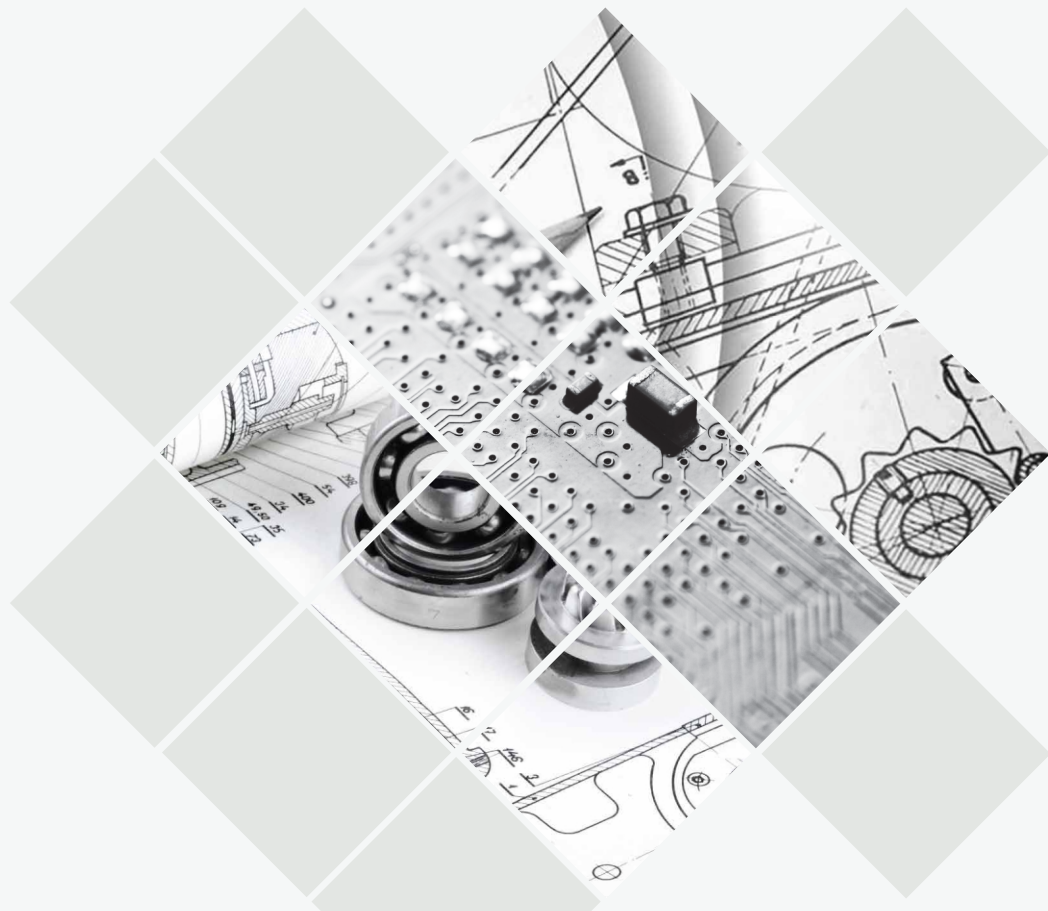


semiconductor industry: riding the industry cycle with QuEST



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Abstract

During industry downturns, most OEMs are forced to cut down on R&D spend and lay off part of their workforce to sustain the cost. Once the industry recovers, these companies find themselves in a situation where they do not have cutting edge products to take to the market. They also suffer from a damaged reputation due to layoffs. In this paper, we will find out how strategic outsourcing can help the semiconductor manufacturing industry to:

- Ensure continuity of R&D during downturns
- Support end-customers globally irrespective of industry cycles
- Take cutting edge products to market as and when industry recovers from downturns
- Improve time to market

1. Introduction

Semiconductor manufacturing industry is cyclic in nature and with a high R&D spend to sales revenue ratio.

Semiconductor industry cycles are caused primarily due to high capital expenditure for building fabrication plants, process migration triggered by Moore's law, and a slowdown in customer demand.

When semiconductor manufacturers make profits, they would invest in new manufacturing capacities. Setting up a typical semiconductor manufacturing plant costs between \$4 Billion and \$9 Billion. Each fabrication plant takes around 1 to 3 years to build and run at full capacity. The construction of a fabrication plant starts when the demand increases, and by the time it becomes operational, the demand could be down. This adds to overcapacity and subsequent crash in prices. The lag time between spending big money and getting to peak production volume further contributes to the cycle.

In the case of R&D, huge amounts of R&D dollars are spent to keep pace with technology advancements. This also means that when companies do not make sufficient investment in R&D, at the right time, they tend to fall behind in innovation. The ratio of R&D-to-revenue in semiconductors is one of the highest among several manufacturing industries, averaging between 15 to 20 percent.

For semiconductor manufacturing companies to be successful and leverage the industry cycle, it is important for them to manage their

investment, R&D, and resources prudently. By outsourcing non-core parts of their R&D activities and support services, these companies can reduce cost and optimize revenue. They can continue to focus on more important matters that are core to running their business, while partners take care of the rest through all stages of the industry cycle. This paper discusses the opportunities a strategic outsourcing model can enable for semiconductor manufacturing companies to ride the industry cycle without hurting their innovation pipeline or brand.

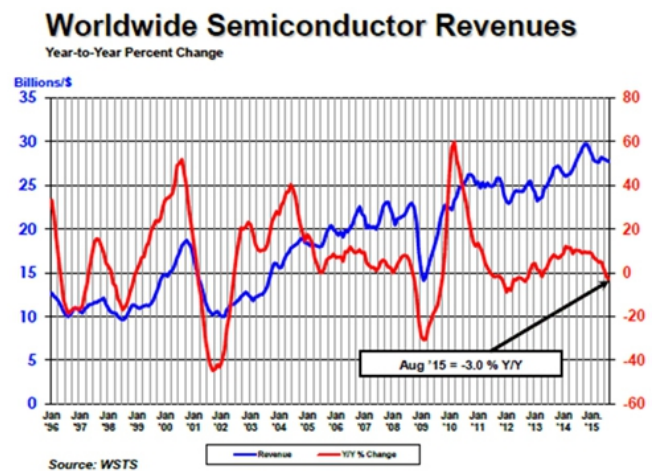


Figure 1: Semiconductor industry cycles

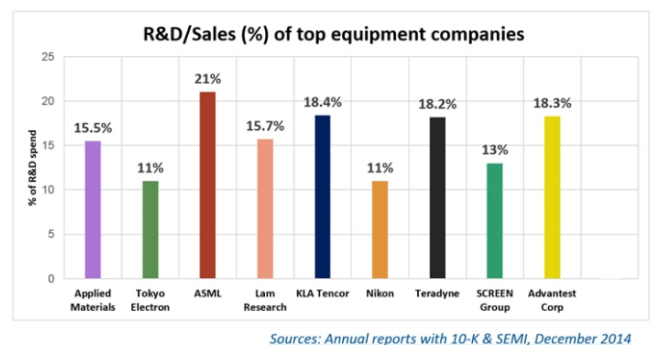


Figure 2: R&D/ Revenue (percent) spend in semiconductor manufacturing industry



2. How companies operate during industry cycles

During downturns, companies cut R&D budget to save on costs. Some companies are forced to cut budgets that are allocated for technology advancements and innovation. When the industry cycle swings back up, these companies who cut budgets for innovation, loose out because they do not have cutting edge products with differentiating features, to sell in the market. Thus, they miss the wave during subsequent upswings.

During upswings, equipment companies ride the wave to make the best out of it. However, catching the upswing is easier said than done. When the upswing starts, higher R&D budgets are allocated, but getting right resources from the market, training them and assigning to product teams take a finite time. By the time these resources become productive, there is quite an amount of time that is lost, which could have been better utilized to create new and differentiating features for the product.

3. Strategic Outsourcing is the way ahead

By outsourcing a part of their non-core R&D activities and a part or all of their support functions to a well-experienced, strategic partner, companies can leverage the industry cycle to their benefits. For new product developments, companies should work on clear outsourcing strategies that classify their R&D activities into core and non-core. The core R&D activities should be done within the organization and never outsourced. The non-core activities should be identified and outsourced to key

strategic partners, who have the experience and expertise in providing engineering services. These strategic partners should possess the right amount of domain knowledge in semiconductor manufacturing equipment industry. By doing it right, organizations can easily control R&D costs and improve margins.

4. Concerns, Risks, and Resolutions

There are multiple concerns facing customers while outsourcing R&D. Some of the primary concerns and mitigation steps are discussed here:

Concern 1: My IP is not secure

A single engineering service provider often works with competitors of the same industry. It, therefore, becomes necessary to take right measures to protect the IP of each competitor. QuEST has earned multiple certifications like ISO 27001 and other industry specific certifications to create an internal culture that values and protects the IP of each customer. Also, non-competitive and non-disclosure agreements are signed with employees working for customers. Customers often employ third party companies to conduct stringent security audits; QuEST has consistently shown a 100 percent compliance readiness.

Concern 2: Mid-level managers have difficulty managing a remote team

While the top management and investors derive much value from outsourcing, the mid-level managers, who are at the forefront of managing a project, have a mental block about remote managing a team. QuEST usually deploys 5-10



percent of a team at customer premises during the initial phase of customer engagement. This onsite team takes over the responsibility of task delegation, tracking, and ensuring that the expected quality of work is delivered from offshore. This onsite team helps in building up and transferring of knowledge to offshore. The team also ensures 100 percent acceptance tests (AT) are passed.

Concern 3: There is higher governance with outsourcing

Product managers are skeptical about the effort to put in while outsourcing R&D. To address this, KPIs are set in the contract that act as a self-governing mechanism. This automatic control mechanism has worked wonders for our customers, even the ones with prior bad experiences with outsourcing. We also conduct periodic review of the KPIs. Parameters are added, deleted, or tweaked to achieve the desired outcome.

5. Strategic Outsourcing: Benefits and Proof of Concept

While outsourcing support for legacy products is easy, outsourcing support for parts of new product development requires strategic planning. It is, therefore, important to select the right partner, who can guide organizations into identifying functions to outsource and strategize well for optimized returns. Strategic outsourcing to QuEST has ripple effects for our customers. Some of them are as following:

Improved end-customer satisfaction score (CSAT)

One of our customers improved their end-customer CSAT scores from 5 to 7, for product support of one of their legacy product lines.

QuEST supported the client's legacy products and end-customer support with lesser budget and better results. This improved their CSAT score from five to seven. We leveraged our excellent domain knowledge and over two decades of experience in working for multiple semiconductor manufacturing equipment companies and semiconductor fabrication plants, to design an optimum solution.

Improved sales and revenues

A client improved their market share by 4 percent during an upswing, by taking their new line of products to the market at the right time, with the help of QuEST. QuEST forms 20 percent of the new product development team and 60 percent of legacy product support team for the customer.

The client was able to maintain the core internal R&D team during the downturn. This enabled them to develop new products (with differentiating features), ready to be taken to the market during the upswing.

Beat end-customer deadlines and be ahead of schedule

QuEST's reusable frameworks reduced corresponding project schedules between 30- 80 percent of the original plan.

Reusable frameworks and packages developed by QuEST were integrated into new products that reduced the time to market.



Improved employee morale and improved brand

A client during their three years of association with QuEST improved their ESAT (Employee Satisfaction) score from 65 percent to 85 percent.

With QuEST as the partner of engineering services, the client was able to move their engineers from doing mundane tasks in supporting legacy products to new product development (NPD) team. This improved employee morale and appreciation for the opportunities provided by the company. Since the company did not lay off employees during the downturn, their brand reputation scored better than their competitors.

6. Case Study: A Top Five OEM Devised a Strategy That Increased Market Share during Subsequent Upswing in the Industry



Figure 3: Transition of relation from staff augmentation to legacy product support to strategic partner

One of the top five semiconductor equipment companies selected QuEST as their outsourcing partner based on our experience of over two decades in the semiconductor manufacturing equipment domain. The client had two teams for their products division –the New Product development (NPD) team and the Product Support (PS) team. The NPD team works on cutting edge products, and the PS team works on supporting legacy products.

QuEST engineers worked with the PS team to support products that were deployed in the field and took care of L2 and L3 support for the products. In multiple scenarios, QuEST engineers travelled to semiconductor fabrication plants to roll out patches and make sure that the new patches do not cause equipment downtime. They also travelled to fabrication plants to assist factory ATs (Acceptance Test). This helped the company save a lot in product support budgets. Since QuEST team was doing a great job with product support, customer's engineers in the PS team could be moved to the NPD team to work on cutting-edge products. This move from legacy PS to NPD boosted employee morale.

With a great feedback from the PS team and with the OEM wanting to do more with the allotted R&D budget, QuEST positioned itself to become a strategic partner to the OEM.

A session was organized wherein QuEST and OEM representatives classified the core and non-core part of R&D. This was done by rating product streams and sub-tasks based on multiple parameters, including:

- Criticality to OEM
- Complexity
- Availability of documentation
- Required amount of collaboration

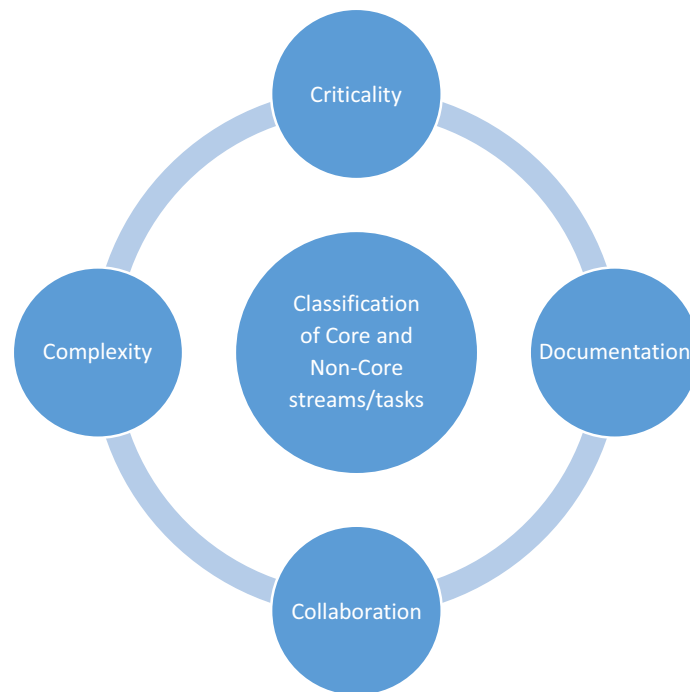


Figure 4: Some of the basic parameters used to classify core and non-core part of product R&D

All core tasks are strictly done internally by the customer. Once the non-core streams and tasks were identified, QuEST started working with the NPD team on non-core portions. Sample non-core streams and tasks included:

- Benchmarking of algorithms
- Development of applications on top of algorithms

On gaining further confidence, more non-core tasks were outsourced to QuEST, including:

- Auto-test frameworks
- User experience (UX)
- Development of stand alone tools
 - Overall Equipment Efficiency (OEE)
 - Preventive Maintenance (PM)
 - Equipment simulator

With QuEST supporting a major part of maintaining legacy products, only a thin

internal team was maintained in the PS team by the customer. As the markets went down, the customer requested QuEST to ramp down the team working on non-core parts of NPD, thereby, avoiding employee layoffs. Most of the legacy PS team was maintained during the downturn. After 18 months, as the market headed up, QuEST was asked to ramp up the NPD team.

QuEST also helped the customer to reduce their time to market for multiple product lines. This was achieved by sharing internal reusable frameworks with the customer. It included packages developed for host connectivity via GEM and EDA (Interface A) standards. These packages were used earlier by multiple customers and deployed at many fabrication plants. This meant that the packages had less number of bugs and were more reliable. With the

high maturity of host connectivity solutions using QuEST developed packages, the customer breezed through the Factory Acceptance Tests conducted at the fabrication plants.

7. QuEST — the Right Strategic Partner

QuEST is the right strategic partner for engineering companies engaged in semiconductor manufacturing domain. We have:

- Two decades of industry experience
 - QuEST is the strategic supplier to companies manufacturing equipment for front-end and back-end of fabrication plants: wafer etch, deposition, ion implant, inspection, metrology, sorter, SMT, die bonders, component inspection, AMHS, and more.
 - QuEST has a strong presence in the ecosystem, via strategic partnerships with cluster and robot manufacturers.
- Homegrown, award-winning frameworks, and products
 - QuEST has frameworks and products for equipment automation, host connectivity (GEM, EDA), and host simulator.
 - QuEST won Editor's Choice Award from Semiconductor International Magazine for home grown equipment automation framework.
- Experience working for all major semiconductor fabs and foundries around the world

- QuEST is armed with the knowledge and experience of working with all major fabs and foundries. We know the standard and custom host scenarios, and thereby, help customers avoid non-conformities during FAT (Factory Acceptance Tests) and get equipment accepted in short timeframes.



Author Profile



Mubarak AR

Mubarak provides technical solutions to prospects and customers in the Industrial Automation domain at QuEST. In his earlier role, he was part of the delivery team that developed solutions and application frameworks for automation and factory integration of semiconductor manufacturing equipment.

Mubarak is with QuEST for 20 years working primarily in the Industrial Automation domain besides having worked with many of the top 10 semiconductor equipment OEMs. During this tenure, he represented these OEMs at fabrication plants of Global Foundries, Samsung, Infineon, AMD, etc.

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