Keysight Technologies
Solutions for Pursuing Test Strategies that Address the Realities of Firm-Fixed-Price Contracts

Application Brief

KEYSIGHT TECHNOLOGIES

Introduction

In defense contracting, firm-fixed-price (FFP) contracts are becoming more common than cost-plus contracts. This fundamental shift in the business model begs an essential question: How can organizations evolve to compete successfully in an FFP world?

Compared to cost-plus, FFP transfers much of the risk from the government to the prime contractor. To mitigate these risks, contractors may want to reassess their assumptions and look for opportunities to streamline or redesign their processes.

The math is simple: profit equals price minus cost. When the price is fixed, greater attention must be paid to any and all costs that whittle away at the resulting profit. It may come as a surprise, but test equipment is often the third-most expensive capital investment across the life cycle of a system. To reduce the cost of test, two high-leverage action steps are available: pursue greater reuse of test assets across multiple products and product lines, and implement new strategies for test-asset acquisition.

This note presents context for the shift to FFP, suggests a few important implications, and offers recommendations for effective reuse and acquisition of test assets.

Problem: Juggling risks and costs

As noted above, FFP burdens the contractor with a greater share of the risks. The nature of this shift is shown in Table 1.

Table 1. Cost-plus contracts versus Firm-fixed-price contracts

	Cost-Plus	Firm-fixed-price
Promise	Best effort	Delivery
Cash flow	As incurred	Delivery
Administration	High	Low
Fee limit	Predetermined	None
Burden of risk	Greater on government	Greater on contractor

When faced with an emerging set of risks, the natural response is to identify ways to mitigate those risks. For prime contractors, existing product lifecycle (PLC) processes were created in a world of cost-plus contracts. With new underlying assumptions, it can be worthwhile to examine those processes and redesign them for risk reduction versus a fixed price.

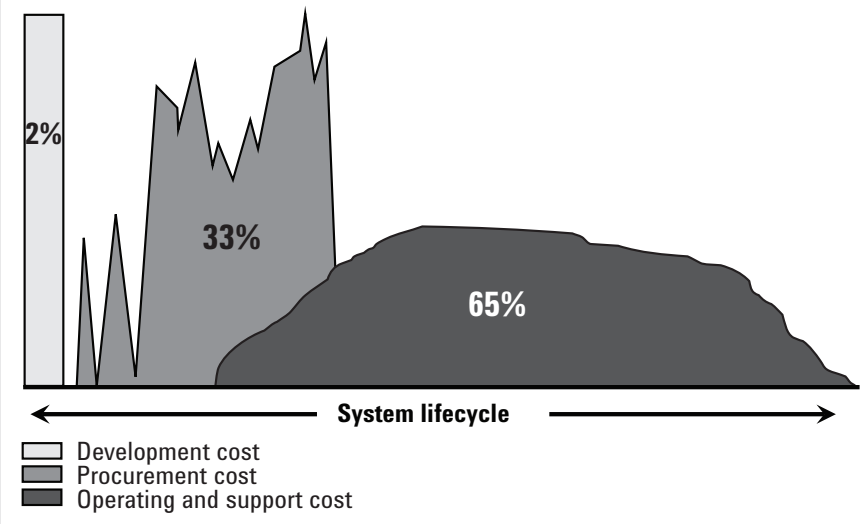
One key success factor is to modify core activities such that they can dynamically change while ensuring minimal fixed costs. For example, in the 1990s many commercial electronics companies began outsourcing the fabrication of printed-circuit boards (PCBs) to contract manufacturers (CMs). As market demand changed, this gave companies greater flexibility in managing the costs associated with labor and manufacturing assets.

Reality check #1: Operation and support dominate total cost of ownership

As one data point, a 2003 report from the US Government Accountability Office (GAO) broke down the total cost of designing, building and operating a ship over its lifetime. The conclusion: nearly two-thirds of the total cost went to operation and support (Figure 1).

The report also suggested that a greater investment in development costs focused on improving operation and support requirements would yield significant reductions in overall cost. For example, designing out common maintenance items served to reduce overall crew size and thus reduce ongoing support needs. [1]

Figure 1. For a new ship, operating and support costs typically exceed procurement and development costs (source: GAO).

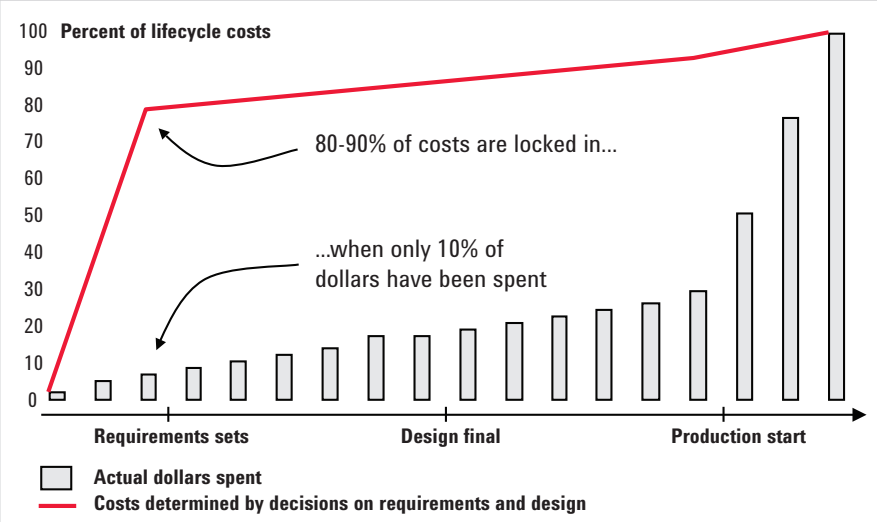


1. GAO-03-520, Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs, June 9, 2003

Reality check #2: Costs are locked in early

Another GAO report from 2003 concluded that 80 to 90 percent of the operating and support costs of a weapon system will be determined as soon as the requirements are set. However, at that point only 10 percent of the lifecycle costs have been spent. By the time the system is ready for production, more than 90 percent of the operating and support costs have been determined—but only 28 percent of the lifecycle costs have been incurred. The distribution of these costs is shown in Figure 2. [2]

Figure 2. For a new weapon system, a majority of the operating costs are locked in during the requirements phase (source: GAO).



Solution: Reducing the costs associated with test assets

After buildings and land, test assets are often the third-most expensive capital investment across the PLC—development, production and support. When dealing with FFP contracts, this has two important implications. First is the need to reduce operating expenses through greater utilization and optimized support of test assets. The starting point is a common test strategy that enables greater reuse of test hardware and software. Ultimately, this can help maximize your organization's return on invested capital (ROIC).

The second implication is the need to reconsider the available set of acquisition strategies for test assets. In the past, "buy" was the default—and perhaps only—strategy deemed acceptable by many prime contractors. Today, with FFP contracts, renting and leasing are viable alternatives that can help reduce risks.

Step 1: Enhancing reuse of test assets

Traditionally, the incentives associated with cost-plus contracts led most aero/defense companies to use a product-centric approach to design and manufacturing. In this paradigm, each customer is treated as an individual product line with a specific set of products. What's more, each product—in design and production—has a unique test strategy that is developed and implemented separately from any other product or product line. Consequently, different sets of hardware and software are developed, no matter how similar these may be across the various products.

2. GAO-03-57, Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs, February 11, 2003

Step 1: Enhancing reuse of test assets (continued)

In the commercial world, manufacturers tend to use a process-centric point of view that spans multiple products and product lines. Each customer is still treated in a unique way; however, products are grouped according to common functions, features, or both. With this approach, synergies between hardware, software and test methods provide useful leverage across many products and product lines, independent of the end customer. This is the starting point for greater commonality, utilization and reuse, and the beginning of reductions in engineering effort and equipment expenditures.

This approach is also the foundation of a strategy that can help you succeed with FFP contracts. The biggest benefit: it minimizes the risk and effort associated with developing, launching and manufacturing any new or enhanced product. Three key ideas help make asset reuse a reality: mixed-product manufacturing, common measurement blocks and a common-process test strategy.

Making the big shift: Mixed-product manufacturing

This is an important step in the shift from product-centric to process-centric manufacturing. One of the best-known examples of mixed-product manufacturing is the model used by Toyota. A Toyota production facility can, for example, build sedans, minivans and sports cars on the same assembly line with no interruption to the manufacturing flow. The net effect: rather than operating three separate lines that are partially utilized, one line runs at 100-percent utilization.

Figure 3 illustrates the difference between a set of independent production lines and one line capable of running multiple products. This same methodology can be used for any set of similar products once you understand how common measurement blocks and test reuse relates to those products.

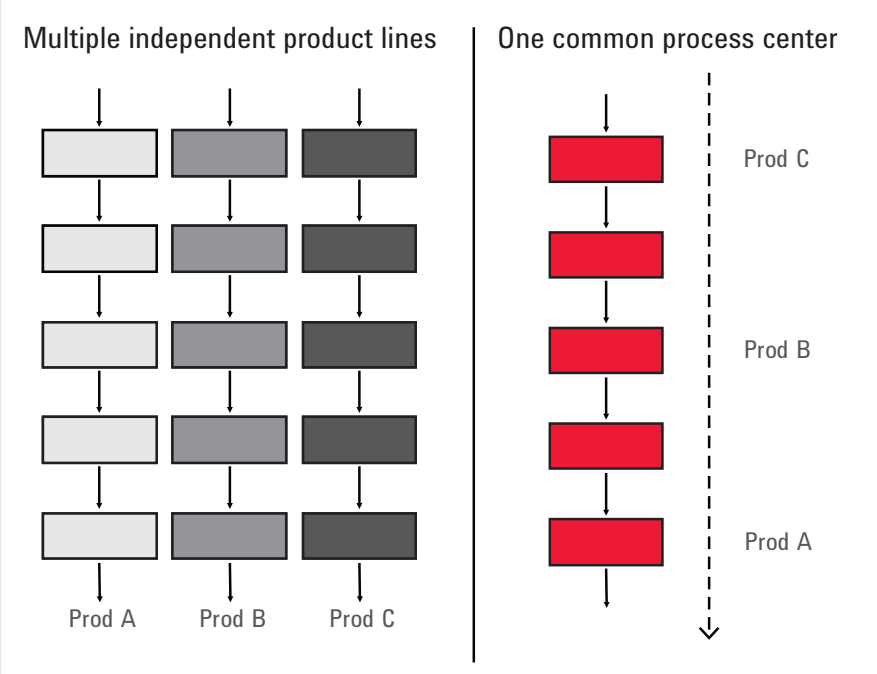


Figure 3. Compared to multiple independent product lines, the "common process center" can significantly reduce infrastructure costs.

When making the shift to a common process center, the starting point is to identify the common measurements that are required across a range of similar products. One way to make this visible is to create a matrix that includes all products and all measurements: common and unique requirements will become readily apparent (Figure 4).

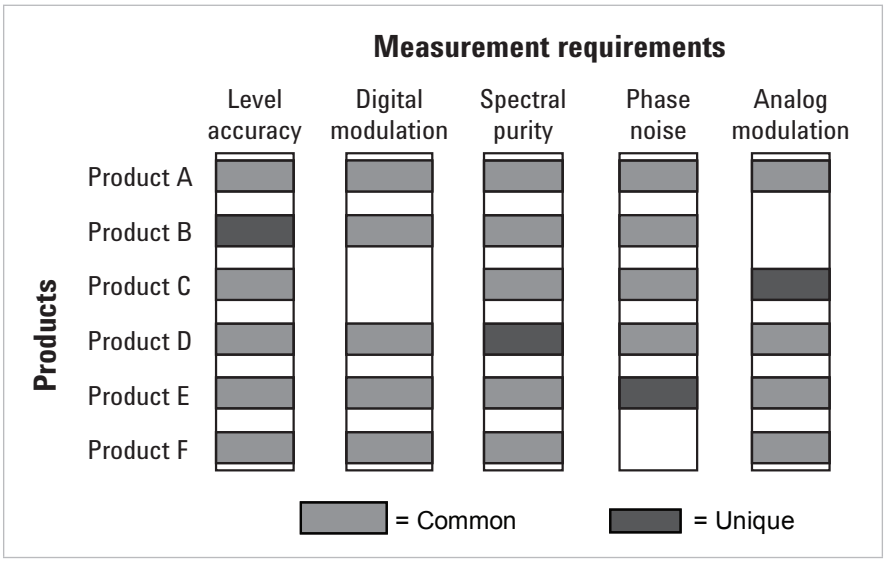


Figure 4. Mapping measurement requirements versus similar products will help you identify common and unique measurement blocks—and a majority may prove to be common.

In many cases, you may find that a majority of the tests are common—and this means you can use a common set of hardware and develop a common set of software modules. This approach dovetails quite nicely with mixed-product manufacturing.

Pursuing a common-process test strategy

Combining common measurement blocks with test reuse is the next step toward a test strategy that spans program lifecycles. This strategy also leverages previous investments in capital equipment and engineering resources.

As with the measurement-blocks approach, a matrix is a good way illustrate the common-process concept. As shown in Table 2, different products and their associated tests can be integrated into common measurement blocks. When several devices-under-test (DUTs) share common measurement needs or tests, the business unit will benefit. Whether the focus is on radar, EW, avionics, or another area, all have common measurement needs that may differ in terms of only a few specific details.

Table 2. The mapping of test assets and DUTs versus measurement requirements provides the foundation for development of a common-process test strategy.

		Measurement					
		Spectral purity	Phase noise	Noise figure	VSWR	Group delay	Insertion loss
Test asset	Signal analyzer	Y	Y	Y			
	Four-port VNA				Y	Y	Y
	Source 1	Y	Y	Y			
	Source 2	Y	Y	Y			
	Source 3	Y	Y	Y			
	Source 4	Y					
	Power supplies	Y	Y	Y	Y	Y	Y
	Digital capture			Y			
DUT A	Test 1	Y	Y		Y		Y
	Test 2	Y	Y		Y		Y
	Test 3	Y	Y		Y	Y	Y
DUT B	Test 4	Y	Y	Y	Y	Y	Y
	Test 5			Y	Y		Y
	Test 6	Y	Y		Y		Y

This is the foundation of test reuse, which includes measurement hardware and software. Benefits include greater test-asset utilization, less reengineering for new or enhanced products, and the potential to lower the per-unit cost-of-test for every product and program.

Buying, renting or leasing: A quick overview

For many aero/defense organizations, buying has been the default choice when acquiring test assets. In commercial circles, renting and leasing have become essential alternatives.

Buying is best when capital is readily available and project risk is low.

Renting, which typically requires a month-to-month contract, works well for short-term needs. Examples include temporary projects, peak loads, proof-of-concept work and equipment evaluation. Renting is also good for projects with uncertain timeframes or a high level of risk.

Leasing is a good choice for longer-term projects with a known, fixed duration. A typical equipment lease lasts 12 or 24 months.

Two types of leases are common: operating and financing ("rent to own"). When an operating lease expires, common options include returning the equipment, extending on a month-to-month basis or buying the equipment at a favorable price.

At the end of a financing lease, you take ownership of the asset and title is transferred. This can be useful when needs and budgets aren't aligned. It also helps maintain borrowing power and preserve capital because it requires less up-front cash.

Step 2: Improving acquisition strategies for test assets

Across the lifecycle of a commercial product, a company makes an up-front investment in resources, people and assets during the design, validation and verification stages. When the product is deemed ready for market, it will be launched and produced, thereby starting to generate its return on investment. Once the initial investment has been recouped, the return becomes positive and the product moves toward profitability (depending on how ongoing support costs are tallied).

This is different from what happens with most aerospace or defense programs. For example, there is no guarantee that a product-under-development will go into production. Most programs put at least two vendors in competition, basically giving each a 50-percent chance of winning the contract.

There is another important difference: the "zone of the unknown" between R&D and production. This is the time between submission of the proposal and the awarding of a contract—and this can range from a few weeks to several months to more than a year.

This interval can increase the risks associated with the R&D phase, especially if "buy" is the default acquisition strategy for test assets. If your organization has an implicit or explicit policy of "we don't rent" or "we don't lease," periods of dramatic change are an opportunity to check the assumptions behind such decisions.

Timing: Making informed decisions along the PLC

If you purchase test equipment in the R&D phase, those assets may sit idle for an extended period during the "unknown zone." If you don't win the contract, the assets could become excess capital.

For programs with moderate to high risk, renting or leasing provides greater flexibility. For example, you could return rented equipment after entering the "unknown zone" and then buy it later—through rent-to-own or outright purchase—if you win the contract.

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During the production phase, demand for test capacity changes dynamically. Figure 5 illustrates the cumulative capital outlays for test assets versus changes in test demand. Between introduction and maturity, spending typically increases in large steps because, in most cases, producing one or more units above existing test capacity requires a complete new test stand. After maturity, production volume goes into a decline, which means fewer test stands are needed and the excess assets become a drain on ROIC.

Figure 5. After production volume begins to decline, the cumulative value of asset purchases remains fixed—and can become a drain on ROIC.

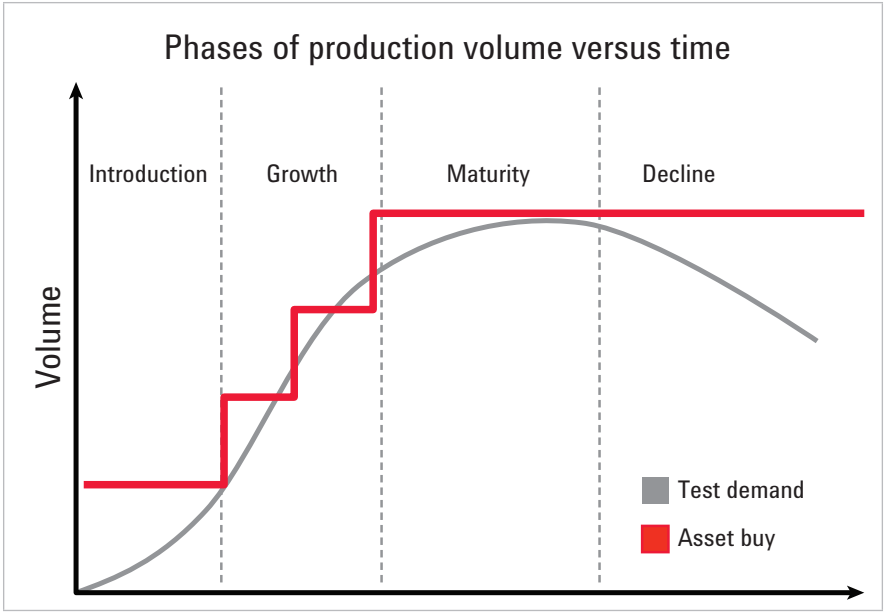
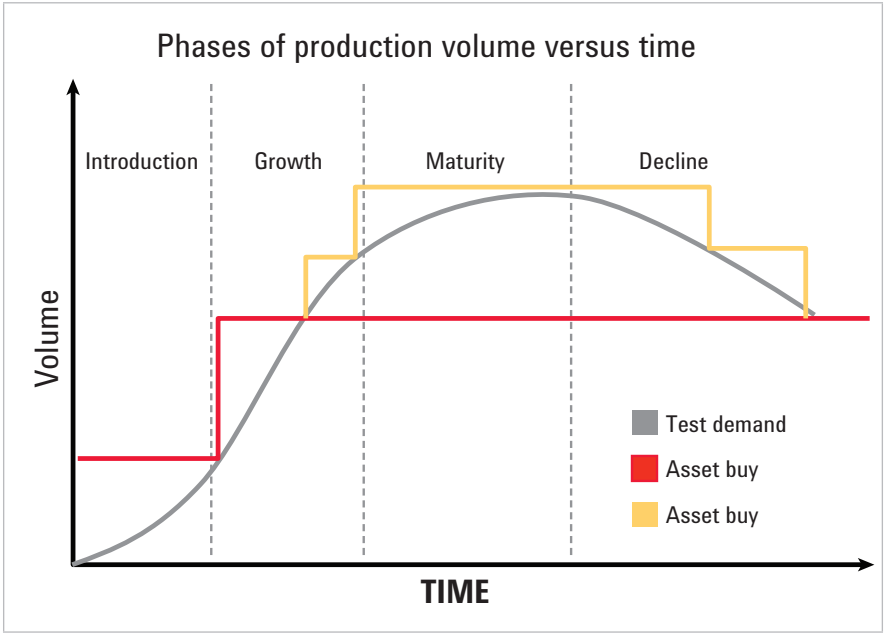


Figure 6 shows a financially attractive alternative. When test demand reaches a predetermined level, a leasing strategy is employed. This is not an arbitrary point. Rather, by understanding the different breakeven costs for renting, leasing and buying, the length of time under the curve can determine the best acquisition strategy.

Figure 6. An acquisition strategy that includes leasing can reduce costs, risks and excess assets.



In this case, the trigger point for the leasing of test assets occurs when the need is expected to exist for more than one year and less than three years. Under these conditions, leasing is most likely to minimize cost and risk, and thereby minimize the value of excess assets that remain during the decline phase.

Reframing: Combining the strategies

Figure 7 shows the next logical extension of this strategy. When the concepts of common hardware and software blocks are combined with flexible acquisition strategies, the result is an overall test strategy that can be optimized for reuse, utilization and flexibility. As suggested in the figure, test assets can be continually rolled forward and reused with new products that have similar features, functionality and test needs. As in Figure 6, demand peaks can still be handled through renting or leasing.

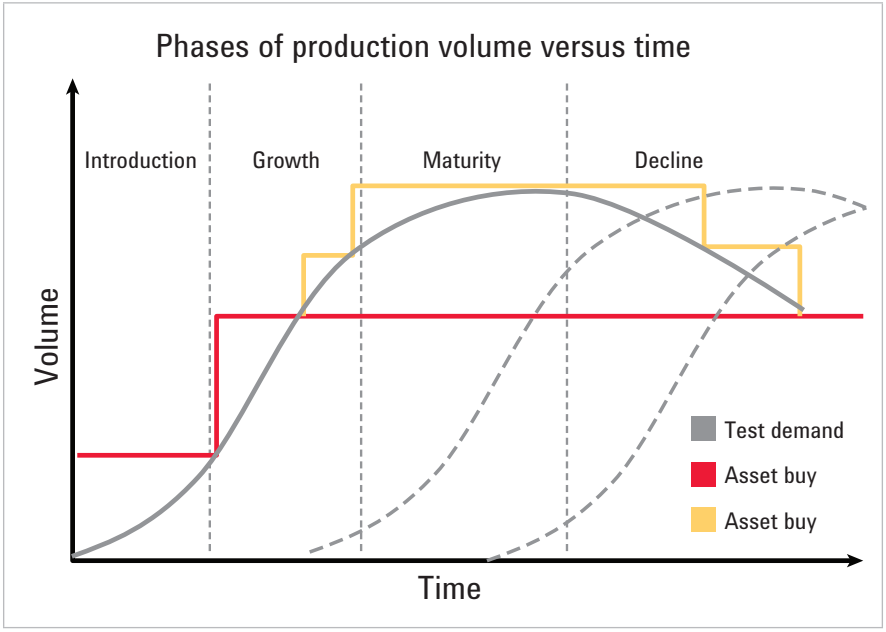


Figure 7. Selective use of leasing (or renting) adds a financial advantage as common hardware and software blocks are rolled forward to support new products.

The interplay of these concepts is summarized in Table 3. Although none of the proposed approaches is "one size fits all," matching each stage of the PLC with a favorable acquisition strategy can help you reduce the total cost of ownership for your test assets.

	Development	Production	Support
Buy	Best with long development cycles and evolutionary products (i.e., those expected to change with time)	Optimal for long-term production and production of evolutionary products	Lowest cost for long-term support requirements
Lease	Effective with product development programs of one to three years, and when using direct allocation of costs	Supports the pursuit of a fixed cost-of-test per unit, and production life of one to three years	Provides flexibility when facing short-term increases in support needs
Rent	Effective for projects that last less than one year	Effective when facing short-term upticks in production volume	Provides flexibility when facing sudden increases in support needs

Table 3. The acquisition strategies offer potential advantages during each stage of the product lifecycle.

For many years, commercial manufacturing companies have been combining these ideas to reduce exposure to cyclical demand and fixed costs. In the era of FFP contracts, this approach can be a useful alternative that aerospace and defense contractors will want to consider.

Conclusion

Testing is still the best way to reduce the likelihood of a product falling short of its specifications. To ensure customer satisfaction and success, many organizations spend money on test throughout the product lifecycle—but this form of risk mitigation can be expensive.

As shown here, you can reduce the costs associated with test assets by adopting or adapting proven strategies from the commercial world. One common thread is the power of reusing knowledge gained from previous products and programs. This is true in the use of common measurement blocks and in the reuse of test assets. It is also true in the analysis of test-asset acquisition strategies versus the usual progression of production volumes and test needs.

The ultimate benefit is clear: the decision to leverage knowledge gained in commercial manufacturing can help aerospace and defense contractors compete more successfully in a world of FFP contracts. It will also position your organization to more easily adjust and adapt with future changes in the business model.

Related Information

- Brochure: *Keysight's Operations Consulting Services,* publication 5990-9036EN
- Book: *Going Lean: How the Best Companies Apply Lean Manufacturing Principles to Shatter Uncertainty, Drive Innovation, and Maximize Profits,* Stephen A. Ruffa, 2008, AMACOM
- Book: *Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative*, 2002, Palgrave Macmillan
- Book: *High-Mix Low-Volume Manufacturing, R. Michael Mahoney,* 1997, Hewlett-Packard Professional Books
- GAO Report: *GAO-03-520, Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs,* June 9, 2003; available from www.gao.gov
- GAO Report: *GAO-03-57, Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs,* February 11, 2003; available from www.gao.gov

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Published in USA, August 3, 2014
5991-2712EN
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