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HOW THE SEMICONDUCTOR INDUSTRY IS TAKING CHARGE OF ITS TRANSFORMATION

Three snapshots demonstrate areas of change and opportunity.

Semiconductors are the unsung heroes of technology, providing high-speed processing power for computers, flat-screen displays, smartphones, and other electronic devices.

But while semiconductor revenues are hitting record levels, recent geographic and product shifts are upending long-standing business plans. Moreover, R&D budgets are rising by about 6 percent annually because of new technological and business challenges, such as increased complexity in coding, testing, and verification.

Three developments in the semiconductor industry—the evolving demand for automotive chips, the availability of new productivity tools, and the growth of China as a revenue source—provide opportunities to increase performance.

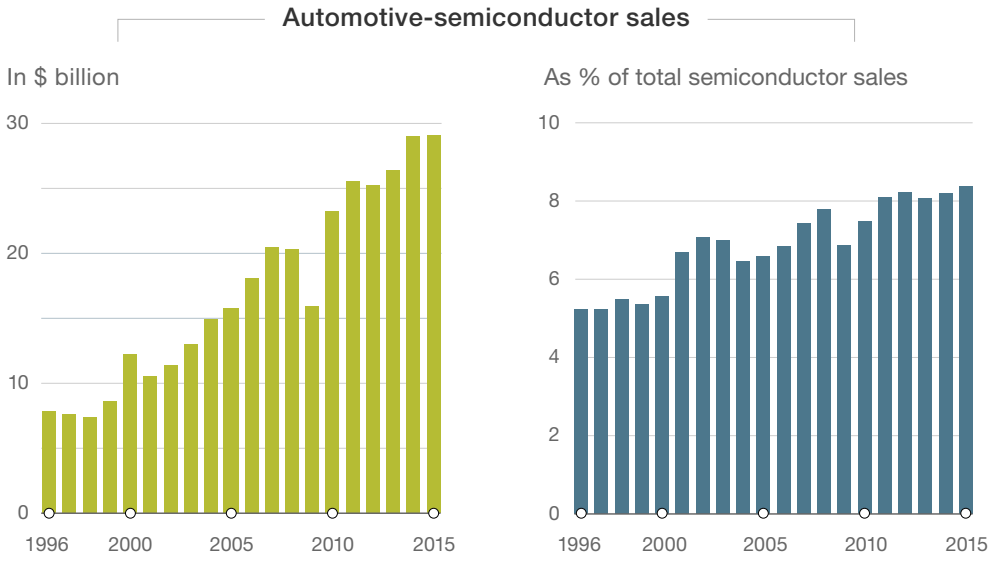
CHANGING IN TANDEM: OPPORTUNITIES IN THE AUTOMOTIVE SECTOR

If you walked into an electronics convention today, you might see hundreds of exhibits from automotive OEMs. Their displays typically focus on new car features that rely on sophisticated electronics, such as mapping applications and automatic-braking systems. This emphasis on innovation has helped increase revenues for automotive semiconductors from about $7 billion in 1996 to almost $30 billion in 2015 (Exhibit 1). Automotive chips now account for about 8 percent of total semiconductor sales, and current projections suggest that they will see about 6 percent annual growth through 2020—higher than the 3 to 4 percent growth predicted for the sector as a whole. That would put yearly revenues from automotive semiconductors in the $39 billion to $42 billion range.

The new electronic systems are shifting demand for semiconductors among the major application segments—body,[1] safety, driver information, powertrain, and

Exhibit 1

The automotive market represents a large and growing portion of semiconductor sales.



Source: IHS; McKinsey analysis

chassis. For instance, the safety segment only accounted for 17 percent of total demand in 2015, but this figure will rise to 24 percent by 2020, since OEMs are now developing more applications in this area. Similarly, the growth of electronic vehicles is shifting demand among device segments (such as memory, microcomponents, logic, and optical and sensors).

Although all semiconductor companies are tracking these trends, the highest performers will go a step further by identifying emerging pockets of growth within each segment. Take safety again. Most growth in this burgeoning segment will come from collision-warning systems, which will account for $4.1 billion in sales, far surpassing other segments. The best semiconductor companies will also begin considering strategic questions now, including tactics for differentiating their offerings, addressing opportunities and challenges within the Chinese market, and collaborating with automotive OEMs or tier-one suppliers.

[1] Semiconductors that control lights, windows, temperature, security, and other applications.

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For the full article, see "Mobility trends: What's ahead for automotive semiconductors," on McKinsey.com.

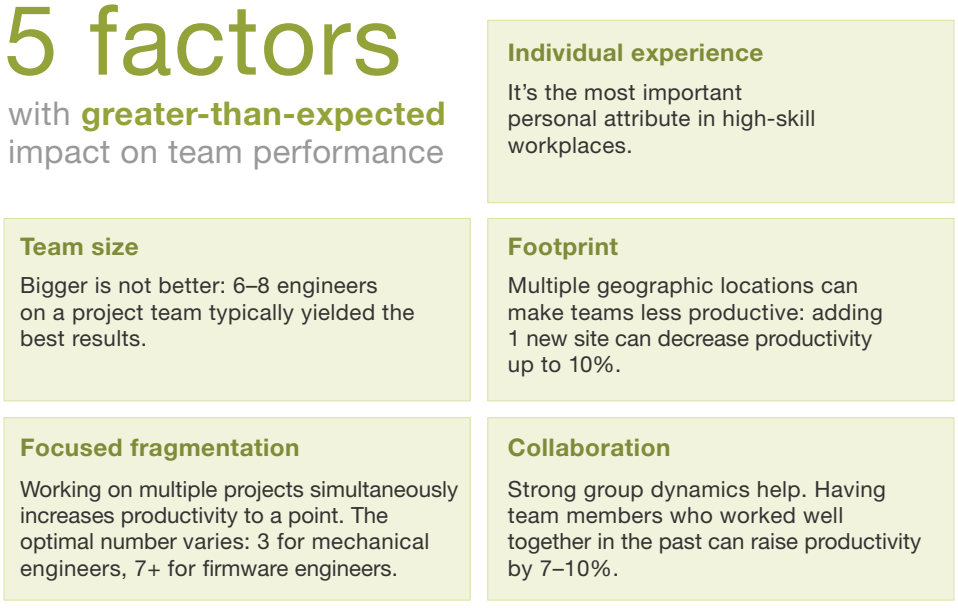
HOW ADVANCED ANALYTICS CAN IMPROVE TEAM PERFORMANCE

Like their peers in other industries, many semiconductor companies have embarked on ambitious programs to decrease costs and boost productivity using better data and analytics. Most of their efforts have focused on streamlining basic engineering tasks, such as chip design or analyzing component failure. But with costs continuing to rise, semiconductor companies are applying advanced data analytics to engineering management, with the goal of deriving fresh insights that will improve decision making.

This new analytical approach, which we term "*Moneyball* for engineers," relies on pattern recognition and machine learning to uncover counterintuitive management insights, typically delivering productivity gains of 20 percent or more for engineering groups.[2] Data from our analyses identified five staffing parameters—including some overlooked measures—that had the greatest impact on team performance in engineering management: team size, team-member fragmentation, collaboration history, individual experience, and geographic footprint (Exhibit 2). Semiconductor managers can transform their engineering groups by taking a new look at these parameters when assembling teams. In

Exhibit 2

Data analysis offered unexpected insights into team performance of semiconductor engineers.



addition to providing a competitive edge, the new team structures should also help employees gain greater satisfaction from their jobs.

[2] *Moneyball* refers to Michael Lewis's book *Moneyball: The Art of Winning an Unfair Game* (W. W. Norton & Company, May 2003), which describes how baseball manager Billy Beane transformed the Oakland Athletics into a powerhouse by gathering less commonly used performance data, and using sophisticated statistical analysis to identify and recruit potential stars at a lower cost.

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For the full article, see "*Moneyball* for engineers: What the semiconductor industry can learn from sports," on McKinsey.com.

CHINA: THE NEW GLOBAL–LOCAL CHALLENGE FOR MULTINATIONALS

China has become an important center of R&D and global product development for many OEMs. Between 2007 and 2015, overall R&D spending in the country rose more than fourfold—the greatest increase among major regions in the world. Both locally owned product-design centers and those owned by multinational corporations contributed to this high growth.

In an effort to better understand the market, we recently surveyed 80 executives at Chinese design centers about their current operations and future aspirations. Survey respondents cited many forces behind China's product-development surge, but one stands out: the greater talent pool within the country (Exhibit 3). With more skilled engineers and technological staff, Chinese product-design centers can create more innovative products for export, rather than simply developing low-cost offerings for the local market.

As Chinese design centers focus on innovation, their total demand for components, including semiconductors, will increase from $350 billion in 2016 to $500 billion by 2020. But the path for capturing growth may be more difficult for multinational suppliers. Many of our survey respondents believe that the Chinese government will provide new incentives, including subsidies, for companies to create products that can be considered Chinese in origin. This shift could prompt multinational OEMs with significant Chinese sales volumes to increase purchases of semiconductors and other components from Chinese-owned suppliers (Exhibit 4). OEMs headquartered in China might also source more components locally. Such changes are both an opportunity and a threat to global chipmakers.

To thrive in this environment, multinational semiconductor companies should

Exhibit 3

China's design strength is drawing more R&D investment.

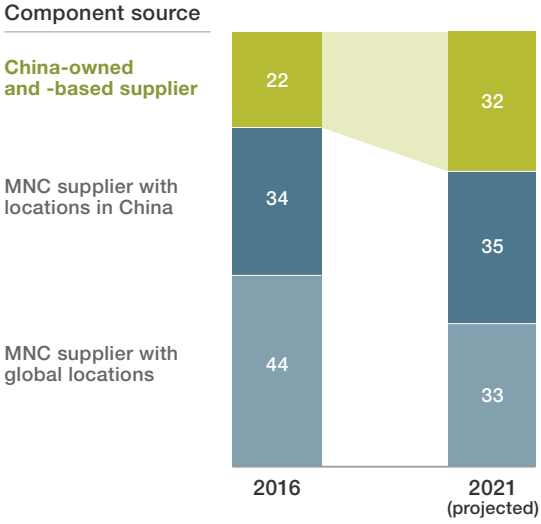
Top reasons industries are increasing product-development and design work in China, % (respondents allocated 100 points)[1]

[1]Data reflect responses from locally owned design centers and those owned by multinational corporations; figures do not sum to 100%, because of rounding.

Exhibit 4

Government policy may encourage MNC-owned design centers to increase their use of local component suppliers.

Share of spending by MNC-owned design centers on core components, % (respondents allocated 100 points)



Source for Exhibits 3 and 4: McKinsey survey of 80 R&D and product-development executives at original-equipment-manufacturing design centers in China, 2016

consider increasing local investment in China while also striving to maintain their global business. Options for local investment include partnerships with Chinese investors or semiconductor vendors, as well as greater customization of products, pricing, and business arrangements for the Chinese market. As multinationals increase their local presence, they may need to restructure their global operating models by moving more decision-making authority to China. The shift to a new model may be challenging, however, since it requires a thorough understanding of China's available leadership talent, regulatory issues, and intellectual-property environment.

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For the full article, see "How semiconductor companies can win in China's new product-development landscape," on McKinsey.com.