual advantage worth pursuing.

As one example, a multinational may want a partnership that only involves sales in China because its primary goal is to build up a market presence there. The multinational's counterparts in China, on the other hand, may want to build a global business. Assessing the value of the short- and long-term benefits and the cost of these geographical sales limits for the parties will enable the multinational to see if the deal can be configured to confer equitable benefits.

Stress-test preferred options with a war-gaming approach

Multinationals cannot assume a static environment as they survey their path forward, since all industry players—competitors, customers, other Chinese companies—will make their own moves, both proactively and in response to those of the multinationals. Partnerships cannot be unwound easily and have to be robust under a variety of competitive responses. Multinationals should thus rethink pursuing engagements whose benefits can be negated by strategic reactions of competitors. They should also avoid situations in which a partner or a competitor would obtain significantly more benefits. War-gaming the competitive response helps to clarify the desired partnership and the series of moves needed to engage and negotiate with partners.

Follow best practices in China partnership development

Regardless of segment or product line, multinationals should observe some general rules of engagement in China:

- Be cognizant that China is not monolithic; no single partner, company, or investor owns

or drives the China strategy. No company or investor can commit for China—only for its own sphere of influence.

- Acknowledge that no single expert has a clear picture of everything going on in China. Multinationals should thus leverage multiple information sources when developing their perspective.

- Be clear up front and throughout the process about the deal constraints, whether in product strategy, the scope of operations, ownership, or IP transfers. These areas are most likely to be contentious, leading to difficult conversations and negotiations. Being honest will build trust.

- Plan partnerships with the exit in mind. At some point, a multinational's objectives will diverge from those of its partner so substantially that the deal no longer makes sense. Multinationals should therefore define contractual mechanisms for ending partnerships peacefully and fairly.

The attempted transformation of the Chinese semiconductor sector, which requires all industry players to raise their game, will have repercussions for both multinational and Chinese semiconductor companies. The greatest change may be in how the parties interact with one another. In a winner-takes-all industry with stringent government regulations, heavy capital requirements, and dynamic technology road maps, deep and lasting partnerships will be difficult to construct and execute. Add cultural differences and the mixed history of deals between Chinese companies and multinationals in other industries, and the need for all players to be thoughtful and deliberate is clear. ■

The author wishes to thank Gaurav Batra, Mark Patel, and Tiankai Zhu for their contributions to this article.

Christopher Thomas is a principal in McKinsey's Beijing office.