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THE VIRTUES OF VIRTUAL PROTOTYPING: ACCELERATED PRODUCT EXCELLENCE

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Virtual prototyping (VP) is on the rise amid the fourth industrial revolution. Engineers seek methods to increase speed and decrease cost throughout the conceptualization, design, and manufacturing processes. With the urgency for optimization, a single platform to easily organize, analyze, test, enhance, and share product designs has become more enticing for today's companies.

Faster, Cheaper, Better

Today's engineers face a daunting catch-22. While they've never had more technological firepower at their fingertips, engineers still struggle to keep pace with customer expectations and whims. Reducing time-to-market and product costs are strong drivers within the manufacturing industry. For this reason, virtual prototyping is becoming more and more popular, as it allows engineers to carry out a series of steps in the product development process without starting up heavy machinery.

Virtual prototyping is the creation of a digital version that models the functionality of the physical object. These virtual representations allow designers to determine potential improvements and prevent system failures without wasting expensive materials on multiple physical iterations. Designed to increase efficiency and lower costs, virtual prototyping has become a key characteristic of top performing businesses.

An even deeper dive into the data to evaluate the impact of cloud-based virtual prototyping solutions reveals how migrating design and testing operations to the Cloud benefits companies. Cloud-based prototyping provides users with a platform that optimizes collaboration and organization; two crucial components of the design process. Additionally, simulation skills are sparse. Sharing simulation knowledge and best practices can spur the adoption of virtual prototyping across disciplines to benefit the entire organization.

When implementing a virtual prototyping solution in the production process, where should an organization begin? How does the use of virtual prototyping correlate with improvements in business metrics (i.e., ROI, productivity)? Examining the approach of Best-in-Class companies reveals several key characteristics.

The Aberdeen maturity class framework comprises three groups of survey respondents. This data determines overall company performance. Classified by their self-reported performance across several key metrics, each respondent falls into one of three categories:

- ▶ **Best-in-Class:**
Top 20% of respondents based on performance
- ▶ **Industry Average:**
Middle 50% of respondents based on performance
- ▶ **Laggard:**
Bottom 30% of respondents based on performance

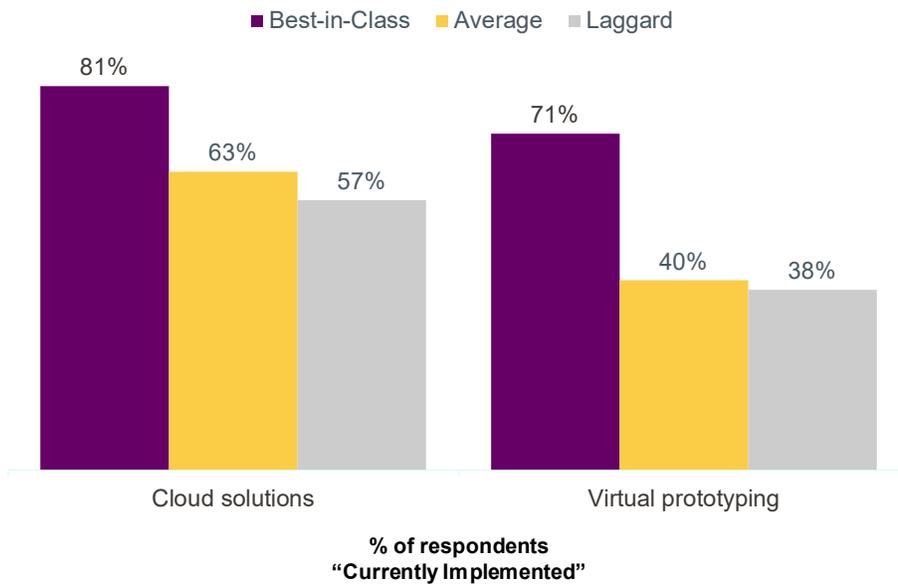
A fourth category, **All Others**, combines Industry Average and Laggard.

Best-in-Class Companies Gravitate Toward Emerging Technology and Infrastructure

Virtual prototyping and cloud solutions go hand-in-hand, which makes the production process more collaborative and efficient. Overall, Best-in-Class companies are implementing this cutting-edge software and infrastructure to support a more-modern engineering environment.

The Best-in-Class have invested in the infrastructure to support their modern data environment and are almost 20% more likely to leverage cloud-based solutions (Figure 1). Transferring data management to the Cloud can increase the speed of data accessibility and upgrade processes as well as provide real-time visibility. Thus, cloud solutions contribute significantly to business efficiency, manufacturing cycle time, and the ability to generate products to meet launch dates.

Figure 1: Adoption of Virtual Prototyping and Cloud Solutions



n = 407, Source: Aberdeen, September 2019

Top performing companies are greater than 30% more likely to implement virtual prototyping solutions. Conducting tests on a product in a virtual environment prior to production prevents unnecessary manufacturing costs, which saves money on materials, and results in products that meet cost targets and revenue goals. Virtual prototyping also increases the quality of products when released, as tests to optimize functionality can be conducted in an online setting. Companies should be looking to add these two capabilities to their arsenal; their more-innovative peers are doing so and succeeding.

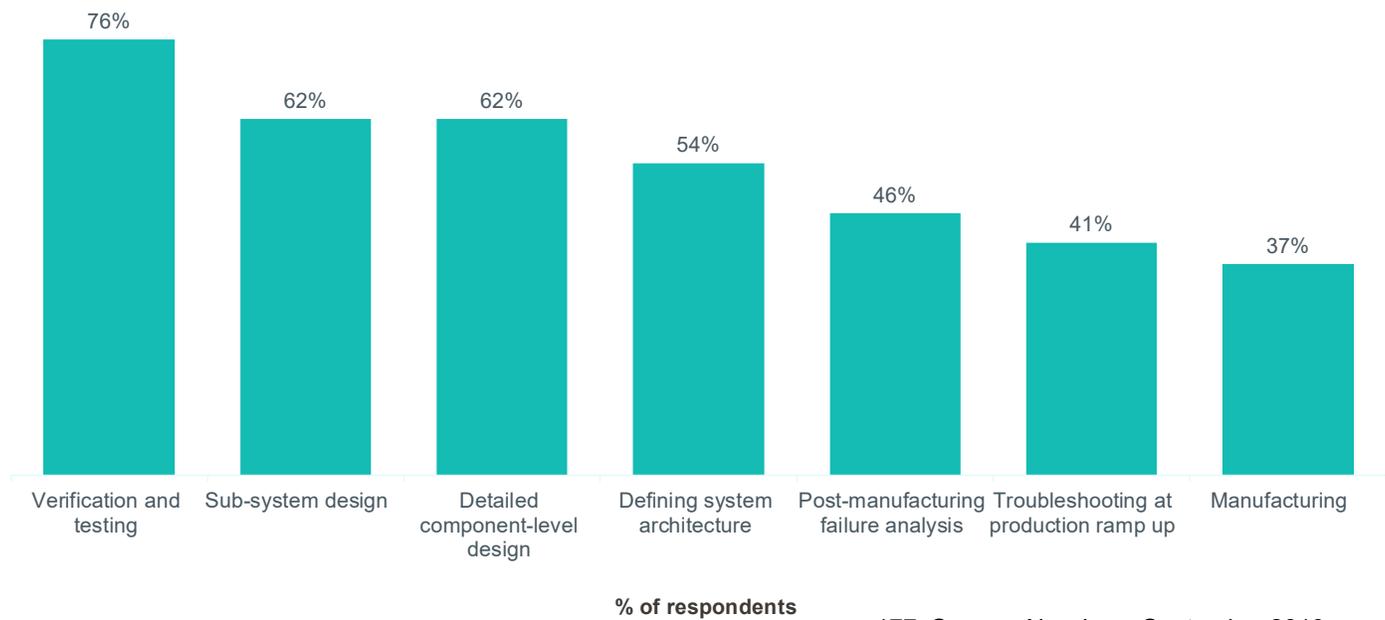
Key Metrics

- ▶ **Improvement in manufacturing cycle time over the past 2 years**
Best-in-Class: 93%
All Others: 57%
- ▶ **Percentage of products that meet launch dates**
Best-in-Class: 92%
All Others: 63%
- ▶ **Percentage of products that meet cost targets**
Best-in-Class: 92%
All Others: 62%
- ▶ **Percentage of products that meet quality targets at design release**
Best-in-Class: 93%
All Others: 65%
- ▶ **Percentage of products that meet revenue goals**
Best-in-Class: 94%
All Others: 65%

Measure Twice, Cut Once

The general theme of virtual prototyping is that it reduces downstream time, cost, and effort by identifying issues before they materialize. As such, virtual prototyping can impact multiple stages in the design process. Concentrating on specific systems can aid in deciding who should have access to prototyping capabilities and which areas of the design process need upgrading. To determine use cases, it's important to understand the procedures that are influenced, especially by virtual prototyping.

Figure 2: Where Does Virtual Prototyping Impact the Most?



n = 177, Source: Aberdeen, September 2019

Verification and testing stand out as the area where virtual prototyping can have the most significant impact (Figure 2). This success may be due to virtual prototyping's ability to model the functionality of an item through the design process prior to production; this allows for a greater number of tests without depleting materials, which translates to higher quality and lower cost.

Virtual prototyping can also benefit design processes at the sub-system and component levels. Isolating actions at the sub-system level in the virtual environment allows engineers to experiment with various scenarios without creating a physical prototype. At the component level, engineers can determine which individual modules will optimize product functionality cohesively, which increases component-level design views and visibility.

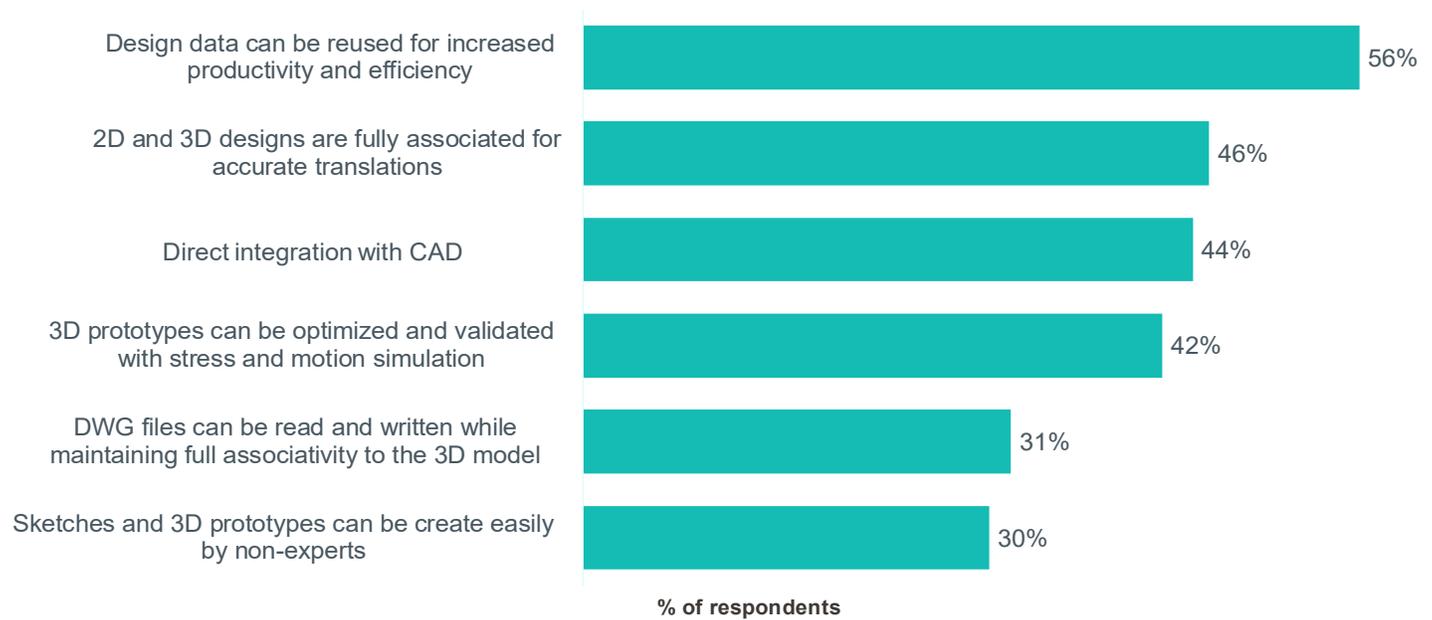
In post-manufacturing use cases, virtual prototyping can model real-life scenarios observed during testing or production rather than fabricated

virtual scenarios. Thus, it may be useful to integrate virtual prototyping in testing procedures first, then identify use cases in design and post-production procedures. Companies that decide to implement virtual prototyping see an impact on the entire product lifecycle.

Key Capabilities of Effective Virtual Prototyping Solutions

Technologies, like virtual prototyping, aren't implemented in a vacuum. The successful use of these tools relies on a foundation of organizational maturity that captures maximum value. Aberdeen's research explored a wide variety of capabilities relative to a company's simulation environment. (See Figure 3 for the most commonly cited as important.)

Figure 3: Most Desirable Capabilities for Virtual Prototyping Solutions



n = 177, Source: Aberdeen, September 2019

Reusable design data allows virtual prototyping users to reference previous models, which conserves time and resources and, ultimately, makes the design process more efficient. Similarly, fully-associated designs enable engineers to repurpose data, which increases efficiency during the drafting process. The ability to use both 2D and 3D models for simulation on the same platform results in a single data source that houses all results, thus, reducing the risk of errors during analysis.

Integration with CAD software, maintaining associativity to the 3D model, and accessibility for non-experts all represent ease-of-use enhancements. Storing drawing data, 3D models, and testing modules on the same platform reduces the number of new hires required for VP-solution implementation, thus contributing to fluidity and intuitiveness. In further attempts to become more agile and connected, companies are turning to cloud-based solutions to increase organization and speed of design validation across the business.

Improve Collaboration by Migrating VP to the Cloud

Today, nearly all software works within a cloud environment; virtual prototyping is no different. The ability to access design data at all times without IT constraints increases independence and agility for engineers.

Combined with the draw of ubiquity, engineers are feeling the pressure to upgrade to cloud-based prototyping platforms for collaboration and sharing capabilities (see sidebar). Cost is also a strong driver of implementing cloud-based prototyping platforms, with 50% of users stating that saving considerable costs is a major pressure instigating upgrade to the Cloud. Converting on-premise, multi-threaded computation processes to cloud computing decreases cost and time, significantly.

Speed is another factor pushing companies toward cloud-based VP: 42% of users indicate that their products require a faster time-to-market and have greater complexity than they have had in the past. This shift reveals trends in the market toward the need to produce more complex units in less time. Cloud-based virtual prototyping and simulation software appropriately addresses both demands. Within a cloud environment, design validation is a much faster process: Designs and test results can be easily shared across the business from engineers to decision makers.

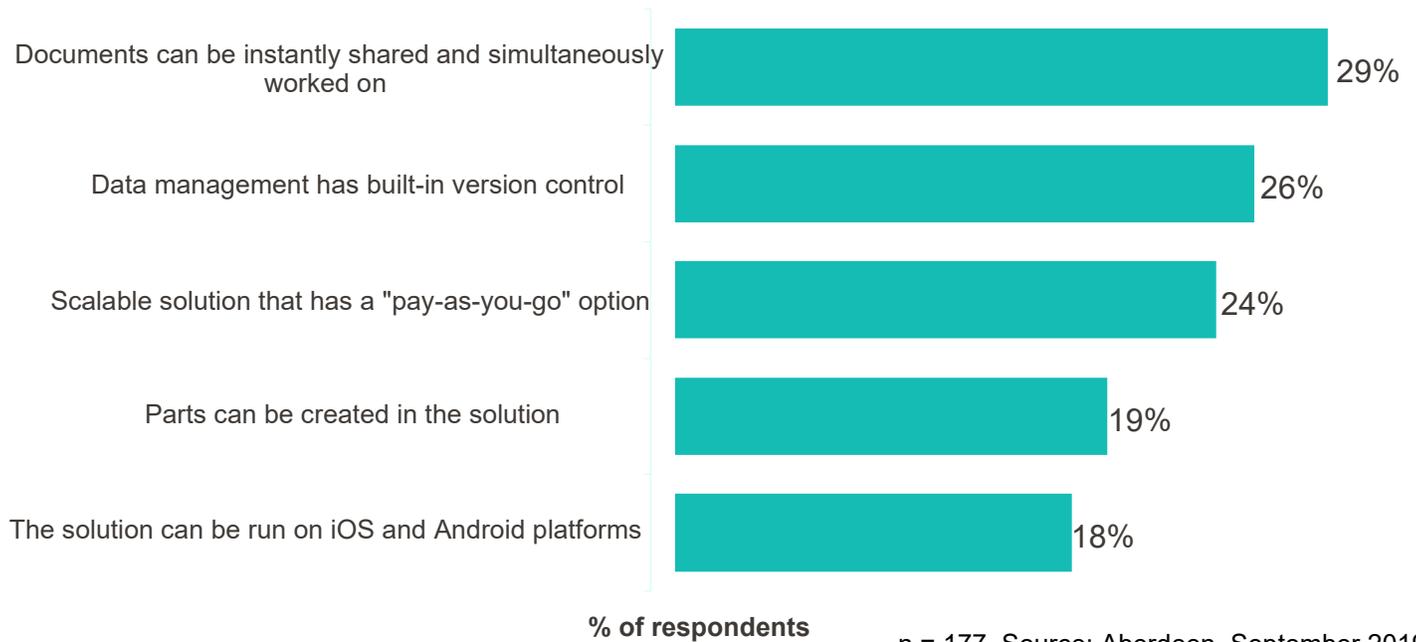
Cloud solutions allow users to easily share designs at a moment's notice while maintaining proper organization, which many manual or on-premise methods struggle to achieve. When looking for cloud-based virtual prototyping solutions, engineers seek collaboration and control (Figure 4).

The ability to instantly share and simultaneously work on documents is crucial for users to work together and complete joint modules promptly. The desire for built-in version control and versatile iOS and Android capabilities shows that users are pursuing solutions that provide them with an organized platform that is also expansive and mobile.

71%

of virtual prototyping and simulation users indicate that **the need for an easier way to share and manage documents** is influencing their decision to adopt a cloud-based solution.

Figure 4: Preferred Aspects of Cloud-Based Virtual Prototyping



n = 177, Source: Aberdeen, September 2019

A “pay-as-you-go” option would allow users to better manage costs by only paying for the time or space utilized. Considering virtual prototyping is most often used in testing — the length and complexity of which varies from product to product — virtual prototyping costs must be customizable, ideally. Smaller organizations have trouble affording high-end simulation software, so “pay-as-you-go” options are especially valuable. Companies can control the number and type of tests they conduct based on budget.

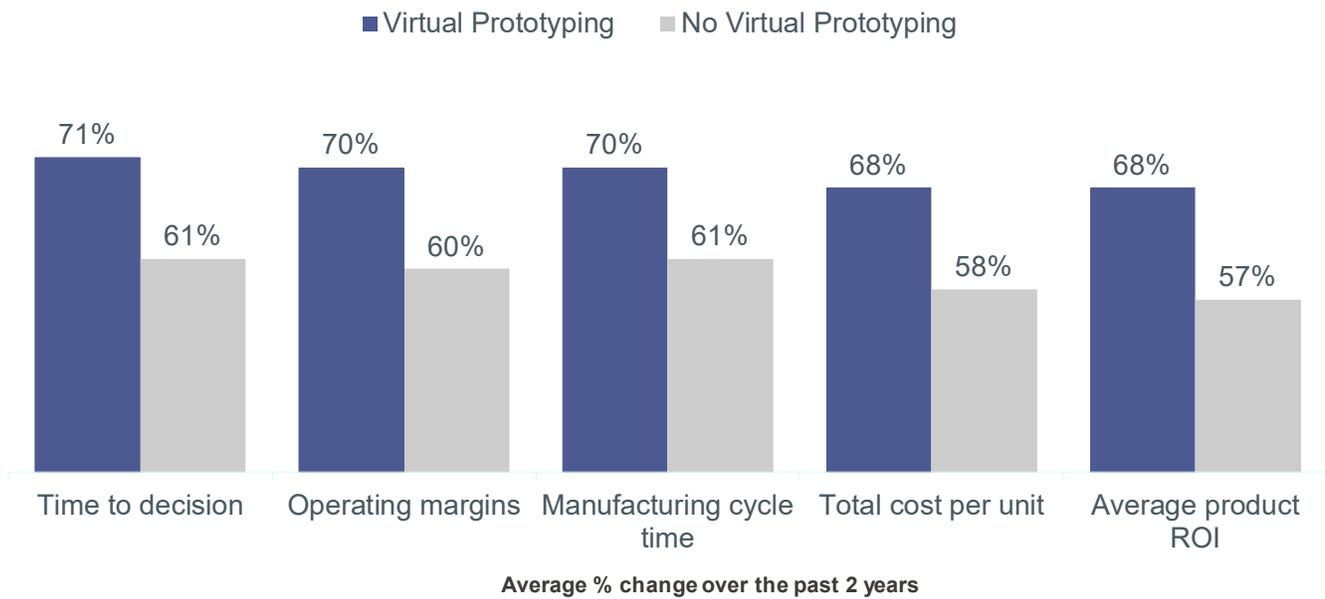
Increasing data management and cooperation, along with other benefits of cloud-based solutions such as lower costs and space conservation, can aid companies in their initiatives to decrease production timelines and spending. VP usage directly correlates with percentage improvements in time-to-market and product-costs metrics.

Virtual Prototyping Generates Significant Results

Time-to-market and product costs are key metrics within the manufacturing field. Virtual prototyping has a substantial impact on these performance indicators.

The margins in time-to-decision and manufacturing-cycle time prove companies utilizing virtual prototyping solutions see a more significant overall improvement in time-to-market. Decisions regarding designs, feasibility, functionality, and production are being made faster with the aid of virtual prototyping tools. A smaller decision window reduces the entire manufacturing cycle timeline.

Figure 5: Business Impact of Virtual Prototyping



n = 407, Source: Aberdeen, September 2019

Companies utilizing virtual prototyping realize improvements in production costs that are 10% greater than others, with the main indicators being operating margins, total cost per unit, and average product ROI. Since virtual prototyping reduces the need for more physical prototypes, the total material cost is lower when using VP software, resulting in higher performance in total cost per unit. The impact on ROI indicates that virtual prototyping influences other areas of the business, not just engineering. For a large engineering-driven organization that consistently launches products into the market, the 11% difference in average ROI improvement can amount to a significant contribution to the company.

The ability to create high quality products more efficiently and at a lower cost is coveted within manufacturing. Virtual prototyping can help companies meet this goal. With adaptive, intuitive solutions, organizations can seamlessly integrate virtual prototyping into their design processes and realize results in time to market and production costs.

Key Takeaways and Recommendations

When reflecting on the many ways virtual prototyping can influence the design process and produce business outcomes, there are a few key points to highlight:

- ▶ **Design verification is the low-hanging fruit.** Verification and testing is the most common use case for virtual prototyping because it gives engineers the ability to conduct a myriad of tests in a virtual environment without wasting raw materials or time manufacturing physical prototypes. The accuracy and versatility of virtual testing also result in the generation of higher quality products at a faster rate.
- ▶ **Tap into the Cloud for greater collaboration and control.** In addition to reducing costs and maintaining orderliness among countless drawing files, a cloud structure provides a platform for engineers to share and reuse designs, easily. Cloud-based virtual prototyping gives engineers finer control over the entire testing and design process by providing visibility into isolated timesteps and components. Advanced collaboration and control support the creation of more complex products as well as the transfer of simulation knowledge, which can result in the adoption of simulation across disciplines.
- ▶ **The Best-in-Class reap time and cost rewards with VP.** With approximately 10% margins in metrics related to time-to-market and production costs, it is not surprising that Best-in-Class companies are implementing VP at higher rates than All Others. Virtual prototyping is streamlining design processes and revolutionizing the manufacturing industry by ultimately making production faster and lower cost while optimizing product quality instead of sacrificing it.

Virtual prototyping successfully works toward achieving the computer-aided engineering goals of reducing time and cost while increasing quality and efficiency. Best-in-Class companies are taking advantage of this innovative software. Whether the need arises to evaluate sub-system or single component functionality or to model the actions of an entire machine, virtual prototyping stands out as an effective solution.

Related Research

Virtual Prototyping vs. Traditional Product Development Methods, (May 2017)

Digital Transformation: How the Best-in-Class Are Preparing for the Fourth Industrial Revolution and Beyond, (January 2019)

Pervasive Simulation Accelerates Innovation in High-Tech, (August 2017)



About Aberdeen Group

Since 1988, Aberdeen Group has published research that helps businesses worldwide to improve their performance. Our analysts derive fact-based, vendor-neutral insights from a proprietary analytical framework, which identifies Best-in-Class organizations from primary research conducted with industry practitioners. The resulting research content is used by hundreds of thousands of business professionals to drive smarter decision-making and improve business strategies. Aberdeen Group is headquartered in Waltham, Massachusetts, USA.

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