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Aberdeen Group
A Harte-Hanks Company

August, 2008

Aberdeen's Simulation Strategy Guide: Making Sense of Engineering Analysis and Today's Solution Provider Offerings

The use of simulation early to direct product development decisions and get performance "right the first time" initially emerged more than a decade ago. The concept behind this strategy is that assessing product performance earlier, before designs have been finalized, means that issues can be resolved while there are more options available to resolve them. Fast forward to the present, and early simulation is not only the most popular strategy for executives steering Best-in-Class engineering organizations, it's also the most differentiated strategy. And while Laggard engineering organizations are planning on making changes, fast, the dynamic landscape of solution providers can make for dizzying simulation software decisions.

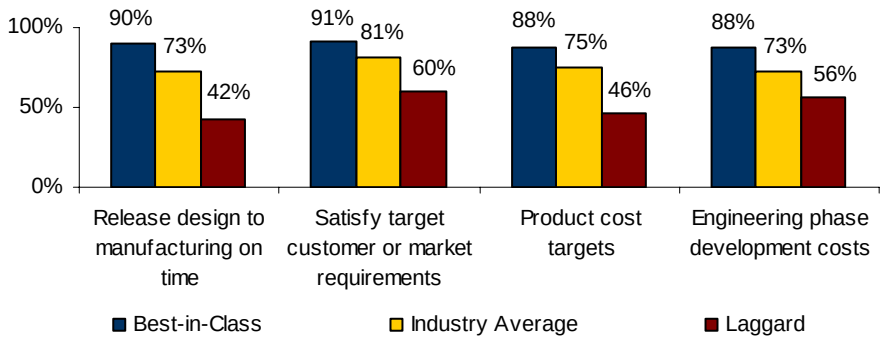
Analyst Insight

Aberdeen's Insights provide the analyst perspective of the research as drawn from an aggregated view of the research surveys, interviews, and data analysis

Aberdeen Analysis

Aberdeen Group's June 2008 report, *Engineering Executive's Strategic Agenda,* surveyed over 620 manufacturers regarding the strategies they are adopting to improve the performance of the engineering department. To determine what strategies can provide the most tangible business benefits, Aberdeen benchmarked respondents according to four key performance criteria. Using these metrics, Aberdeen classified companies into the top 20% (Best-in-Class), the middle 50% (Industry Average) and the bottom 30% (Laggard) of performers. Figure 1 displays the performance gaps that define each.

Figure 1: Top Performers Earn Best-in-Class Status

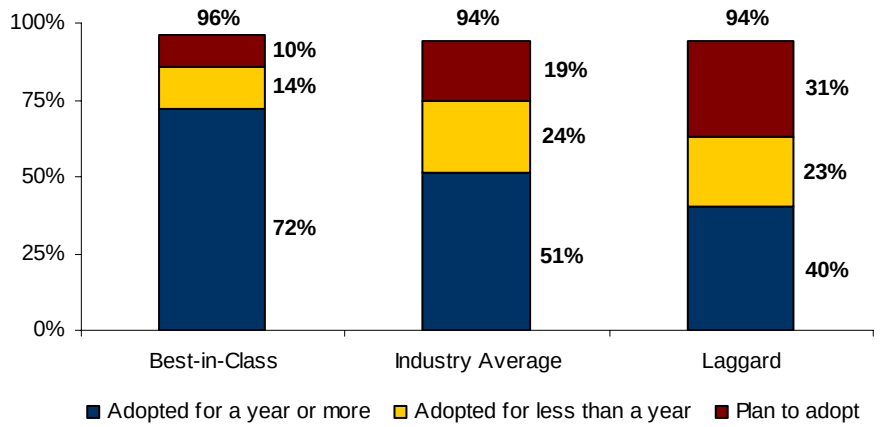


Source: Aberdeen Group, June 2008

Aberdeen found that the use of simulation early in product development to assess product performance remains a highly differentiated strategy in the market today (Figure 1). It is currently the most widespread strategy

amongst the Best-in-Class, with 72% of these companies having adopted a "right the first time" for over a year. It is also a highly differentiated strategy across the competitive framework, with the Best-in-Class 36% more likely than Laggards to currently have this strategy implemented.

Figure 2: Current and Future Plans - Get Product Performance Right the First Time in the Design Phase



Source: Aberdeen Group, June 2008

"Simulation is used on our products to predict the performance before we invest $500K or so in a fully functional prototype. The output from the different simulations have proven to be fairly good predictors of performance. They have also pointed out weaknesses that we have addressed in various ways before implementing a design. "

~ Chief Executive Officer
Medical Device Manufacturer

However, the performance differentiation companies are currently seeing from this approach isn't sustainable. Many companies that are not leading their respective industries are planning for change. Despite its broad adoption currently, assessment of product performance earlier is also the third highest engineering strategy that will be pursued over the next two years by 19% of the Industry Average and 31% of the Laggards. As a consequence, it will cease to be a performance differentiating strategy. The differentiation between the Best-in-Class and Laggards will transition from *whether* or not the strategy is pursued to *how* the strategy is pursued.

What's the objective behind this strategy? At a high level, it's simple. Many are planning to perform more iterative assessments of product performance using digital prototypes and hope to reduce physical prototyping. That is exactly what is occurring and is again differentiated across the performance framework (Table 1).

The Best-in-Class have been more successful than their competitors in their attempts to decrease the number of physical prototypes that they build. Findings from Aberdeen's October 2006 report, *Simulation-Driven Design: Getting it Right the First Time,* indicate that the Best-in-Class develop 1.6 fewer prototypes than their competitors. Similarly, Aberdeen's May 2008 *Best Practices for Migrating from 2D to 3D* report found that the Best-in-Class build on average 5.0 prototypes, 2.2, and 2.7 fewer than the Industry Average or Laggards, respectively.

Table 1: Objective Behind Early Simulation and Analysis

	Best-in-Class	Industry Average	Laggard
Decrease physical prototypes	44%	39%	32%
Increase number / iterations of virtual prototypes	56%	39%	27%

Source: Aberdeen Group June 2008

Given the broad adoption and the high growth expected of earlier, virtual assessment of product performance, there are two questions that emerge. The first is: what are the Best-in-Class doing differently to achieve their success? Just as importantly, how fast are the rest going to catch up and negate a potentially sustainable strategy?

Taking Analysis Mainstream: Engineers Use Simulation

There has been a trend within the last decade to take simulation mainstream. The idea is to involve an increasing number of casual analysts (designers and engineers) to perform simulations. Allowing these non-specialist engineers to perform more mundane and directional simulation tasks frees expert users to focus on more advanced tasks.

Has it been successful? The Best-in-Class are slightly more likely to have engineers and designers perform simulations and analyses than others, but not decidedly so (Table 2). The strategy is still emerging among all levels of the performance framework.

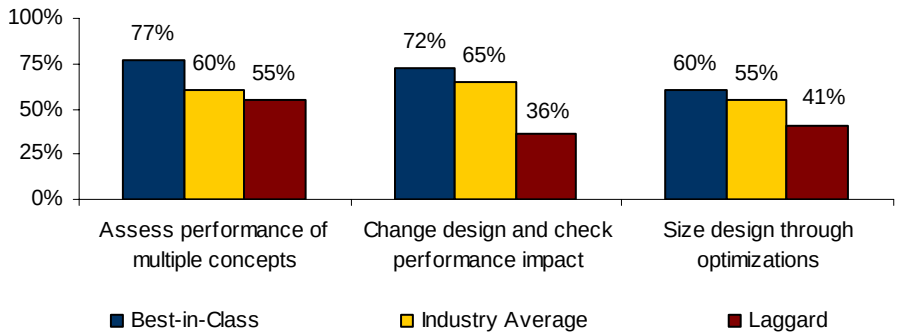
Table 2: Current and Future Plans - Casual Analysts

Casual Analysts (Designers and Engineers) Perform Simulation and Analyses	Currently Use	Projected Use
Best-in-Class	48%	76%
Industry Average	32%	61%
Laggards	38%	76%

Source: Aberdeen Group, June 2008

However, two things are clear. First, the Best-in-Class are realizing the benefits of performing simulation up front. Second, a good portion of engineers and designers should be boning up on their simulation and analysis skills if they haven't already. Well over a third of engineering organizations plan on pursuing this tactic. With this trend becoming a reality in the next two years, how does one best prepare? The Best-in-Class are supporting the effort in dramatically different ways (Figure 3).

Figure 3: Supporting Simulation Driven Design

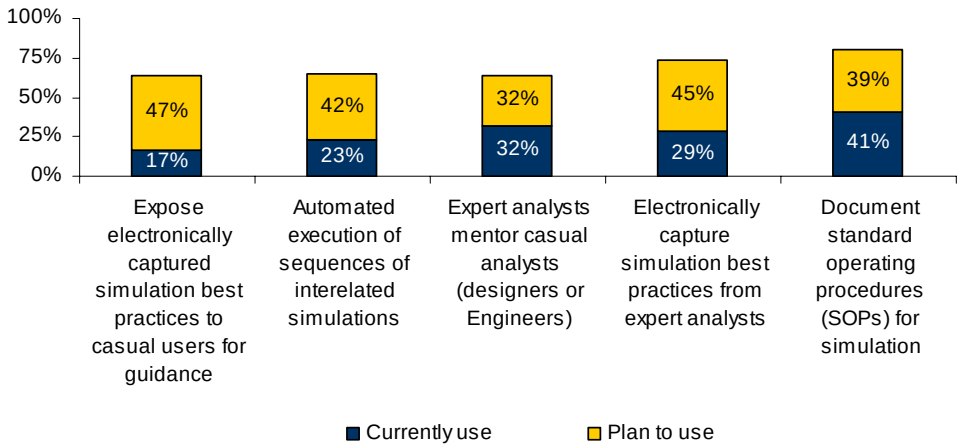


Source: Aberdeen Group, October 2006

Much of it comes down to iterative design and simulation. In some cases, it's about making changes and validating corresponding changes in performance. In other cases, it's about automating design iterations driven off simulation feedback. Regardless, all of these approaches support the effort to achieve more iterations of the product's performance early in the design phase.

What are these manufacturers doing to support these efforts? While some of the following practices are used infrequently right now, many of these will be used to great extent in the near term. Overall, companies across the competitive framework are planning to adopt a wide variety of new practices and technology.

Figure 4: Current and Future Plans: Improving Simulation



Source: Aberdeen Group, September 2007

What's the takeaway? Casual users (designers and engineers) should become better versed on performing analysis. Engineering executives need to provide simulation solutions that allow these casual users to iteratively design and simulate product performance. As a result, simulation tools need to be easy to use, very accessible, support many design simulation use cases, and enable and support best practices.

"Because we make over-molded electronics products, we've explored a few different types of simulations for different purposes. For one, we've used mold-filling simulations to determine the base placements for injection-molding gates. Also, because over-molding can be rough on electronics, we explore various scenarios of failed electronics components so that when we do experience problems, we know which scenario actually occurred."

~ Steve Heckman, Plastics One

Looking at the Entire Product's Performance: Multi-Physics comes to Play

However, enabling a simulation strategy isn't just about performing a simple structural simulation on a product. The Best-in-Class also are simulating a broader range of the product's performance to understand with a higher degree of fidelity how a product will perform in its operating environment.

Table 3: Simulations Performed

	Best-in-Class	Industry Average	Laggard
Structural	100%	95%	63%
Dynamics	77%	74%	55%
Kinematics	55%	51%	29%
Heat transfer	66%	67%	44%
Fluid flow	55%	57%	50%
Electro-magnetics	23%	29%	13%
Transient (time-based)	71%	68%	60%
Fatigue	61%	43%	26%

Source: Aberdeen Group, October 2006

This by no means is a static picture. Just as the use of simulation to assess product performance earlier is expanding, there looks to be an expansion of the range of product performance that is simulated on the horizon (Table 4). This is the case for a range of simulations, with the highest growth expected in fluid flow analysis and transient analyses.

What's the final point? Simple structural simulation tools, while perhaps easy to use, are not enough to keep up with manufacturing peers. Target only that and you will quickly be left behind. Look broader to the entire range of multi-physics that represents the operating environment of your products. And this holds true even if you don't plan to use it immediately. You can always scale your simulation strategy out to support multi-physics analysis when you are ready.

Table 4: Current and Future Plans - Simulations Performed

	Currently Use	Projected Use
Structural	95%	98%
Dynamics	73%	84%
Kinematics	48%	65%
Heat transfer	67%	82%
Fluid flow	59%	84%
Electro-magnetics	29%	36%
Transient (time-based)	68%	86%
Fatigue	44%	79%

Source: Aberdeen Group, October 2006

"In a couple of cases, I have been able to correlate product development process models to real life and determine the systemic drivers. This allowed me to improve the system output by pushing on those drivers. The neatest one involved determining the driving factor behind some levels of variability in similar designs, and then implementing a tool to reduce that variability, reducing both the level and number (cost) of errors."

~ Dan Bodimer
Business Process Manager
AP Engineering Services

Simulation Management: Looking to Explode

Findings shared so far indicate a wide adoption of engineer-based simulation and analysis supported by iterative simulations and reuse of simulation best practices. Furthermore, some areas of physics disciplines such as fluid flow, fatigue, transient and kinematics simulations will see adoption growth of over 15% within the next two years. With simulation and analysis growing in many directions at once, management of all of this simulation data and information can quickly become problematic as CAD based PDM does not understand the interrelationships between simulation artifacts and their relationships to design data.

Table 5: Current and Future Plans for Engineering Organizations - Managing Simulation Data and Processes

	Currently Use	Projected Use
Centralized control of simulation data and information	28%	64%
Centralized records of simulated product configurations	34%	71%
Centrally managed relationships between simulation and product data	23%	63%
Document relationships between product decisions with related simulations	40%	75%
Share simulation data and information with supply chain	30%	53%

Source: Aberdeen Group, September 2007

Aberdeen Group's September 2007 *Engineering Decision Support* report examined how companies manage expanded sets of simulation-related data, automated simulation processes and tracked their deployment of enabling technologies. While current levels of adoption are low, findings show that this specific area is poised for dramatic growth as well (Table 5).This ranges from 23% in sharing simulation data with the supply chain to as much as 40% in the central management of relationships between simulations and other product data.

In the next two years, if you are still managing simulation data and analysis on your desktop, you will be in the minority. The same holds true of the management and sharing of simulation data, information and know-how. So it's important to put together a plan on how this data and information will be controlled and managed in your engineering environment now instead of being caught by surprise down the road.

Summary

As you consider developing the tactics behind your simulation strategy, there are a number of questions you should ask yourself before moving forward.

1. **Who are you trying to empower?** Aberdeen research shows that a large number of manufacturers are planning to enable casual users to perform iterative design simulation.
2. **What range of physics are you trying to simulate?** Aberdeen research shows that a large number of manufacturers are planning to expand the range of simulated physics over the next two years. What types of physics are most relevant to your product?
3. **What simulation data and knowledge do you need to manage?** Aberdeen research shows that many manufacturers are planning to control and manage a burgeoning range of simulation data and information. What pressures is your organization feeling? Liability? Documentation for eco-friendly products?
4. **How closely will you integrate the management of simulation with PLM or PDM?** As simulation data is often inherently based on design data, there is an obvious link between simulation management and PLM. What is important for your organization synchronize between those two areas?

All of these questions should be considered as you not only formulate your simulation strategy, but as you select simulation solution providers as partners. For more information on this or other research topics, please visit www.aberdeen.com.

Related Research	
The Engineering Executive's Strategic Agenda: June 2008	*Engineering Decision Support* (September 2007)
Complementary Digital and Physical Prototyping Strategies: February 2008	*The Simulation-Driven Design Benchmark Report* (October 2006)

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