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The Talent Shortage in The Semiconductor Industry is a Big Opportunity for Engineering Service Providers

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There is a paradox in the semiconductor engineering service industry. While on the one hand, it has one the lowest R&D outsourcing intensity (ratio of R&D outsourcing to R&D spend), on the other hand, there is a talent shortage in the semiconductor industry. This PoV looks at talent requirements and trends in the semiconductor industry and suggests ways how semiconductor engineering service providers can leverage it.

Introduction

As chips are becoming more intelligent, the volume, as well as the complexity of software going into the chips, is also increasing exponentially. For example, chips now possess high processing power and have been playing important roles for safety-critical systems like autonomous driving. So, besides chip design, the role of chip testing, verification, and validation is also becoming important due to the complexity of design (low geometry nodes, power factor, durability, etc.) and type of applications (for example, any failure in an autonomous driving system due to chip defect can be fatal). Overall, the time of chip testing, verification, and validation has increased 40%-50% in recent years compared to the same a decade ago. Also, semiconductor companies need to spend more money on the testing infrastructure due to more modern testing methods and recruit more software-oriented professionals. As testing timeline and costing

are increasing without any significant value addition, semiconductor companies will possibly follow the outsourcing path in the recent future. This is an opportunity for the engineering service providers to target this space, but they need to be prepared with the required solutions and skillsets to differentiate. In this report, we discuss how the engineering service providers can align their semiconductor talent management program based on the semiconductor engineering landscape.

Semiconductor value chain activities are becoming more specialized

To understand the recent trends of the semiconductor industry, we have analyzed some of the recent initiatives and announcements, as described in Exhibit 1.

Exhibit 1: 2020 is the year of big-ticket acquisition in the semiconductor industry

Description	Strategic implication	Overall trends
Nvidia-Arm acquisition	Targeting high-performance computing application	• More examples of Scope acquisition (particularly targeting complementary/niche capability) rather than Scale acquisition • Semiconductor engineering is becoming more specialized and some of the broad players (present across the value chain) focusing on specific areas • In-house chip development for strategic purposes
Apple plans its chip-production	Vertical integration	
Intel outsources chip manufacturing to TSMC	Outsourcing to focus on core business	
Analog Devices acquisition of Maxim Integrated	Leverage application-focused offerings of Maxim	
Intel acquisition of Moovit	Targeting urban mobility application capability	

Source: EIIRTrend

Overall, the semiconductor engineering value chain is becoming more specialized for both horizontal and application-specific capabilities as value chain activities are becoming more complex, and emerging technologies are getting embedded into the chips and influencing both the chip design and manufacturing activities. So semiconductor players will look for technology providers for specific capability augmentation, increasing the scope of overall outsourcing. The increasing level of usage of software in the chips also demands sophisticated testing methods, moving away from chip testing primarily from the mechanical point of view.

The verification, validation, and testing focus is across the entire quality assurance methods of chip design and development life-cycle

To understand the overall quality assurance process of semiconductor design and development, we have explored each of the broad steps in Exhibit 2.

Exhibit 2: Semiconductor companies need to focus on both pre and post-manufacturing phases for quality assurance

Broad quality assurance steps	Description
Verification	Includes features, functionalities, performance, and safety verification against the desired one based on the specified design (typically before tape out).
Validation	Testing in a controlled environment (typically in the lab) of the specimen manufactured chip before mass manufacturing. Validation of the features, performance, and safety aspects among others based on the use-case requirements.
Manufacturing testing	Includes testing of mass-manufactured chips for wafer defects, stress testing, etc.

Source: EIIRTrend

The lack of cross-domain knowledge is fueling the talent shortage in semiconductor engineering

To be a competent and qualified semiconductor quality assurance professional, the context of usage of the chip is very important. In most cases, testing professionals are well versed with the technical knowledge (either emerging technology or semiconductor engineering expertise) but not with the complexity of the applications. Thus, they need to understand the vertical/use-case application of the chip to construct different scenarios for full-proof testing.

Exhibit 3: The industry and use-case context is important for semiconductor testing, verification, and validation

Trends/ applications of emerging technologies	Critical factors for the design	Critical factors for testing, verification, and validation
5G IoT AI Vertical/use-case specific applications Advanced node design	• Latency • Power consumption • Computing power • New architecture • Security	• Integrated validation along with functional features validation • Custom-built (depending on underlying hardware and software) power and performance validation • Leverage AI for defect identification, anomaly detection, predictive maintenance • "What-if" scenario analysis for full-proof validation

Source: EIIRTrend

Domain knowledge and cross-domain expertise are critical for the competency development of the engineering service providers

Service providers can prepare themselves accordingly to engage with semiconductor players for testing, verification, and validation prospects, as described in Exhibit 4.

Exhibit 4: Service providers need to relook at the existing quality assurance priority and reimagine the same with a software-led approach

Requirements	Descriptions	New capability ask
Old Priority	• Functional requirement • Overall performance requirement	• Domain understanding for out of the box test case identification for particular use-cases • Simulation models for validation of extreme scenarios and particularly software algorithms • Point solutions to facilitate testing automation (quality control of wafer fabrication, cloud-enablement of EDA tools, etc.) beyond traditional automated testbeds • Understanding of new technologies (AI, 5G, IoT, etc.) to analyze chip reliability & performance and chip manufacturing
New Priority	• Scenario analysis (particularly "What-if" analysis) • Software optimization (from both performance and security point of view) • Leveraging Industry 4.0 levers	

Source: EIIRTrend

To realize the benefit of the new priorities, service providers can follow the below four-pointers.

- **Solution development focus:** Service providers need to identify the pain points of the semiconductor enterprises and can build solutions accordingly.
- **Multi-disciplinary approach:** Service providers need to enable cross-domain learning for the resources to maintain a balance between technology and domain learning. A structured internal training program and platform can be an option for this.
- **Ecosystem collaboration & Co-innovation:** Ecosystem collaboration and co-innovations are great learning for the resource.
- **Academia collaboration:** As semiconductor engineering innovation is accelerating at a rapid pace, academic collaboration is beneficial for both research and resource upskilling.

Acquisition-led capability augmentation: Niche acquisitions can also provide service providers with the necessary capabilities and talent base.

Bottom Line: Critical thinking is the way forward for successful semiconductor engineering quality assurance processes – Service providers should inculcate this among the technology-savvy resources

The semiconductor quality assurance professionals are often completely technology-oriented, and in many cases, they come from the development team, driving the testing methods very technology-oriented. But the usage-centric view is also very important as this validates the technology capability of the chip under the unusual and unconventional scenario.

About the Author

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Pareekh Jain is Founder and Lead Analyst of EIIRTrend and Pareekh Consulting.

EIIRTrend.com is a neutral platform to discover emerging engineering, IoT, Industry 4.0 and R&D (EIIR) trends across 12 industry verticals. Pareekh Consulting is a focused analyst and advisory firm for EIIR.

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He is regularly quoted in the media on engineering services, IoT, and outsourcing trends, including Harvard Business Review (HBR), NDTV, Times of India, Economic Times, Business Standard, Hindu, Business Line, Livemint, Financial Express, Rediff, Voice of America, and Business Insider.

Pareekh is a thought leader, having authored various publications on topics related to EIIR outsourcing. He loves business fiction writing in his free time, and has authored a novel, Who Is That Lady?

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