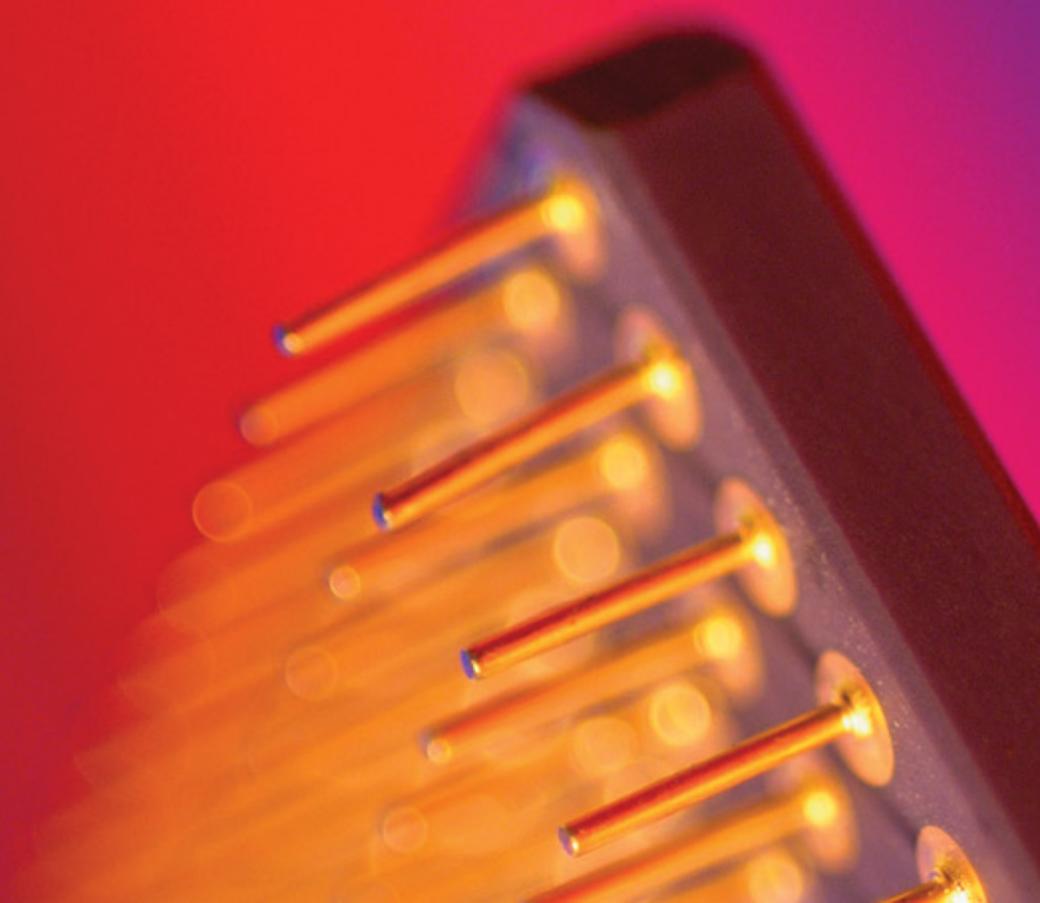




The right to win in semiconductors

**Driving R&D efficiency through
portfolio management**

kpmg.com



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Executive summary

In the race to reap the benefits of Moore’s law in the face of slowing revenue growth and rising research and development (R&D) costs, semiconductor companies must focus their R&D investment more efficiently—or risk being left behind. By consistently differentiating its products and demonstrating market leadership, a company earns the “right to win” in the industry. The good news is that R&D efficiency is possible through disciplined portfolio planning and product management, making the “right to win” an achievable goal.

The promise of Moore’s law, the foundation of the semiconductor industry’s success for decades, remains valid—but its effects are taking longer to realize, and that extended time frame is causing profound industry shifts.

One of the most obvious changes is ongoing consolidation driven in part by increasing R&D and manufacturing costs as well as a desire to counter the industry’s slowing revenue growth. This consolidation is concentrating revenue and earnings power at the top of the industry.

With companies striving to bring innovative products to market, two-thirds of the respondents to KPMG’s Global Semiconductor Outlook survey cited a combination of the need to acquire intellectual property and engineering talent, rising R&D costs, and manufacturing cost efficiency as key factors driving Mergers & Acquisitions (M&A). A growing preference to acquire intellectual property highlights the increasing cost of developing innovations in-house, as well as the difficulty of generating an acceptable return from an entire portfolio of technology products.

As companies weigh critical make/buy decisions for innovative technologies, many believe purchasing in-progress research can offer more compelling returns than relying exclusively on company-developed research. Larger R&D budgets as a percentage of planned revenue are required to maintain market position, and this further increases investor expectations of returns on R&D investment. This dynamic is promoting semiconductor companies to rethink their investment strategy and look for ways to enhance R&D efficiency.

Viewing M&A and R&D investment together as a comprehensive approach to product development and portfolio management provides R&D teams with a clear path to differentiate their products and earn the “right to win” in the segments they participate in.

In addition to deciding where and how to invest, companies must develop and execute on a product road map that can be delivered on time to maintain and grow market share. Without proper discipline, chasing multiple incremental opportunities or investing in “me-too” programs that match existing products can delay key programs and snowball into multiple generations of delayed products. This can lead to market share loss or more aggressive price discounting—compounding the risk of generating fewer margin dollars to fund future R&D investment.

As R&D costs rise and revenue growth slows, the successful companies will embrace disciplined portfolio and investment planning aligned to end-market needs. These companies will win the race for R&D efficiency and continue to gain the benefits of Moore’s law.

Industry forces at work

Fewer players with the scale to invest

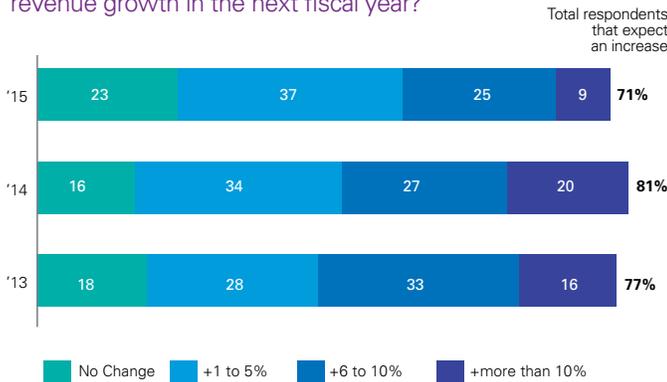
The year 2015 saw a 2 percent decline in sales for the semiconductor industry after several years of healthy growth. Growth is slowing because it takes massive product cycles to move the needle on the industry's large revenue base. Even revolutionary product categories such as connected cars and the Internet of Things will have a difficult time returning revenue growth to historically high levels.

While items connected to the internet will increase in the years to come, the value of semiconductor content in these devices is much less than the previous drivers of unit growth such as PCs and smartphones. This is fueling the prevalent concern over average selling price (ASP) erosion in the industry. The R&D challenge is compounded by a need to develop and commercialize products at a dramatically faster pace – a shift described in KPMG's publication "The Clockspeed Dilemma".

Reduced expectations for revenue growth among industry leaders were highlighted in KPMG's Global Semiconductor Outlook survey. While respondents remained optimistic about revenue growth overall, this year saw a notable muting in expectations to flat-to-moderate growth levels, compared with previous years (Figure 1).

Figure 1: Revenue expectations slowing

What is your outlook for your company's semiconductor revenue growth in the next fiscal year?



Source: KPMG Global Semiconductor Outlook 2016

Consolidation has created a concentration of revenue and earnings power at the top of the semiconductor industry: in 2015, the top 10 percent of companies in our analysis of the leading 70 publicly traded companies controlled 61 percent of the revenue and 72 percent of the operating profits in the sector (Figure 2).

Figure 2: Revenue and operating profits of the top 70 public companies in the semiconductor industry

	Revenue	Revenue*	Operating profit	Operating profit*	Operating margin
Top 10%	\$172 billion	61%	\$40 billion	72%	23%
Remainder	\$109 billion	39%	\$16 billion	28%	14%

*Percent of total

Source: Capital IQ Data and KPMG Research

After growing at 6 percent and 8 percent in 2013 and 2014 respectively, the industry again slowed in 2015. Revenue projections were cut throughout the year as global economic forecasts became more pessimistic. Reduced increases in revenue in the second half of 2015 will likely lead to lower revenue in the first half of 2016 due to typical seasonal weakness, and will likely lead to another year of below-average growth.

Our current expectation is for flat results to slight increases in revenue for 2016. These projections are consistent with the trends the industry has seen since 2006 with average growth of 3 percent, versus average growth of 12 percent in the 15 years prior to 2007. As lower revenue growth becomes the norm, the industry is likely to see the consolidation trend continue as companies pursue scale and synergies to boost profits (Figure 3).

Figure 3: Semiconductor revenue YOY growth rate & 5-yr rolling average



Source: Gartner, SIA Data, KPMG Estimates

M&A boom driven by lower revenue growth and R&D challenges

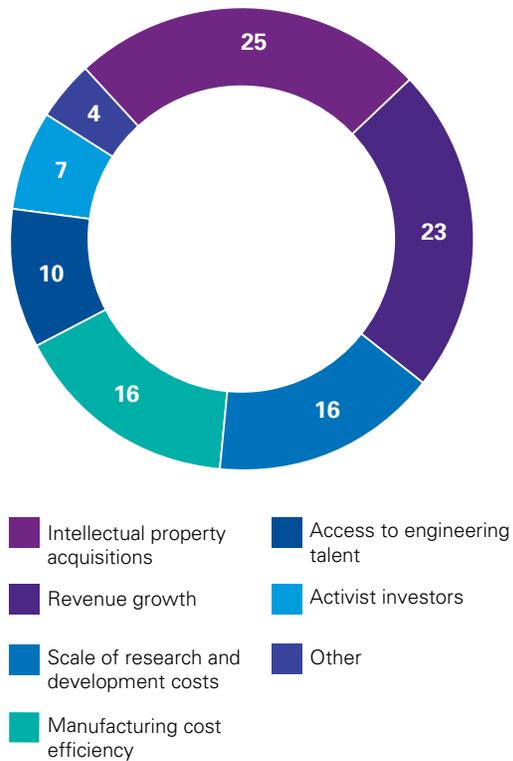
Lower revenue growth, combined with increasing R&D costs, have spurred unprecedented M&A activity in the semiconductor industry. Last year saw over \$115 billion in semiconductor M&A, significantly higher than the previous peak of approximately \$75 billion in 2006. Although the size of the deals may not be as large this year, the majority of semiconductor executives in our KPMG Global Semiconductor Outlook survey expected M&A activity to continue in 2016.

Two-thirds of the respondents cited a combination of needing to acquire intellectual property and engineering talent, rising R&D costs, and manufacturing cost efficiency as key factors driving M&A (Figure 4). This growing preference to acquire intellectual property highlights the increasing cost of developing innovations in-house, as well as the higher difficulty of generating an acceptable return from a portfolio of technology products. Consolidation increases the need to evaluate the product differentiation opportunity of potential programs before committing R&D resources.

This massive growth in M&A activity shows a shift in thinking about R&D investment. The fact that companies are seeing a greater return on investment (ROI) through acquiring IP versus developing it in-house reflects the trends of companies having to focus R&D investment on core offerings while acquiring new capabilities outside their current efforts. This shift in thinking requires companies to manage their portfolio of R&D investments in a more coordinated effort with their M&A strategy, and integrate a “make versus buy” decision into their portfolio planning processes.

Figure 4: M&A drivers

What is the key factor driving the high rate of M&A activity in the industry?



Source: KPMG Global Semiconductor Outlook 2016

Moore's law isn't dead, it just needs to buy more time

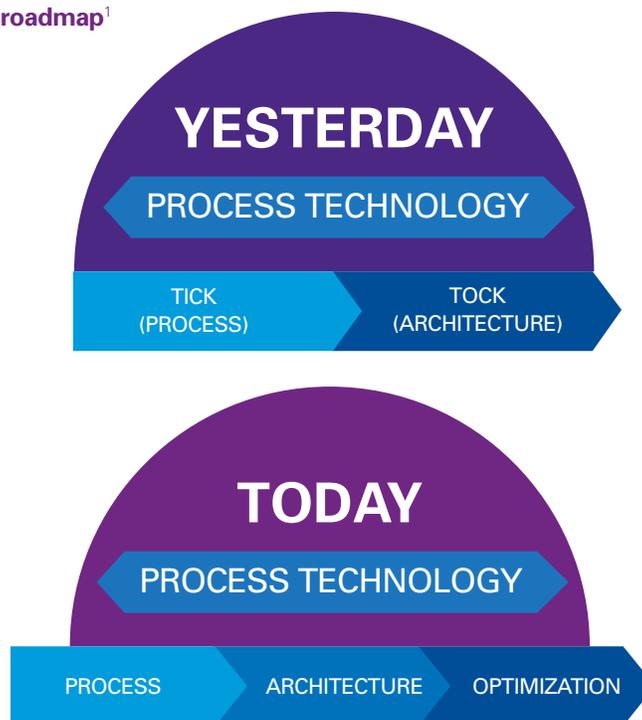
The promise of Moore's law has driven R&D spending in the semiconductor industry for over 50 years. Today, however, that promise is only available for a select few companies that can afford to participate.

Moore's law is still valid, but its effects are taking longer to realize. Intel disclosed in 2015 it will lengthen the time between releases of manufacturing technologies (nodes) to once every two to three years instead of the cadence of once every two years that was predicted by Gordon Moore.¹ This will allow Intel to release three product generations on a single process node and recoup more of its investment before transitioning its most performance-sensitive (and profitable) products to the next node.(Figure 5)

Although other leading-edge manufacturers have not officially announced this strategy, the expectation is that foundry service providers such as TSMC and Samsung will likely follow suit. This shift is necessary as rising costs mean fewer designs carry the burden of driving revenue growth, and the resulting bets on new products are getting bigger and bigger.

In mid-April 2016, Intel announced a restructuring designed to shift its R&D and manufacturing focus away from PCs toward cloud and Internet of Things (IoT) devices. The company said it plans to concentrate on data center and IoT operations including memory and field programmable gate arrays as it consolidates programs, staffing and facilities².

Figure 5: Intel process technology roadmap¹



¹ Intel Corp. Form 10-K (Annual Report), filed February 2, 2016

² Intel Corp. news release, April 19, 2016

The increasing costs of R&D and new product introductions are leading the industry to a point where only a handful of new products can be developed on a new process technology within the critical ramp period. For 10 nanometers, a traditional SoC (System on a Chip) would need to capture a share upwards of 20 percent in a \$3.6-billion end market to break even based on a \$350-million estimated R&D budget (Figure 6). That’s a massive risk that only a few companies have the capacity to take.

Higher R&D costs mean fewer companies can continue to offer leading-edge products, which provides increased incentives to consolidate. This consolidation leads to fewer customers for manufacturers such as TSMC and Samsung, so their ability to capture customers early is necessary to mitigate the risk on massive capital investments.

The slowing pace of Moore’s law and riskier investments are also motivating companies to innovate in new ways, such as utilizing 2.5-D and 3-D technologies. Others are looking at new applications on older technology nodes, such as radio frequency or microelectro-mechanical systems (MEMS) on eight-inch wafers. Examples are Xilinx’s use of 2.5-D interposers in the high-end field-programmable gate array market, Sony’s use of TSV (Through Silicon Vias) for image sensors or Micron and Toshiba’s use of 3-D applications for the flash memory market.

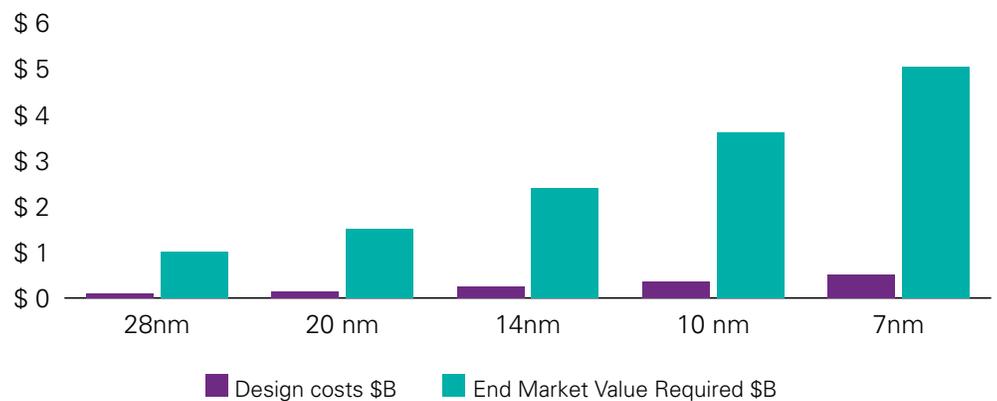
Many other companies are exploring 3-D technologies as a hedge against the risk of scaling by taking the traditional application of Moore’s law out of the critical path for successful innovation. Those explorations are helping companies innovate and grow revenue without massive investments in scaling.

Moore’s law has always been an economic precept driven by the cost of real estate on silicon and how many transistors can be built on that area. While the technology required to support Moore’s law is increasingly challenging, it is not a barrier to increasing performance and transistor count on silicon. The real challenge is obtaining the necessary return on the rapidly increasing costs required to stay on that path.

Although the industry could certainly use the computing power generated by leading-edge performance, the size of the market that needs that power is no longer able to support the R&D required to deliver it. Even the explosive growth of smart devices using mobile systems on a chip (SoC) that take advantage of leading-edge manufacturing has not generated revenue or margins required to deliver transitions in critical areas such as lithography and wafer size. As a result, new technologies require longer life cycles to provide the ROI to support the R&D innovation needed to bring a new technology to market. This dynamic requires semiconductor companies to rethink their investment strategy and look for ways to increase R&D efficiency, and to focus on potential differentiation as they evaluate potential R&D investments.

Figure 6: End markets required to support design costs

(Value in Billions)



Source: KPMG Estimates

Integrating R&D and portfolio planning

Improving R&D efficiency with effective portfolio management

Companies have achieved a 30 percent or greater increase in R&D efficiency—as measured by return on invested R&D dollars—through the implementation of proper planning processes and better resource allocation. This typically results from a combination of bringing differentiated products to market faster and more efficiently, and prudently dropping programs deemed to lack differentiation. Such practices can lead to faster time to market and top-line growth via market share gains.

It is important to stress that companies with poor R&D efficiency usually do not suffer from an inability to innovate. These companies, however, often lack business processes needed to allow the firm to execute on its strategy and deliver the right technology at the right time and at the right cost. The areas of greatest importance are alignment of R&D investment with market needs, allocation of the proper resources, and clear financial requirements for the programs to meet.

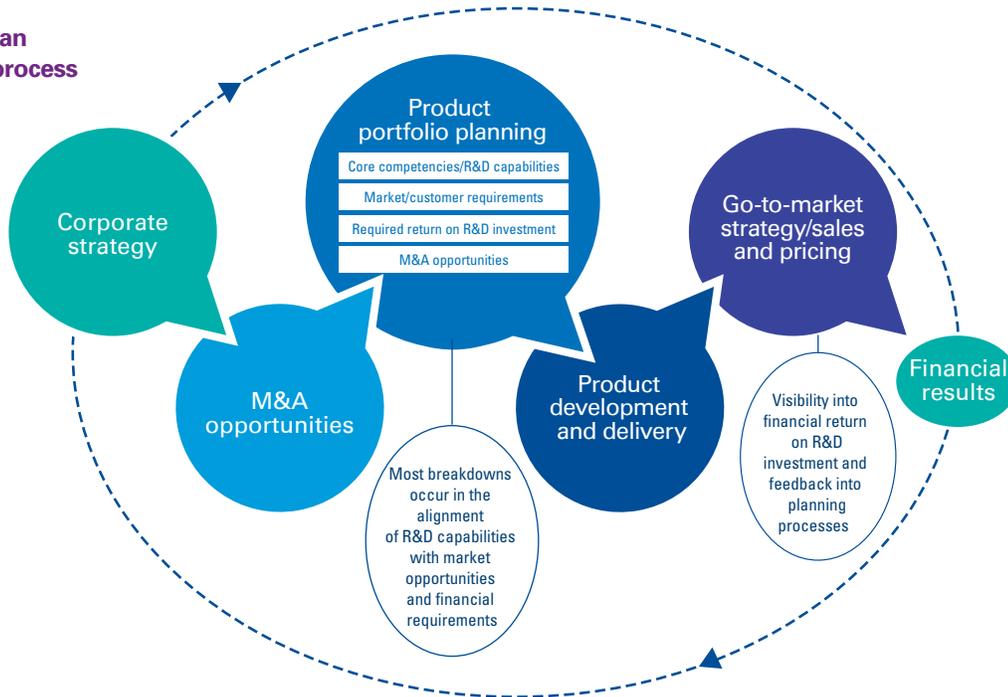
The integrated planning process for those areas requires inputs from sales and marketing, R&D, operations, and finance. The process should capture market requirements in a specified time frame based on end-market customer feedback, and should align with the R&D organization’s ability to deliver (Figure 7).

A question that more semiconductor companies are asking is whether they should be investing R&D resources in developing new capabilities, or if they should acquire IP through M&A. Using M&A as a tool in portfolio management allows the R&D teams to focus on differentiating their offerings and earning a clear “right to win” in the segments they participate in.

Once the portfolio management team has aligned internal R&D capabilities and external M&A targets with opportunities from the marketing organization, they can provide management with a list of potential programs the company should pursue to address market needs. After financial requirements and analysis, management can rank the potential programs based on the company’s strategic priorities and expected ROI. Once program execution begins, management should make sure the programs with the highest-rated priorities are fully resourced and brought to market on time.

Linkages between the marketing, R&D, and finance organizations are important to align the company’s strategy with its go-to-market approach. The proper channels must be in place to ensure alignment at key junctures of program development and execution; this enables the organization to course-correct if changing market requirements impact a program’s business case. Identifying these changes early can make the difference between being on time to market for a program, or missing market windows and sustaining heavy losses on an investment.

Figure 7: Developing an integrated planning process



The benefits of effective portfolio planning

Several benefits accrue from proper program planning and careful resource allocation. Delivering a predictable road map that has credibility with the customer base is critical to maintaining and growing market share. A sustainable road map also signals the required resources for next-generation programs instead of focusing only on the requirements of today's programs.

Other advantages to strong portfolio planning processes include benefits to pricing, supply chain complexity, and R&D operational expenses. When companies are late to market or out of alignment with market needs, they can deliver products without key features and be forced to cut selling prices. Having a planning process that aligns market requirements with R&D activities enables companies to reduce the likelihood of having to discount their products heavily.

Another potential benefit is the avoidance of stock-keeping-unit (SKU) proliferation. Typically, when it becomes apparent the core technology investment will not generate required financial returns, a company will produce variations of the platform technology to capture more revenue. Those additional variations add substantial complexity to supply chain and manufacturing operations. And although the incremental R&D investment may seem small, the impact on other organizations could be substantial due to fully supporting a separate product offering across operations, manufacturing, sales and marketing.

One of the main benefits of R&D efficiency is the ability to get products to market on time. For leading-edge products, when power and performance count, time to market means the difference between success and failure. Companies must not only deliver individual programs, they must balance a portfolio of R&D resources and deliver multiple programs on time—and do it generation after generation. The proper balance of resources is critical; even one program that goes over budget could affect the development of the next generation of products by delaying the dedication of resources.

Without a proper view of portfolio profitability, it is impossible to determine the impact of a program across an entire company. With a well-developed planning process in place, the platform technology investment should succeed in capturing sufficient market share to generate required financial returns without having to chase incremental opportunities that provide only marginal benefit but can risk higher-priority investments.

Why R&D efficiency is critical

Semiconductor companies spend more on R&D (as a percentage of sales) than any other industry, with only pharmaceuticals and automotive companies rivaling their level of spend—and while dealing with ever-shortening product life cycles. High R&D spending is critical to their futures because current products become uncompetitive quickly, so new products are needed continuously for companies to survive.

The large amount of R&D required to maintain market position in an industry with stagnant revenue increases pressure to get a higher return on R&D to drive profits. Whereas a pharmaceutical company may have 20 years to recoup its R&D investment (based on patent protections on a blockbuster drug), a semiconductor company will have a very short market window to secure profits due to the rapid obsolescence and declining price of electronic products such as smartphones, tablets, wearables, mobile computers, smart televisions and other consumer devices. Because of this dynamic, effective execution is critical to meeting market windows and obtaining profitability on product offerings.

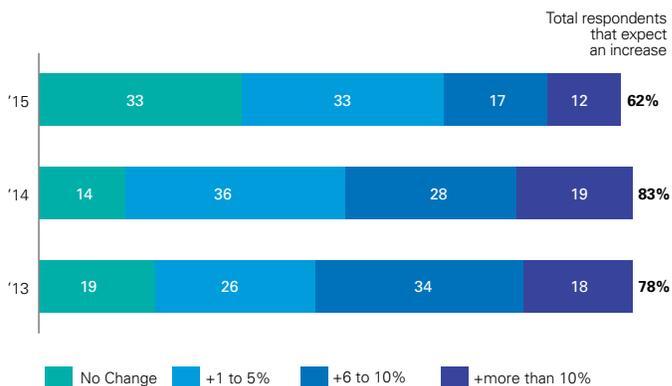
When companies fail to execute and miss these important product cycles, we often see revenue decline due to a loss of market share as other companies capture those design wins. This revenue loss generally leads to pressured R&D budgets, which prohibits the level of product development necessary to maintain or expand market share—which in turn causes companies to miss the next major product cycle and drives further losses. This can create a deadly spiral in which a company's inability or unwillingness to fund necessary R&D programs leads to rapid market share erosion and revenue declines.

How does that downward spiral begin? When a company misses market windows and its products are not aligned with end-market needs, it is likely to lose market share or become exposed too heavily to a shrinking market. That can obviously lead to negative impacts on revenue and earnings, and a common reaction is to constrain R&D spending as part of an overall retrenchment.

Sometimes organizations take on too many programs and stretch resources too thin in an effort to capture every incremental opportunity, which can jeopardize the delivery of programs serving the core business. Without proper discipline, chasing multiple incremental opportunities can delay key programs and snowball into multiple generations of delayed programs.

We are seeing the effects of reduced revenue expectations among semiconductor companies today. Respondents to KPMG's Global Semiconductor Outlook survey forecast lower levels of R&D investment (Figure 8). While an understandable response to reduced revenue expectations, trimming R&D expenses creates a risk of harming a company's ability to develop innovative products and increases the pressure to develop specific programs successfully.

Figure 8: What is your outlook for semiconductor-related R&D spending by your company for the next fiscal year?



Source: KPMG Global Semiconductor Outlook 2016

Signs that a company is struggling with R&D efficiency and portfolio planning:

- Products are consistently late to market
- Programs are not properly scoped for risk and difficulty of delivery
- Programs are often under-resourced
- There is a declining rate of design wins
- New programs are added to the roadmap without going through proper vetting and planning
- Numerous SKUs are added to the roadmap to fill competitive gaps that should be addressed by platform products
- R&D managers find it difficult to manage priorities for shared resources

Mitigating risk in R&D investment

Instead of bearing the entire risk of the R&D investment for important product development efforts, companies can find ways to de-risk through M&A, joint ventures, and consortia. Other than managing internal resource allocation, companies must also settle the make-versus-buy decision for key IP and product developments. A company able to evaluate its own capabilities—versus outside sources of delivering new revenue opportunities—can realize great benefits from acquiring assets that are underperforming in another environment and could become a complement to the current portfolio.

Some companies have been extremely successful at identifying assets that would be more profitable if acquired and integrating the assets into their portfolios. Success with this approach requires a thorough internal review of portfolios and engagement with advisors to decide on potential targets.

Other ways to de-risk the R&D investment include exploring the formation of a joint venture, participating in consortia such as IMEC, CEA LETI or SEMATECH, or creating partnerships that spread the risk across multiple parties. Many companies engage with consortia such as IMEC to ensure alignment on key early-technology milestones and with supply chain partners such as foundries and capital equipment providers. The establishment of standards across manufacturing platforms fosters the ecosystem that will advance Moore's law and reverse decaying R&D efficiency.

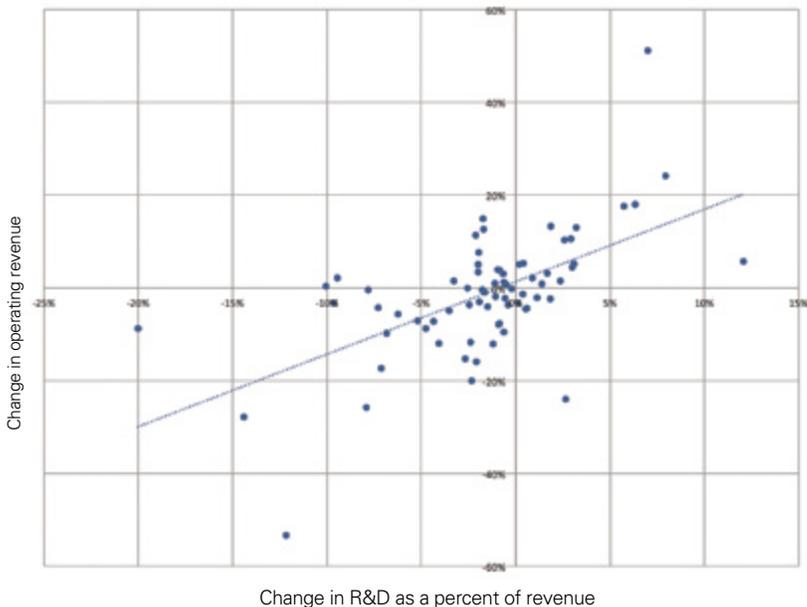
How R&D spending affects profitability

Though R&D is a crucial lever for maintaining competitive advantage, simply increasing R&D spending does not necessarily lead to higher revenue growth and profitability. In fact, KPMG's analysis of the 71 largest public semiconductor companies globally found no significant difference in operating margins between companies that increased R&D spend and those that maintained or reduced it. What matters more, in terms of profitability, is the relationship between spending increases and revenue increases.

A sign of solid business processes is maintaining or decreasing R&D spend as a percentage of revenue over time. This has become more difficult as revenue growth has slowed, but R&D costs have not moderated. Due to this, we have seen R&D (as a percent of revenue) increase by 2 percent since 2010 (from 15 percent to 17 percent). The companies that maintained or lowered their R&D relative to revenue saw operating margins increase 65 percent of the time, and their operating margin increases were 11 percent better than that of companies that grew R&D spend more quickly than revenue (Figure 9).

The results indicate those companies have been effective at implementing tools and processes that control spending and allocate resources correctly in their product development teams. This shows most directly how effective processes create shareholder value through increased earnings potential on R&D efficiency improvements.

Figure 9: Change in operating margin vs change in R&D as percent of revenue



Source: KPMG Analysis

How to implement effective portfolio planning and drive R&D efficiency

Tracking investments by program and monitoring the financial results to report actual returns on R&D investments by program can seem daunting at first. Usually, the best way to start is by analyzing the company's performance in its current customer and product portfolios, and where it has targeted current R&D investments for future revenue. Such determinations pinpoint the strengths and weaknesses of the current portfolio and lead to better understanding the company's true potential for success with future investments.

We believe the establishment of such processes and tools is central to the start of a robust integrated planning process with proper inputs from all key organizations to ensure alignment with market needs, R&D capabilities, and financial returns.

Companies such as Intel and Texas Instruments, for example, have used a ZBB (zero-based-budget) approach to their R&D investment portfolios. We have found this approach to be widely applicable in the semiconductor industry at companies that have competing priorities for R&D resources across multiple product and customer segments. The ZBB approach ensures the highest-priority core programs get fully resourced, and are held accountable for delivering products to market effectively. The ZBB framework has been highly successful, but it does require companies to be more disciplined in their planning processes and their uses of data.

What types of companies would benefit from the ZBB process?

Companies with large R&D investments in time-to-market critical segments: We see the most success with this approach in markets with critical needs to deliver products to market on schedule. The ability to allocate resources to the areas that are most critical, control scope creep, and manage the road map closely are among the advantages this approach offers.

Companies with high R&D investment across segments with various growth prospects: This approach also is very useful when companies are attempting to manage R&D budgets across multiple segments when one segment is in a mature, low-growth state and other target segments have much higher growth potential. The ZBB process helps the transparent reallocation of funds from mature segments to higher-growth areas that require more resources, but should generate a higher ROI.

What types of companies would benefit from a more traditional approach to portfolio management?

ZBB is a great process, but it's not for everyone. It requires mature planning processes and a high amount of overhead to ensure products can deliver the expected ROI based on priority status in the company's portfolio. While ZBB may not be the right fit for all firms, the principles of portfolio management benefit all companies.

Companies that do not have high R&D investments and have highly diverse portfolios would likely see a lower benefit from investing in a full ZBB process. Such companies need a more traditional approach to managing their portfolios, which involves understanding the true profitability of each product and customer combination, managing the right level of overall investment in products and segments, and controlling overhead. The approach may be traditional, but it is not commonly done well at many semiconductor companies.

The high levels of consolidation and growth in product portfolios have made it very difficult for companies to manage their product portfolios and optimize offerings to generate higher profitability. This leads to a situation where many companies continue to support product lines that no longer offer value to the company. Using portfolio management to make tough decisions on those products and segments can allow a company to redirect resources to areas with higher chances of adding value and further increasing return on R&D investment.

Conclusion:

As seismic shifts in the semiconductor industry take hold, the race is on for companies to efficiently manage their substantial R&D investments and product portfolios and best position themselves to capitalize on new trends. Doing so will earn them the "right to win" in the semiconductor industry.

Companies that are effective in analyzing their portfolios and assessing their internal R&D core competencies can greatly benefit by leveraging M&A, partnerships, or other targeted actions within their product portfolios to improve return on R&D investment.

We encourage companies to take a hard look at the real performance of their portfolios and determine the levers available to get more out of their R&D investment and continue to reap the benefits of Moore's law.

KPMG Global Semiconductor Practice

Our network of professionals has extensive experience working with global semiconductor and technology companies ranging from the Fortune 500 to pre-IPO startups. In addition to providing Audit, Tax and Advisory services, we aim to go beyond today's challenges to anticipate the potential long- and short-term consequences of shifting business, technology and financial strategies. With a worldwide presence, KPMG continues to build on our member firms' successes thanks to our clear vision, maintained values, and our people in 155 countries. We have the knowledge and experience to navigate the global landscape.

KPMG Strategy focuses on delivering corporate and private equity strategies based on our proprietary 9 Levers of Value framework, along with end-to-end implementation that helps companies get from strategy to results. Our dedicated strategy professionals have deep strategic advisory experience, particularly in building equity value and accelerating growth.

KPMG's Deal Advisory practice assists clients with evaluation and execution of investments, including M&A transactions, from pre-deal planning and target identification to due diligence and business integration.

Our Corporate Finance practice provides a broad range of investment banking and advisory services to its domestic and international clients. Our professionals have the experience and depth of knowledge to advise clients on global mergers and acquisitions, sales and divestitures, buyouts, financings, debt restructurings, equity recapitalizations, infrastructure project finance, capital advisory, real estate, portfolio solutions, fairness options and other advisory needs.

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