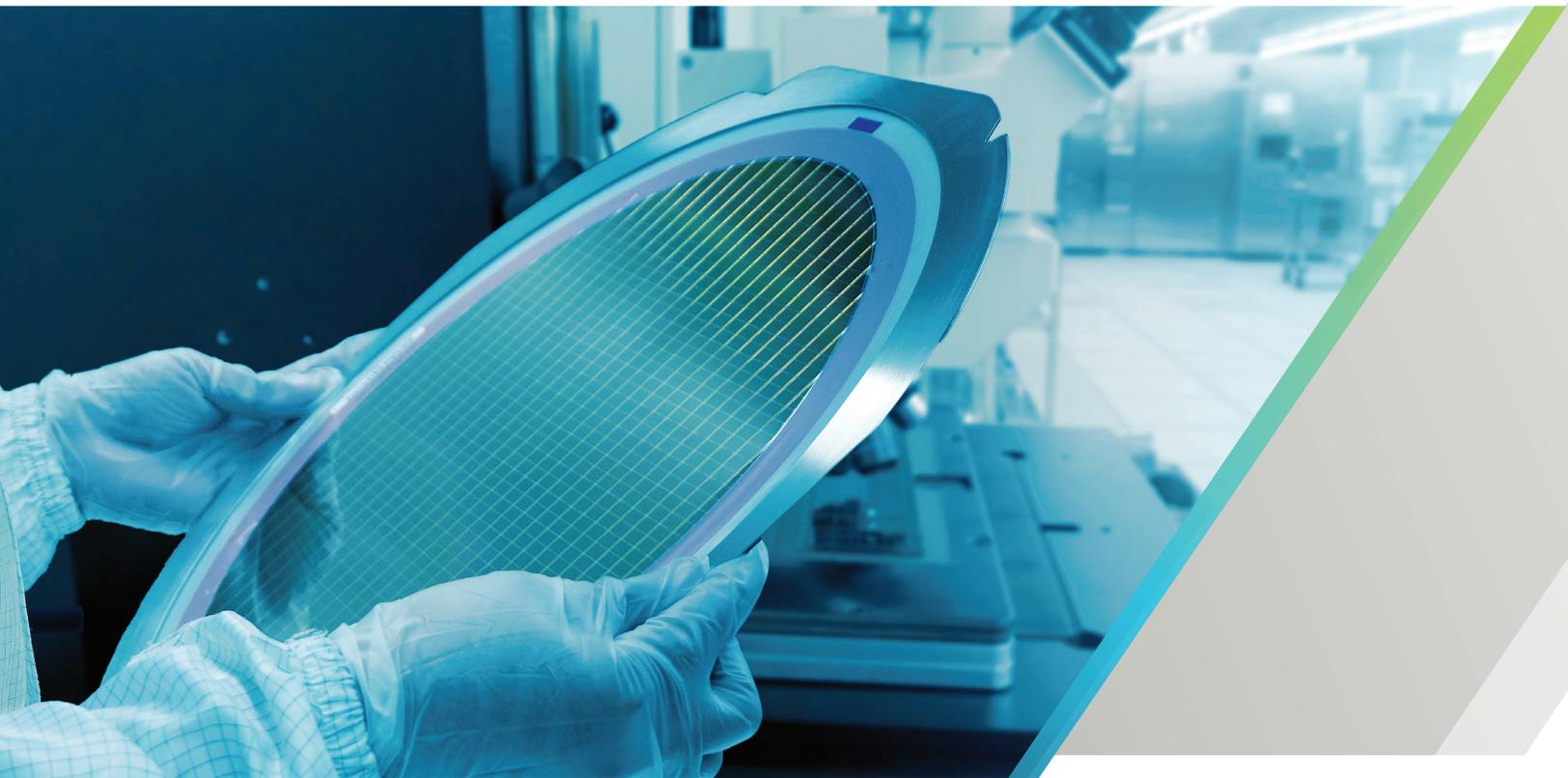


# CALCULATING ROI FOR A SMARTER T&M CALIBRATION STRATEGY

for Semiconductor Companies

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WHITE PAPER



## Introduction

Most semiconductor companies have internal labs for calibrating their test and measurement equipment. They can be incredibly advantageous for high volume calibrations such as torque wrenches, dial indicators, and calipers. For calibrating more sophisticated benchtop test equipment, however, it is critical to calculate a return on investment (ROI) to determine the worthiness of the investment. Calculating an ROI should consider all of the investment factors: cost, turnaround time, facility expenses, line downtime, and staffing. This paper will help you understand the factors to consider, and why, and assist you in creating an initial ROI calculation for your calibration program.

## Understanding your requirements for calibration

The first consideration when calculating the ROI of a program is understanding the specifications and requirements from the accrediting body as defined in the company quality policy. This can vary from company to company as well as site to site. Adhering to IATF16949, AS9100D, ISO9001, or MIL-PRF-38535 will require stricter requirements for organization's calibration program.



Semiconductor companies, and especially fabrication sites, use large amounts of benchtop test and measurement equipment that must be calibrated, with accreditation, to the highest ISO 17025 and IATF 16949 standards. These stringent specifications directly correlate to the amount of time, money, and personnel required to run a successful calibration program internally.

For equipment used in the fabrication process to characterize data, perform failure analysis, or test reliability, even the smallest inefficiencies in calibrating this equipment can result in a very large waste over the span of a year, five years, or ten years.

## Considerations for Calculating the ROI of Your Calibration Strategy

### INTERNAL CALIBRATION LAB COSTS

The most notable advantage of internal calibration labs is fast turnaround times, and therefore cost savings, for equipment within the lab's scope and capability. This turnaround time is compelling if the lab technicians are dedicated exclusively to calibration and not required to split work duties between multiple projects.

Challenges arise for accredited calibrations, where experienced technicians are required and can carry a higher cost of acquisition than training an existing employee. There is a diminishing return on how effective a standalone internal calibration lab can be depending on staffing, workload, and complexity of calibrations. For example, perhaps a company has one employee dedicated full time to certifying torque wrenches and they can complete 8 per day, 40 per week, or roughly 2,000 per year. This would result in a potential savings of nearly \$100,000 in outsourced calibration work. However, once one factors in the average salary of a calibration technician (\$60,000) + a torque calibration standard and load cells (\$10,000) plus an annual recertification (\$2,000) that potential \$100,000 in cost savings is now approximately \$28,000. This rough calculation also implies that the technician would be working all 52 weeks in the year, 5 days per week, 8 hours per day without vacation or holidays. From this example we can see that there are many hidden costs and considerations, but this model can lead to cost savings paired with very little downtime of equipment.

However, this exact scenario is very unlikely in the semiconductor industry for more sophisticated benchtop test and measurement equipment. Internal cal labs are inherently better suited toward physical-dimensional calibrations such as calipers and torque wrenches, and maybe some low-end scopes. For electronic test equipment, such as oscilloscopes, RF spectrum analyzers, digital multimeters, power supplies, and other essential equipment, the capital acquisition cost of calibration equipment required alone can cost more than \$500K per site, require specially certified technicians, and require implementing/maintaining a compliant quality system to satisfy the company's quality policy and accrediting body. Costs including facility space, certification costs, process documentation,



quality control, and others can also factor in. This is where it is essential to perform a tight calculation of a calibration strategy ROI.

Looking at oscilloscopes and using the same hypothetical situation as the torque wrenches, one would need a dedicated technician to calibrate, for example, three oscilloscopes per day. That equals roughly 780 oscilloscopes per year, close to a potential of \$110,000 worth of calibration services. The required reference standards would cost about \$50,000. Factoring in the calibration technician’s salary of \$60,000 plus the annual recertification cost of \$2,000, the operational cost estimate is \$112,000 which result in a net loss on operation costs.

Regarding quality, next comes the evaluation of test expertise and measurement uncertainty. Oscilloscopes are used in a more demanding capacity than torque wrenches from an accuracy standpoint, and when combined with the cost considerations, this may be an instance where outsourcing calibration services to a proven ISO/IEC 17025 accredited third-party vendor can deliver a savings.

### INTERNAL LAB TIME CONSIDERATIONS

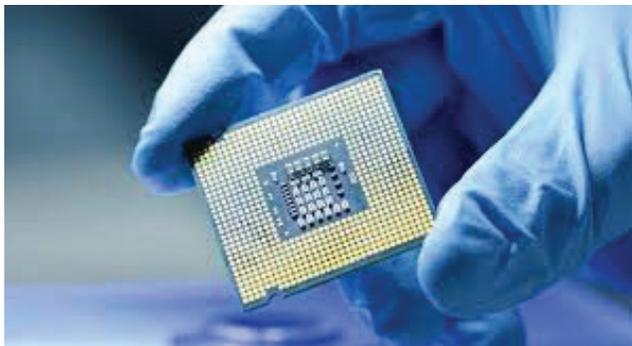
Time is of course money for semiconductor companies, and an important factor to consider in an ROI calculation. Turnaround time can vary depending on instrument complexity. For torque wrenches, turnaround times can be very fast, perfect for an internal cal lab. For high-end equipment, the backlog can be hefty with wait times sometimes stretching weeks or even months. If the equipment is used in R&D or production environments, delays affecting product introductions and production lines down all carry significant costs. For example, for a crypto characterization station that uses a Tektronix 6 Series mixed signal oscilloscope to measure jitter and phase noise, data collection can often run multiple weeks at a time. It is imperative to ensure that beyond maximum uptime and availability on that scope, there is also high confidence in the calibration accuracy. In this fast-paced environment, it is critical to ensure product lines get to market on schedule to maximize revenue.

Finally, an additional time cost can sneak up on a lab in the form of calibration management. Managing cals for thousands of pieces of equipment is a challenge on many fronts – understanding when calibrations are due, setting up instant access to certificates, service history logs, and other important details. Even setting up an internal software system to manage the calibration schedule carries an investment cost.

### INTERNAL CALIBRATION LAB COST COMPARISON

A basic ROI workup of an internal calibration lab, by equipment type. Does not include burdened costs of technician benefits, facility costs, consumables such as batteries, etc.

Cost Center	Torque Wrench	Oscilloscope
Calibration In-House Savings	\$100,000	\$110,000
Technician Salary	(\$60,000)	(\$60,000)
Reference Standard Equipment	(\$10,000)	(\$50,000)
Annual facility recertification cost	(\$2,000)	(\$2,000)
Gain or loss	\$28,000	(\$2,000)



A large semiconductor customer of Tektronix reduced their Turnaround time from 15 days to 2.65 days by using Tektronix as their embedded onsite partner to augment their internal lab capabilities.

## Strategies for Improving the Time and Cost ROI of A Calibration Program

### CONSIDER CALIBRATION AUGMENTATION FOR COMPLEX EQUIPMENT

The above examples illustrate the test equipment calibration costs on two opposite ends of the spectrum. The torque wrenches represent the lower end equipment that does not carry a large impact on manufacturing outcome the semiconductor world. Calibrating this standard equipment has a much lower bar for entry and could possibly be performed in-house for a substantial cost savings. On the other end of the spectrum, there is equipment that directly affects the reliability and outcome of product lines, probe and test, as well as technology development. This equipment should add quality to the ROI calculation due to potential downtime and product recalls due to inaccuracies. This is where a company has an opportunity to maximize ROI: maintain an internal calibration lab plus employ an external accredited calibration service provider. For low impact equipment, internal calibration labs can contribute significant savings in high volume with low risk. When combined with an external accredited laboratory to calibrate the higher end equipment, the ROI calculation can recognize improvements for time, cost, production uptime, while satisfying quality assurance requirements.

### CONSIDER QUALITY

Semiconductor companies must pass multiple audits, including ISO 9001, ISO 17025, and IATF 16949. Non-conforming calibrations are one of the most common sources of audit failure, requiring additional time and cost to remedy. Calculate the ROI to understand if it makes sense to invest in the accreditation and training costs, workforce training and certification, and calibration equipment needed to perform quality audits on both basic and sophisticated equipment.

Similarly, if using an outside calibration vendor, ensure the understanding of the quality received and relate that to the ROI. Does that third-party vendor perform calibrations that

match the company’s audit requirements, or is re-work necessary, requiring additional time and cost? Do they offer technicians certified to the industry accrediting body, A2LA? Or are they “self-certified,” which might have gaps in the most current knowledge of standards?

Finally, for sophisticated benchtop equipment, you may want to consider an OEM of test and measurement equipment as a single-source vendor possibility. OEMs typically adhere to the strictest industry standards and compliances and possess the most complete automated test sets for this complex equipment.



### CONSIDER HIDDEN VENDOR COSTS

As part of a company’s ROI calculation on outsourcing, it’s important to identify any additional fees or costs that may not be obvious. These include onsite visit premium fees, shipping fees, OSS (outside service solution) fees, pickup and drop-off fees. When evaluating vendors, dig in to ensure the price quotes received are compared thoroughly and transparently.

### CONSIDER SINGLE-SOURCE CALIBRATION VENDORS

Semiconductor companies may want to ensure quality and send each piece of benchtop test and measurement equipment back to its original OEM for quality calibration service. While this is a good strategy for quality, it may end up unfavorably costing the company in terms of personnel time, turn-around time, and shipping fees. For production-essential equipment, consider using a single-source vendor that can provide documented, accredited, OEM-quality calibrations on equipment of any brand. As a strategy to ensure audit-passing quality, a company can ask the vendor for a trial calibration event, for example, on 10 sophisticated pieces of equipment, and examine the quality before signing any long-term contracts.

### How to Calculate the ROI of Calibration Services

Calculating ROI can be a difficult but rewarding exercise to identify the smartest calibration strategy for a business. To make it easier, please access the [Tektronix Calibration ROI Calculator](#), an interactive Excel spreadsheet that can help weigh the factors for calculating an ROI, including the costs of:

1. Time
2. Money
3. Staffing
4. Calibration equipment
5. Facilities
6. Accessories and Consumables
7. Software
8. Documentation
9. Equipment recalls
10. Workload overflow

ROI CALCULATOR		Tektronix			
<b>IN-HOUSE CALIBRATION OSCILLOSCOPES</b>					
		Year 1	Year 2	Year 3	Total
		2022	2023	2024	
Time Saved - TaT	\$	5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 15,000.00
<b>SUBTOTAL COST SAVINGS / INCOME</b>	<b>\$</b>	<b>81,000.00</b>	<b>\$ 81,000.00</b>	<b>\$ 81,000.00</b>	<b>\$ 243,000.00</b>
<b>IMPLEMENTATION COSTS</b>					
Software	\$	6,000.00	\$ 6,000.00	\$ 6,000.00	\$ 12,000.00
Additional Licenses	\$	5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 10,000.00
Reference Standards	\$	75,000.00	\$ 4,000.00	\$ 4,000.00	\$ 83,000.00
Labor Costs	\$	60,000.00	\$ 60,000.00	\$ 60,000.00	\$ 120,000.00
<b>SUBTOTAL IMPLEMENTATION COSTS</b>	<b>\$</b>	<b>146,000.00</b>	<b>\$ 75,000.00</b>	<b>\$ 75,000.00</b>	<b>\$ 225,000.00</b>
<b>OTHER RECURRING COSTS</b>					
Annual Maintenance	\$	2,000.00	\$ 2,000.00	\$ 2,000.00	\$ 4,000.00
Facility Costs	\$	10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 20,000.00
Overflow External Calibrations	\$	70,000.00	\$ 70,000.00	\$ 70,000.00	\$ 140,000.00
<b>SUBTOTAL ONGOING COSTS</b>	<b>\$</b>	<b>82,000.00</b>	<b>\$ 82,000.00</b>	<b>\$ 82,000.00</b>	<b>\$ 164,000.00</b>
<b>SUBTOTAL EXPENDITURES</b>	<b>\$</b>	<b>228,000.00</b>	<b>\$ 157,000.00</b>	<b>\$ 157,000.00</b>	<b>\$ 324,000.00</b>
<b>RESULTS SUMMARY</b>					
Total Project Cost Savings	\$	243,000.00			
Total Project Expenditures	\$	324,000.00			
Net Project Savings	\$	(81,000.00)			
ROI (after 3 years)		75.00%			

Use this tool to quickly plug in the variables and get a quick understanding of where any inefficiencies may lie and identify any possible savings strategies. This ROI calculation combined with an organization's possible pain points can provide data-driven guidance in decision making.

## Conclusion

The concluding step in this decision-making process will come down to the amount of time, money and effort invested into your test and measurement program. Taking all vectors into consideration is crucial when determining where cost is the main concern or when time will take precedence. Understanding where any inefficiencies may lie and identifying any possible low hanging fruit that can be quickly and easily addressed. This is where taking a deep dive into your return on investment comes into play and fully understanding the true associated costs that come along with a comprehensive and compliant test and measurement program.

## About the Author

### ABOUT ALEKZANDER ARZDORF, CALIBRATION LAB SUPERVISOR

Mr. Arzdorf recently joined Tektronix as the lab supervisor of the Tektronix calibration lab in Duluth, Georgia, where he also serves as the semiconductor subject matter expert for the global calibration services teams. Previously, he served as the senior manager of quality and reliability for Microchip Technology, a semiconductor company, where over the span of four years, he reduced equipment downtime to less than 3% and achieved a calibration program cost savings of nearly \$1M annually. Mr. Arzdorf began his career serving three tours in the United States Army, working in metrology, where he graduated from both the TMDE program and the Master Course with Distinguished Honor Graduate status.

Tektronix is the leading accredited calibration services provider with 75+ years of experience in serving the world's largest mission-critical manufacturers in aerospace and defense, semiconductor, automotive, medical, communications, and other industries. Tektronix works as a strategic partner, delivering tailored solutions that save time and cost in achieving accredited and/or compliant calibrations on over 140,000 different electronic test & measurement equipment models from more than 9,000 manufacturers. Tektronix employs over 180 ISO/IEC 17025 accredited parameters and offers an extensive global service network that encompasses 100-plus locations with more than 1,100 experienced technical associates.

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