



Keeping Up with the Pace of Change

How Innovating the Validation Lab Speeds
Product Development



INTRO

Keeping Up with the Pace of Change

The digital world is more connected and moving faster than ever. From augmented and virtual reality to artificial intelligence (AI), technologies that seemed fictional just a few decades ago are now part of our day-to-day lives. These disruptive innovations push the boundaries of measurement science on two major fronts:

**01.**

The rapidly evolving rate of innovation leads to abbreviated, more aggressive market schedules.

**02.**

The growing complexity of the measurements themselves is driven by the need for increased test coverage on more complex designs.

Consider some of the technological advancements that are disrupting the way engineers design and test products. Though innovation pushes engineering organizations toward new realities, change creates new challenges. Engineers have a unique opportunity to reimagine product development processes to make a bigger impact on the world.

Organizations keeping up with the pace of change have a distinctive market advantage. The good news is, future-proofing engineering workflows is easier than you might think. And guess what? You can start just about anywhere!



MARKET FACTORS

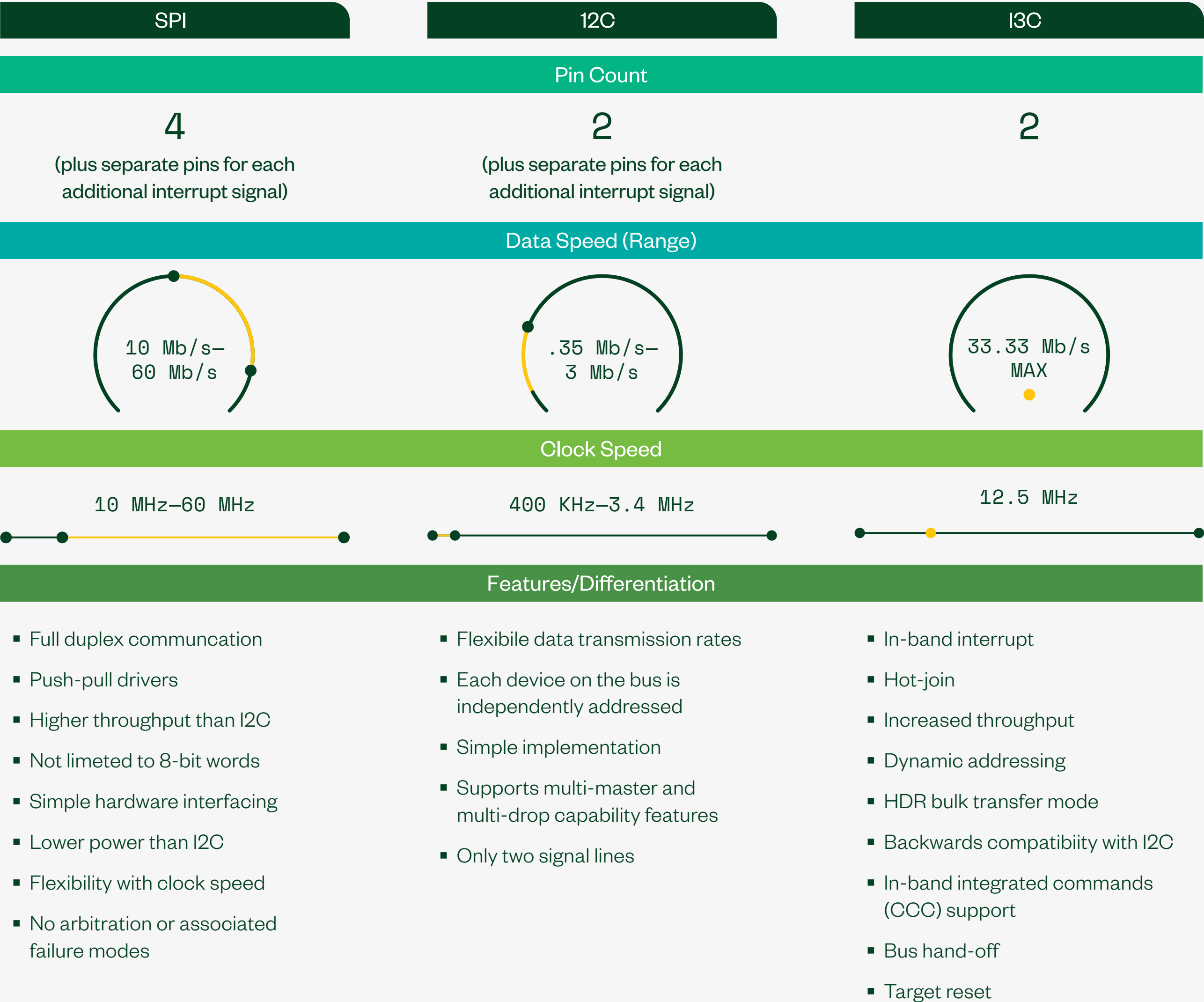
New Technologies and Applications Demand More Test Coverage

Business opportunities in new and established markets are driven by innovative technologies. New technologies not only help engineering organizations grow, but they change the way these organizations design and test products—forcing them to solve more complex problems in less time. For example, in the automotive and semiconductor industries, electrification and autonomous driving are increasingly popular, but they require higher-volume characterization. These industries need to save time and keep up with demand by automating different stages of the product development process. We see this trend impacting both the DC and RF signal spaces, too.

For example, the evolution of I2C and SPI to MIPI I3C proves how increased design complexity complicates

existing validation practices. This new development in digital communication protocols forces engineers to go beyond functional compliance checks. Without the benefit of incorporating previous designs into next-generation devices, teams are challenged with having to create a more complex measurement framework to account for I3C’s increased speed, complexity, and number of features. Validating against full parametric, functional, voltage, and timing characteristics significantly increases cost of test. In short, researching a new protocol standard, designing the appropriate measurement IP, developing a user interface, and reporting results requires a significant amount of time.

New Capabilities Can Impact Validation: A Comparison between SPI, I2C, and I3C

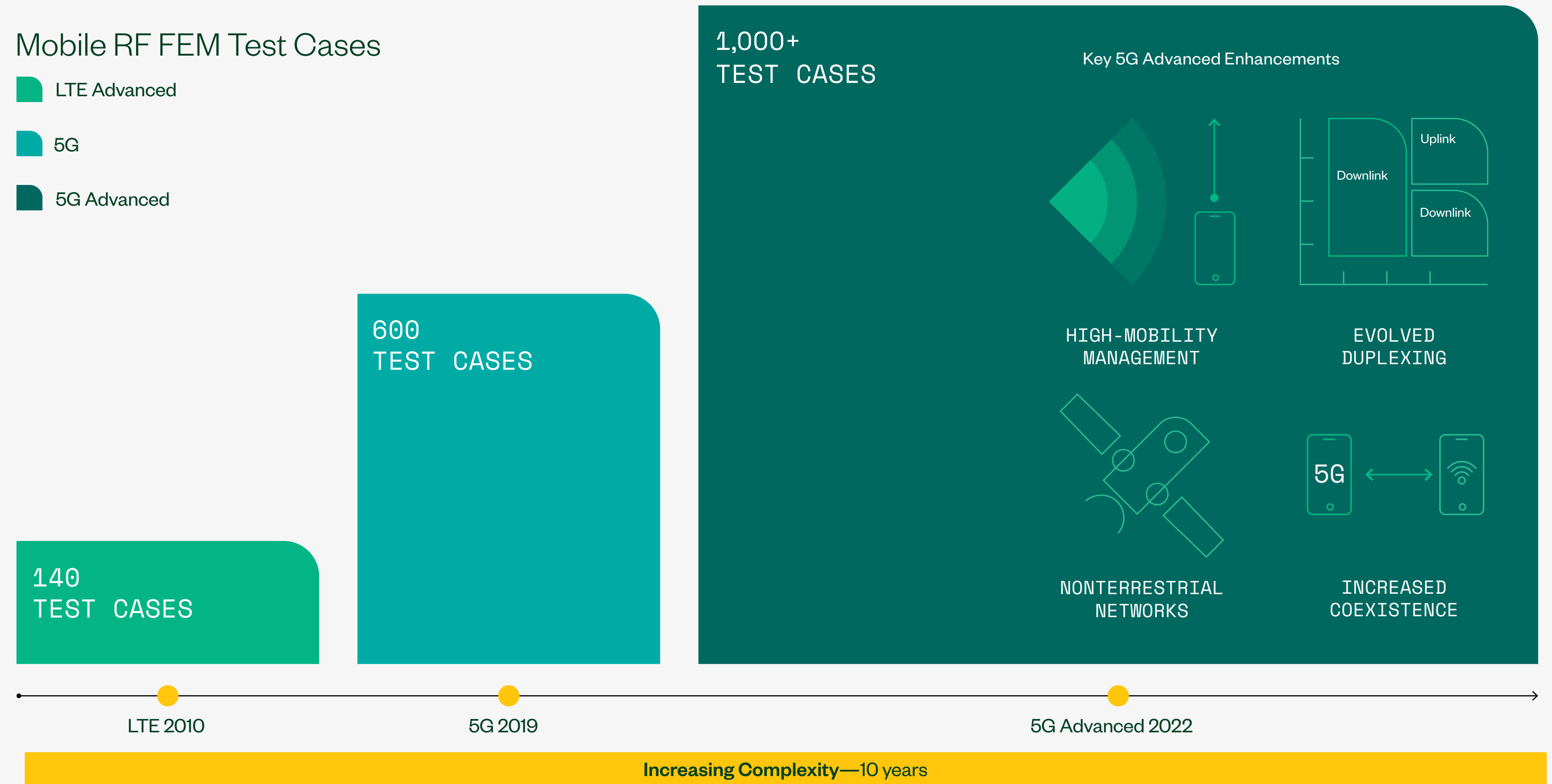


With evolving protocols, engineering teams also must adapt to more complex product design. For instance, when characterizing a 4G RF front-end module 10 years ago, engineers probably had fewer than 75 test cases. Today's 5G front-end modules have 600 test cases—each with a different combination of radio band, carrier bandwidth, and waveform type. The shift from 4G to 5G presents the clear need for greater test coverage with more complex measurements. For 5G mmWave devices, incorporating antenna-in-package technology eliminated physical connections to access the mmWave signal. As a result, many 5G mmWave devices require over-the-air testing, a completely new test methodology. What's more, major 5G Advanced enhancements, such as increased coexistence between networks (wireless and nonterrestrial) and evolved duplexing, may increase design complexity by 2X compared to today's 5G devices.

5G Advanced Continues to Drive Mobile Complexity

Mobile RF FEM Test Cases

-  LTE Advanced
-  5G
-  5G Advanced



CHALLENGE

Rapid Innovation Requires Solving More Complex Problems in Less Time

Though new technologies create business opportunities for companies to take market share, they also change the way that engineers design and test products. With the rate of engineering innovations escalating faster than ever, engineers must accelerate every phase of product development. From 5G to mobility to digital transformation, these advancements drive shorter development timelines.

While innovative applications require more extensive and complex validation, product schedules often don't allow for increased validation or characterization times. On the contrary, they press for even more rapid product development—creating a smaller market window. Because they need to test devices more extensively while market windows continue to shrink, engineers must streamline processes and find opportunities to expand productivity.

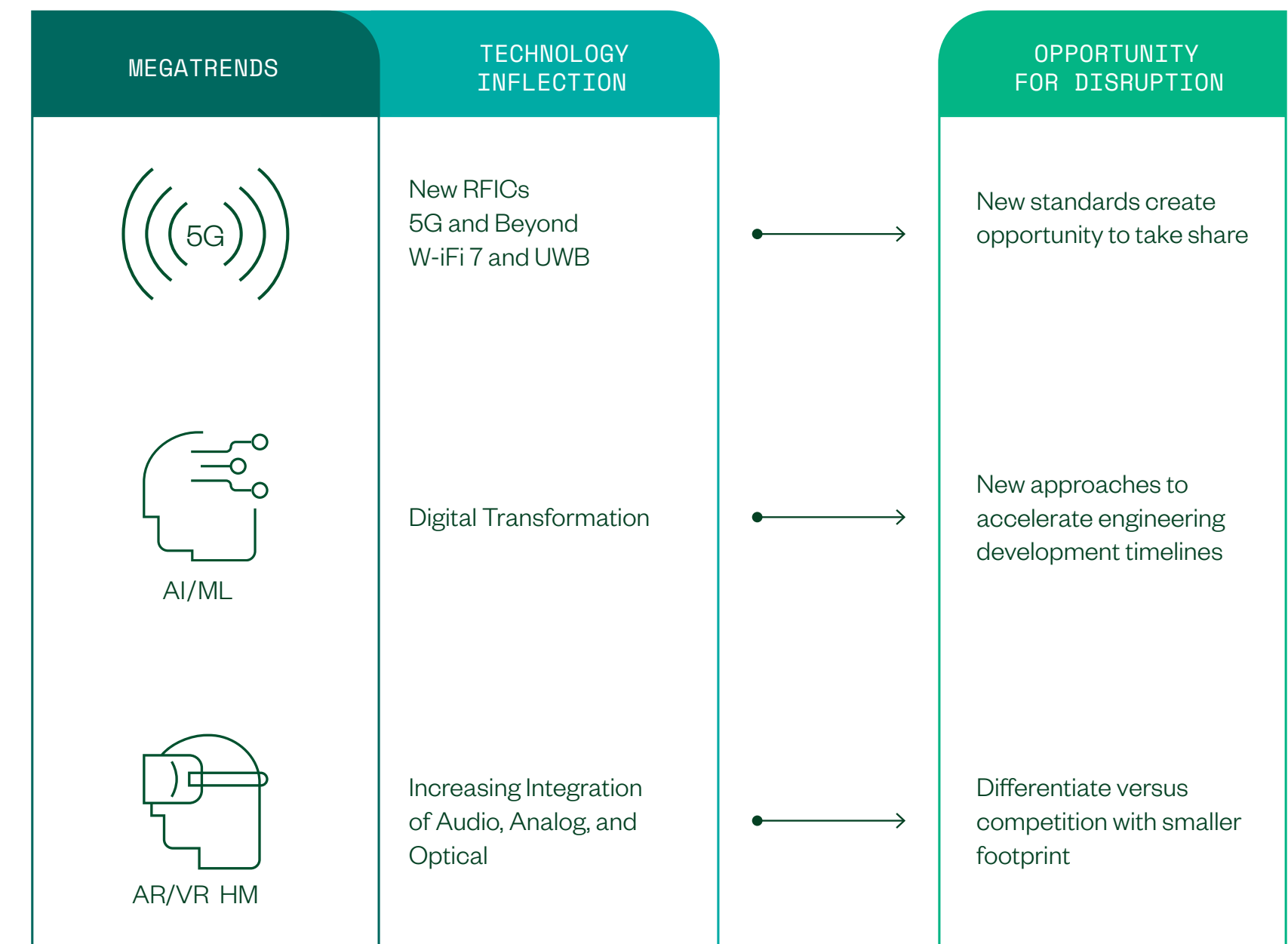
Increasingly complex products and shorter production timelines continue to drive enhanced productivity. Yet, design and test workflow inefficiencies significantly impact product release dates. These demands mean that streamlining the engineering workflow has become more important than ever. The challenge then becomes setting up engineering teams for success.

“While accelerating product development has always been a key focus for our customers, recently, we’ve seen a significant decrease in time designated for validation. 10 years ago, validation teams could spend up to 1-2 months fully characterizing their devices. As product schedules are shortened and more complex systems require an increase in design time, validation is now left with roughly two to four weeks, including bring-up, debug, and statistical characterization. We expect to continue seeing this trend further shrink the validation window, which is why it’s so critical to start figuring out how to modernize validation methodology to get ahead of this curve.”

Marvin Landrum

Offering Manager Director, Semiconductor & Electronics Business Unit: Validation, NI

Megatrends Create Opportunities



OPPORTUNITIES

Test Teams Must Be Set Up for Success

Design, validation, and test engineers often juggle their organizations' competing priorities. These teams must mitigate cost and complexity to meet revenue expectations in less time and with smaller budgets. But organizations usually aren't structured such that engineering teams can effectively balance priorities.

For example, silos between research and development teams and labs often lead to duplicated efforts—especially in large organizations. This, compounded by multinational mergers and acquisitions, produces repetitive organizational structures and multiple teams working to meet the same challenges.

Not sharing best practices among departments leads to inefficiencies and missed opportunities—most significantly in the product development validation phase. Incohesive strategies between product design and production result in a lack of IP reuse and require validation engineers to repeatedly restructure processes.

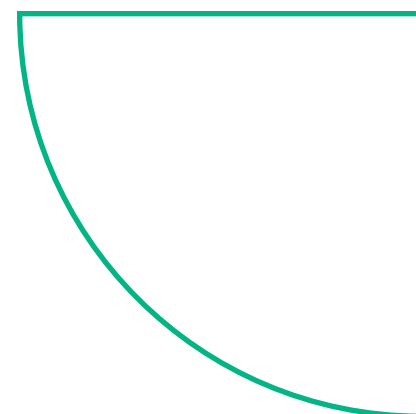


From the substantial setup time required by nonautomated environments to the highly manual nature of correlating inconsistent data, seemingly minor inefficiencies can prevent companies from delivering products to market quickly. However, even small adjustments can generate significant impacts that help teams meet aggressive market schedules. Agile organizations that proactively address inefficiencies in their workflows today are the strong market players of tomorrow.

“I see many companies benefitting from increasingly sharing both test software and test methodologies across sites. In fact, some of the most successful organizations we work with have driven efficiency by standardizing test measurement software globally.”

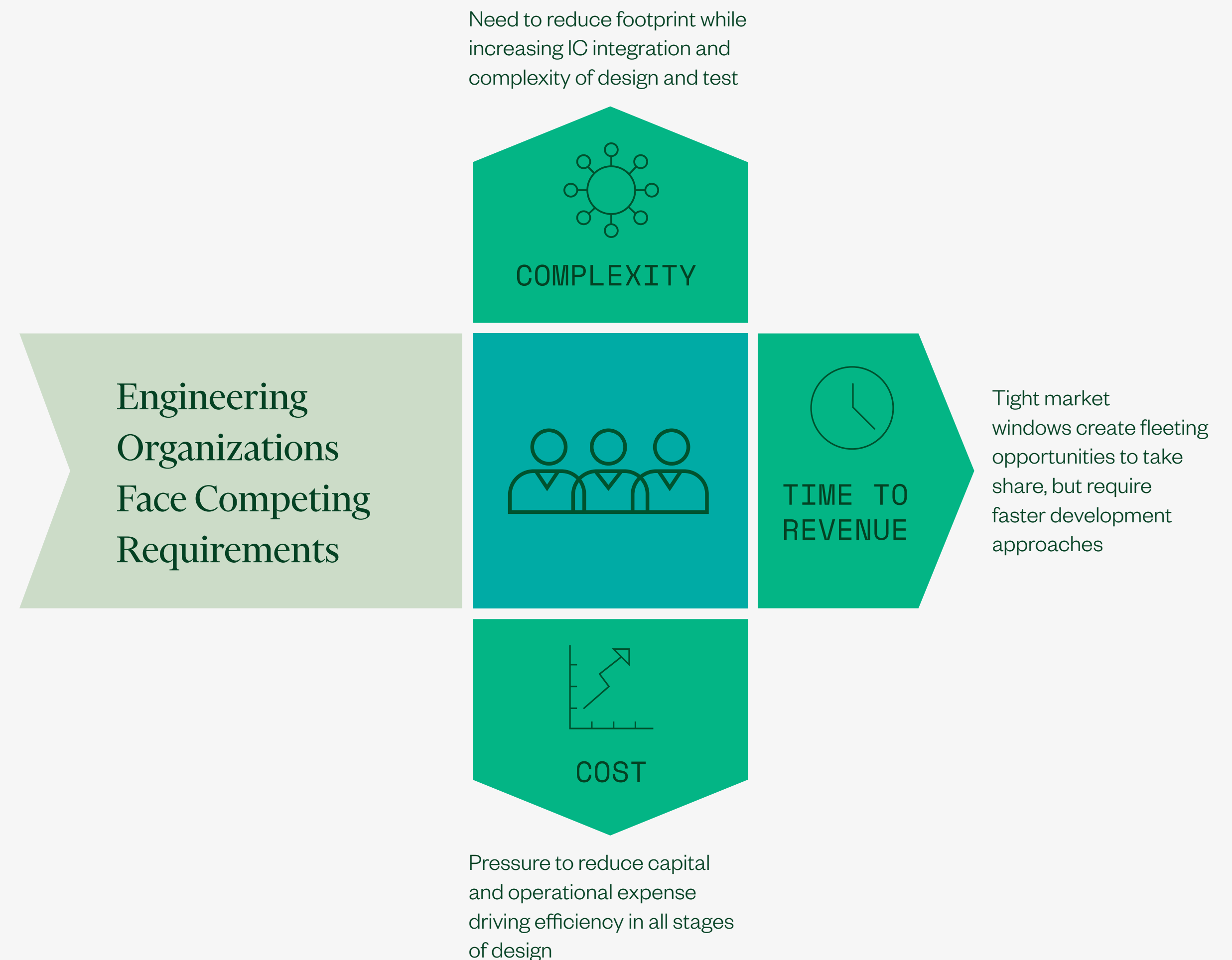
Ritu Favre

Executive Vice President and General Manager, NI



Bottom line? Getting to market quickly has never been more important or more complicated—you might want to rethink your approach to validation.

Companies Facing Pressure to Accelerate Innovation



IMPACT

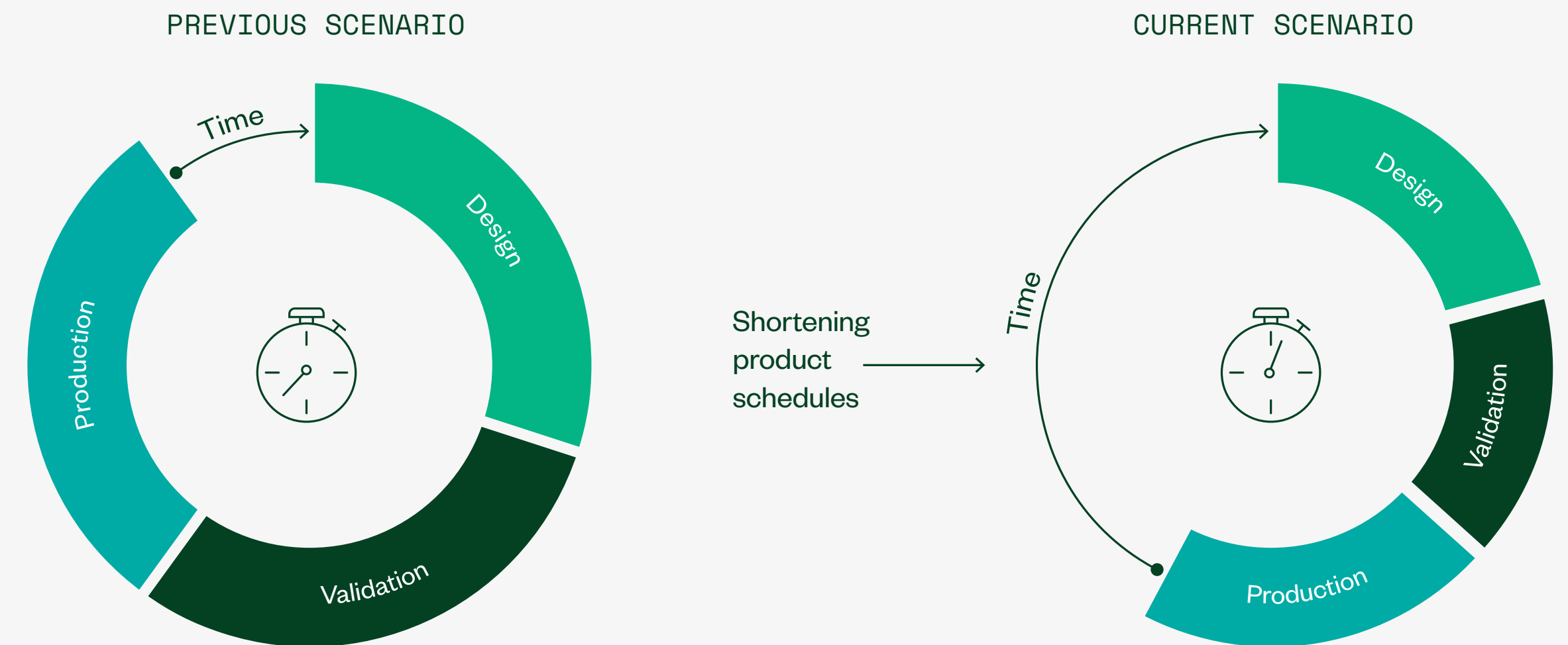
Small Changes Can Lead to Big Results

Reimagining your lab may seem daunting. In addition to new skillsets and techniques, change introduces inherent risk. Fortunately, even relatively simple changes, such as automating measurements, can have a huge impact. For instance, automation reduces characterization time and produces invaluable measurement data. Automating measurements tends to increase their quantity, producing more data with which to characterize products and perform advanced analytics—all while reducing time and cost.

Automation as a best practice is a helpful first step, but often, duplication results from lack of collaboration and communication across teams. Sharing both test software and test methodologies across sites can save substantial development and validation time.

Some of the most successful organizations drive efficiency by standardizing test measurement software globally. Companies that adopt a common software framework ultimately reduce engineering costs and shorten design schedules. They streamline

As market schedules shrink and device complexity increases, there is less and less time for validation.



Product Design Schedule

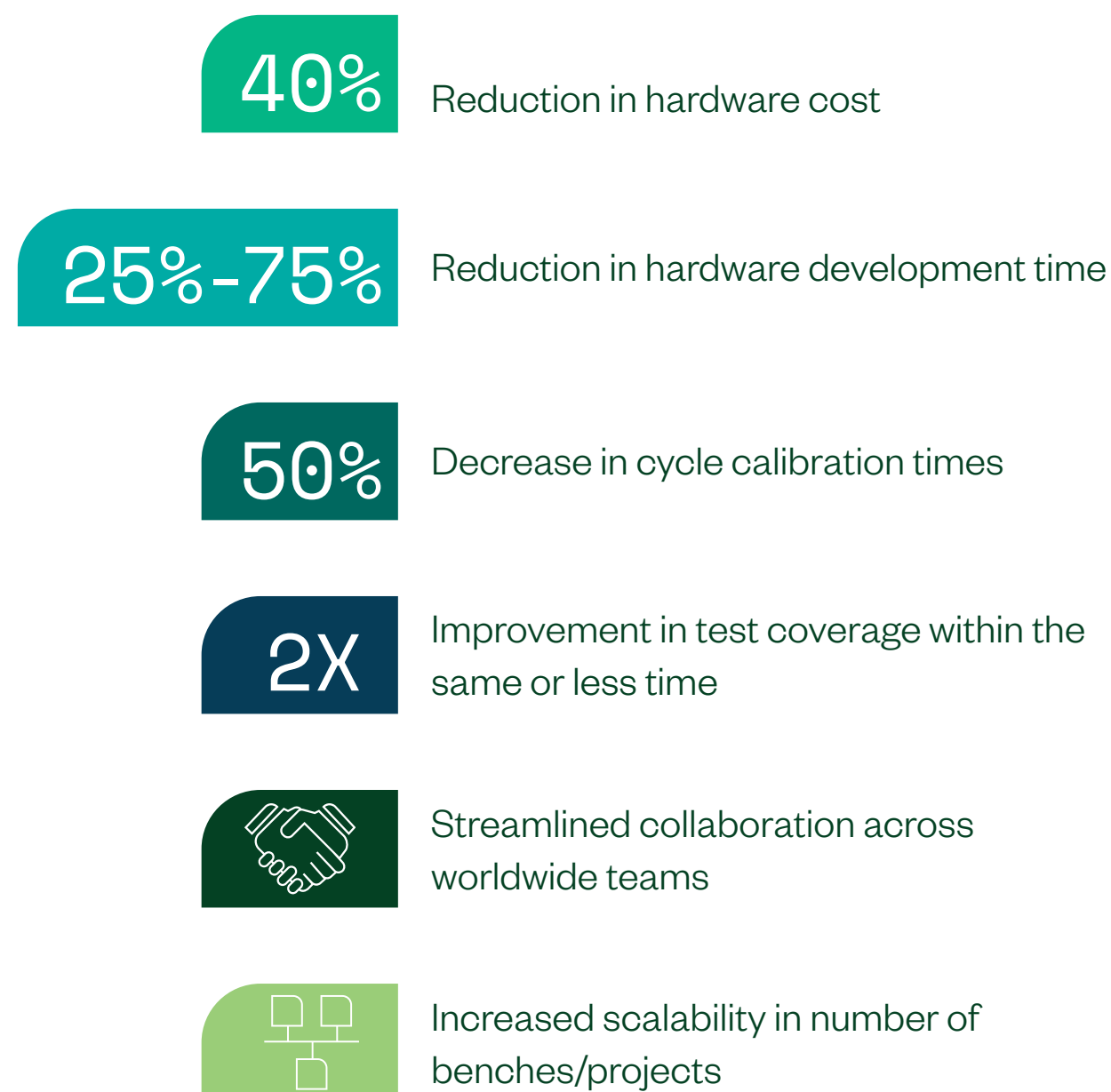
validation workflows by increasing code reuse, expanding measurement coverage, and better using measurement data. This results in a faster development cycle to achieve business objectives.

Many customers already have experienced the benefits of modernized validation. For instance, one of the industry's leading semiconductor companies was challenged to keep pace with change at a global scale. As their design complexity increased with new product introductions, so did the number of tests. This slowed down the design process and created a bottleneck in the workflow. Increasing demand that drove more wireless IC design left validation teams struggling to keep up. Simply put, because their wireless designs needed a greater number of complicated characterization tests, they found their existing processes inadequate.

To solve this, our customer migrated from a highly manual test environment and began their modernization journey by automating and sequencing individual characterization tests. They could then perform uniform and fast measurements across different conditions (voltages and frequencies, for example). However, since the demand for these devices grew, and their design centers were located around the world, they soon realized that they needed to find a scalable solution.

For their next step, they developed a common test management and automation framework and deployed it worldwide. The framework provided teams with a common interface and spurred the development of modular, global, reusable tests. By streamlining their characterization process with test development, management, and automation software, they could achieve the level of commonality, maintainability, and reuse to keep up with new component design.

After deploying this framework, we conducted an in-depth study to help them understand the true impact of investing in both hardware and software standardization. We found that our customer saw:



Contributing factors for success included:

- A common infrastructure
- Reusable IP-sharing with easy access libraries (common libraries for instrument drivers and templates, for example)
- Elevating talent with training and certifications—expertise is key, as it:
 - Encourages teams to become more self-sufficient
 - Drives automation-practice adherence
- A strong validation community collaboration across the organization (via troubleshooting and an idea exchange)



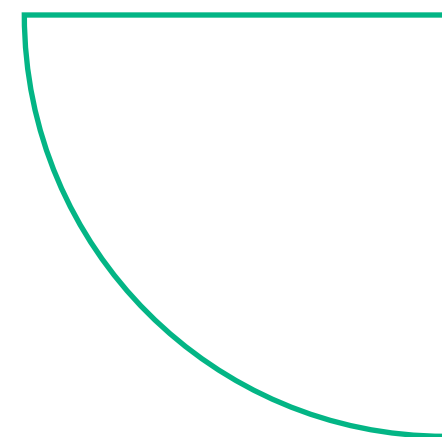
DATA

Improved Workflows Generate More Meaningful Data to Manage Life Cycles

Each step in the product development process generates a great deal of data; however, managing it and applying it strategically throughout the design process is difficult. A common software framework can help source consistent data, but product analytics solutions can generate actionable insights. Companies can take advantage of deeper product insights by connecting the data gathered during different product stages.

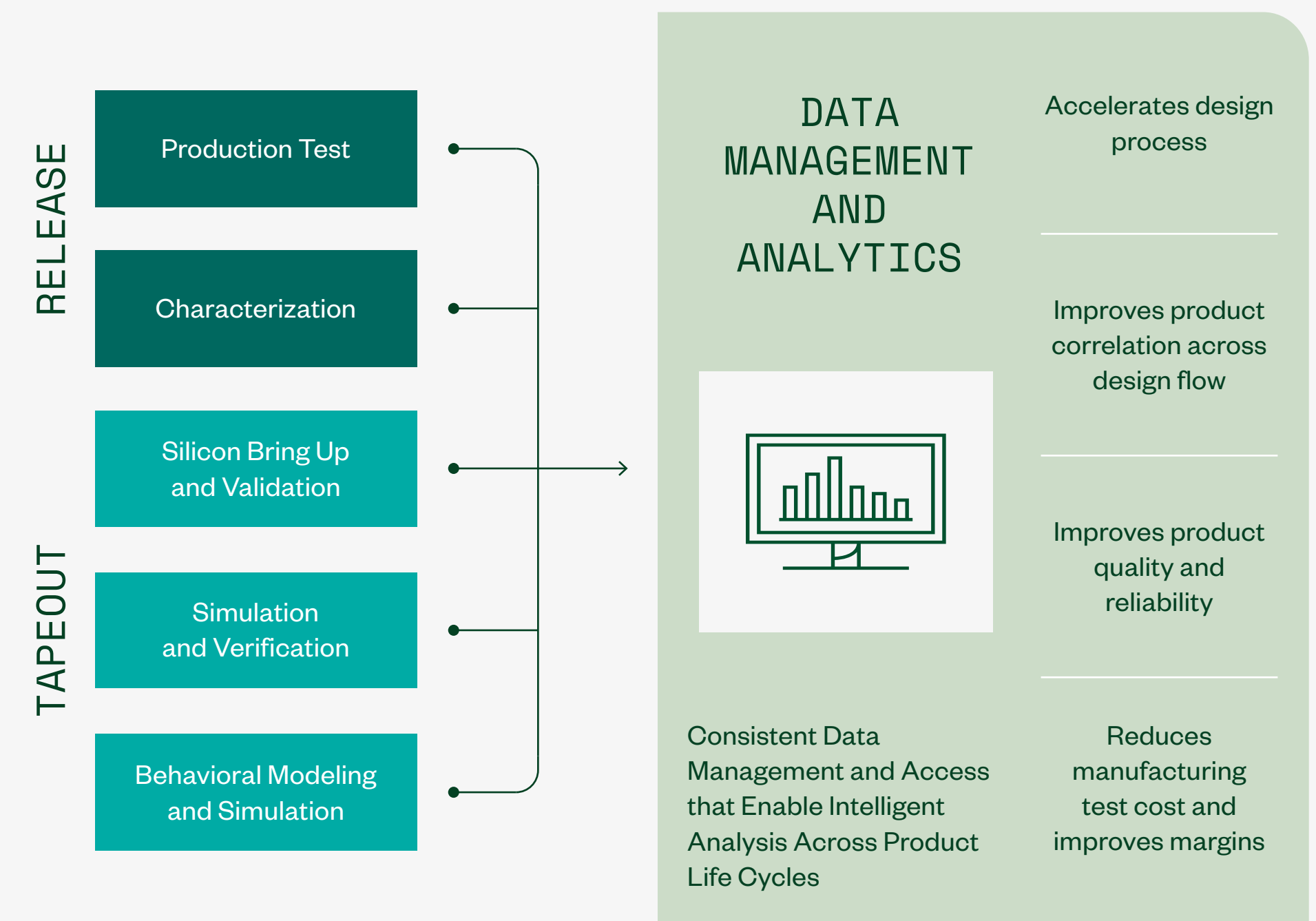
Data management and analytics tools can improve productivity and accelerate product development. Without them, knowing whether two data sets were generated using the same settings is challenging, especially when generating hundreds or thousands of data sets from a single product in the characterization lab.

As product complexity escalates with each generation, data management and analytics tools become increasingly critical across product development workflows. Rapid analytics technology innovations such as artificial intelligence and machine learning already are increasing productivity.



Teams that recognize these opportunities can start to think about how to take advantage of them, regardless of their current lab setups. They can reimagine their labs now to ensure future adaptability and scalability.

Sharing Data across the Workflow Accelerates Productivity



CONCLUSION

Creating Your Vision for a Future-Proof Lab Starts Today

As technology advances, engineering organizations become responsible for more complex product development with less time and fewer resources. Because of this continuing trend across industries, only teams that proactively address the inefficiencies in their workflows now will be effective in tackling technological innovation in the future.

Modernizing the lab is an evolving journey with many pathways. Every lab has the opportunity to become the next center of operational excellence in its organization. Simple changes that include starting to automate measurements or implementing adaptable software and hardware solutions can lead to massively increased productivity. Teams that want to modernize processes should focus on long-term strategic initiatives.

Taking the steps to elevate tools, people, and processes is the most reliable way to keep up with the pace of change. Consider how innovating your lab approaches can help your team effectively rise to the technological challenges of today and prepare for those of tomorrow.



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