



Outsourcing Test – What are the most valuable engagement periods?

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The Outsourced Assembly and Test (OSAT) industry offers value to semiconductor companies in several areas. As a leading tier one OSAT, Amkor invests in advanced packaging research, that provides semiconductor companies with device packaging options that are low cost, reduced footprint, handle higher power dissipation and cater to today's high bandwidth requirements. Test R&D teams offer a broad array of test services and can assist in formulating cost competitive test strategies over the entire product lifecycle. In order to keep pace with ever increasing integration and cost pressures – automated test equipment (ATE) is ever evolving, requiring OSATS to invest 30-40% in test capital.

Early engagement and consultations with the OSAT company can return a high value, in the areas of packaging options, wafer bumping, probing, final test, end-of-line and logistical services. With tight coupling to packaging road maps, a tier one OSAT can assure robust contacting solutions for high first-pass yields. By having one source for bump, probe, assembly and test there is singular ownership and fast yield feedback. OSATs offer a broad array of testers, probers, handlers, as well as, test development services. If your company is considering outsourcing test – it is important to consider early engagement, to maximize your return on the effort. This engagement is of highest value when the customers include other OSAT value added services as opposed to merely requesting a production only quotation.

Product Life Cycle (Leveraging Test)

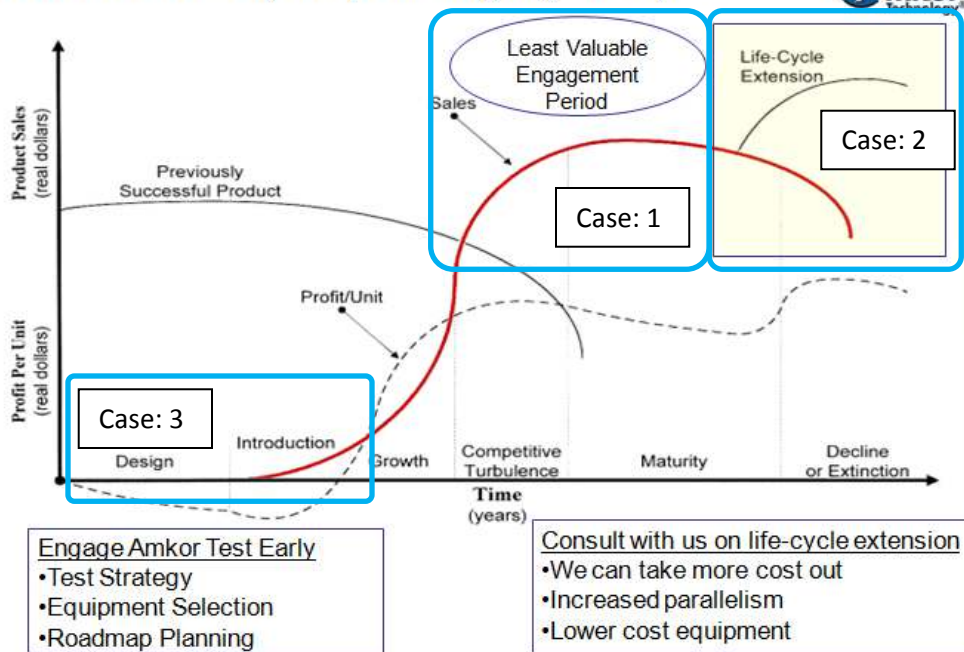


Figure 1

The illustration in Figure 1 captures the six main phases of a product lifecycle from Design to Decline or Extinction. The sales and profitability of the new product and the previous successful product is also shown. Based on this we can consider three engagement periods for outsourced test services.

Case 1: Seeking OSAT engagement at the region of peak sales just as the product moves from Competitive Turbulence to Maturity

In this case, the test solution has matured and an adequate amount of production capacity is typically in place. At this stage, moving from internal test at the Semiconductor IDM to outsource at the OSAT is the least valuable engagement period.

Why is it? Well, the test solution has already been specified and optimized to some degree and the OSAT's value proposition is reduced to primary factors like the hourly rate for the test service, capacity, and drop ship services. Occasionally, an OSAT may have available open capacity on the required equipment, but that is rare. Some semiconductor companies focus much of their outsourced test interest in this mid life cycle point, and are disappointed not finding an OSAT who meets their targets. From the OSAT's point of view, it is hard to justify making a significant investment at this point of the product lifecycle, with the knowledge that the product sales are at the peak, with only a downward trend to follow. In such situations, both parties leave the discussion with some level of frustration.

Case 2: Option of extending a product life cycle

For products that are enjoying a long lifecycle, what value would an OSAT bring in the maturity phase? Typically IDM customer are continually launching new products and carefully managing their existing product pipelines. Engineering management struggles on the issues of whether to assign top engineering talent to new product development or to sustaining a mature product. Since there is continuing demand for test engineering and cost reduction services on the mature products, this stage in the product life cycle is an ideal time to engage with an OSAT for a consultation around life cycle extension.

Tier one OSATs have experienced test development teams that can offer proposals that provide significant test cost reduction which improve the mature product's profitability, using techniques such as increasing parallelism and - or migrating the test solution to lower cost platforms. At first glance, lower cost test platform may imply new capital purchases (one of the least preferable paths for an OSAT). However with a broad equipment portfolio, the OSATs have older generations of testers on hand and waterfall strategies are in place.

More specifically, OSAT's capital investment is usually driven by high volume forecasts caused by new leading edge products from top tier customers. These advanced assets are typically purchased to support the tier I customers and satisfy the customers' needs in the "first wave" lasting a period of 1.5 to 3 years. Customers pay a premium when they require the latest tester technology to test their product. As this first wave subsides, these customers often launch new products with newer technologies that require OSAT's to move to next generation testers. This often creates opportunities to apply older (1.5 to 3 year) test assets to other applications. Customers will enjoy a lower cost of test by leveraging on-hand assets and following a planned migration to higher parallelism. Customers, who follow in the wake, take advantage of a lower cost of test.

Another avenue for reuse of these "first wave" assets is in wafer probe. What was once a leading edge final test tester can now be effectively redeployed into a wafer probe solution. This can also be seen when a mature packaged product moves to WLCSP, that is when the final test platform becomes the probe platform. Moving to slightly older generation equipment is a very effective way to lower your cost of test. When moving to a lower cost platform customers should provide the OSAT with the minimum test specification and test requirements. For some situations where the volume is very high, the OSAT can evaluate the move from singulated final test, to extremely high parallelism achieved through strip test.

Case 3: Early Engagement

The third period, namely early engagement, is actually the most valuable to both the customer and the OSAT. The customer may be faced with the following conditions – low internal capacity, tight capital spending conditions or a roadmap misalignment between the product’s test requirements and the on-hand test equipment capabilities. Early engagement is a common and often mandatory practice for advanced package design. Test engagement discussions, as early as possible, in the product design cycle with the OSAT, allows for the inclusion of design for test (DFT) and design for manufacturability (DFM). Secondly, the OSAT can complement the customer’s design experience with valuable practical knowledge gained in the areas of test that can be incorporated into the design. When discussions are skipped, there are often unforeseen jumps in the cost of test.

For example, data sheet specifications for a product are guaranteed in one of three ways - by design, by characterization or by production testing. Exotic tests can be relegated to characterization (or guarantee by design). Without good awareness of the OSAT’s ATE portfolio and their equipment roadmap, customers can end up specifying production test requirements that rely on exotic, rarely used instruments or even over qualified ATE. Early engagement avoids these pit falls.

Other cost drivers come from electrical contacting at probe and final test. For example, if pad size or ball pitch, are made overly challenging, it will call for more expensive probe cards or contactors. Early discussion with the OSAT and understanding standard contacting limitations will allow customers achieve a lower cost of test.

Having early design reviews the OSAT, can identify opportunities for increased test access, with no real estate penalty in the final product. For overall test strategy and roadmap planning, there’s a lot of power in the “one stop shop” of having a tier one OSAT provide bump, probe, assembly and test (fully turnkey solutions). For complex products with multiple die, the test strategy can be distributed across probe, in-situ test during assembly, post assembly continuity tests and final tests (functional and/or system level). Various sampling and characterization schemes can be established and then scaled back accordingly using data driven test time reduction. Real time test data can be leveraged for various adaptive test routines. The test strategy can also be woven into and across the other services for full traceability and fast feedback by integrating manufacturing and materials information from bump and assembly with wafer probe and final test information. In summary, there’s a lot of potential pay back and surprise avoidance with early test engagement.

It is worth mentioning that ATE companies work closely with the top tier customers who lead in their market space (communications, computing, consumer and automotive/industrial) in defining the tester HW and SW roadmaps. ATE companies work with IDMs to evaluate early prototypes of their new hardware and software features. This pattern tends to go with the introduction of new test equipment over time where a tier I customer is a full specifier of the test equipment and has been working for some years under NDA with the test equipment maker. However for mass production, the actual buyer is often the OSAT – and later in the tester lifecycle other customers can take advantage of the fleet.

Amkor welcome these discussions and knows the value of early engagement. It is perfectly acceptable to engage even during product definition stage or even if your test specification doesn't exist yet and so on – these are areas to cross check and collaborate.

In closing, by raising awareness of when to engage in an outsourced test discussion – customers will be better positioned to achieve a lower cost of test. Customers should take full advantage of the OSATs value added services beyond pure test production services to get maximum value from the relationship. Engaging a full service tier one OSAT across bump, probe, assembly and test has many advantages. Engaging early on, in product design is best, followed by engagement on mature products in need of new/differentiated solutions to take more cost out and extend the product life in the market.