

Quantifying the Impact of Simulation Across the Product Life Cycle



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INTRODUCTION

Reducing the cost of innovating, developing, manufacturing, and operating their products is one of the consistent and persistent initiatives pursued by executives across most industry sectors. In the current economic climate, driven largely by the COVID-19 pandemic, a company's ability to implement cost reduction measures that impact operations today, while positioning for significant competitive advantage post recovery, has never been more business critical. This eBook concludes that companies that deploy simulation technologies across the product life cycle are much better positioned to survive and thrive than their competitors that do not.

Simulation software has long been established as a critical tool to help engineers tackle the top market pressures their businesses face:

Top Five Pressures to Improve Product Innovation

- / 1. Increased pressure to meet delivery deadlines
- / 2. Need to differentiate products from competitors
- / 3. Market demand for lower cost products
- / 4. Increasing pace of innovation
- / 5. Reduced development budgets

Best-in-Class companies that invest in simulation know they are able to better tackle these pressures head on: they meet delivery deadlines, differentiate products from competitors, lower cost across the product life cycle, and deliver products on-time and on-budget. Unfortunately, these impacts are often anecdotal and lack financial quantification.

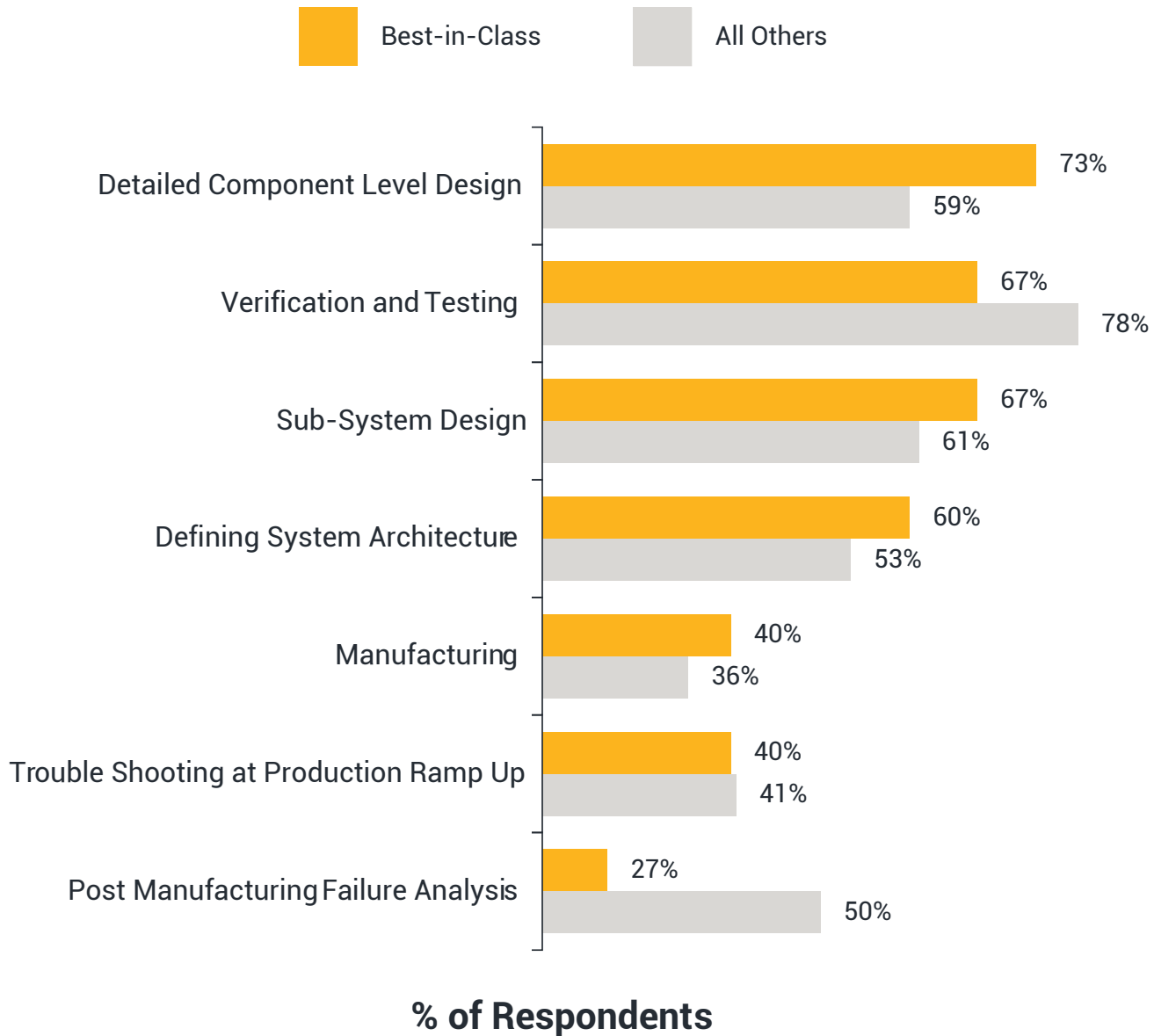
In the current economic environment and with increased scrutiny of all company investments, this lack of impact quantification may result in pressure on engineering teams to reduce their investments in what is a business-critical technology. By consolidating the research findings from hundreds of respondents, this eBook provides quantified data on the impact simulation makes in three key phases of the product life cycle (ideation / design / analysis, manufacturing, launch) as well as the compounded impact these have on the overall business metrics of the organization.

For the purposes of this research, Aberdeen defines simulation as a physically accurate virtual representation of a real-world product, process, or system. A simulation requires a digital model of the product, process, or system to be developed that is able to accurately capture the key characteristics, behaviors, or functions of the selected product, process, or system (including physics, chemistry and biology). In this way, the simulation can be validated against experimental data and then used to predict the performance of a product, process, or system either under specific discrete conditions or over time.

BEST-IN-CLASS COMPANIES USE SIMULATION ACROSS THE PRODUCT LIFE CYCLE AND FOCUS ON ACCURACY // // //

Best-in-Class companies (defined by Aberdeen as the top 20% of companies based on performance in key business metrics) are taking advantage of the benefits of simulation capabilities across the life cycle of their products (Figure 1).

Figure 1. Best-in-Class companies Use Simulation at All Stages of Development



n = 491, Source: Aberdeen, September 2020



In addition, Best-in-Class companies make significantly more use of 3D simulation and simulations that are able to capture the multiphysics effects that impact product performance. Combined, this enables them to more accurately predict the behavior of their product in its operating environment.

Simulation as a Best-in-Class Enabler (% of companies)

3D simulation

- Best-in-Class: 71%
- All Others: 37%

Multiphysics simulation

- Best-in-Class: 65%
- All Others: 44%



RESHAPING THE IDEATION, DESIGN AND ANALYSIS PROCESS WITH SIMULATION

At this stage of the product life cycle, the emphasis is on reaching production as quickly and cost effectively as possible. Best-in-Class companies are focusing their energy on using simulation to support early ideation and design as well as the more traditional use in detailed design, verification and validation. After implementing a simulation solution, companies experienced material decreases in the length of development time and the number of expensive and time-consuming physical prototypes, (Table 1).

Table 1: Impact Metrics of Simulation Across the Ideation, Design and Analysis Stage

Metric	Average % change after implementing a simulation solution
Length of development time	-14%
Number of complete physical prototypes	-11%

The 11% decrease in physical prototypes has a direct impact on costs. Designing and testing products in a virtual environment eliminates a large chunk of engineering expenses, especially if companies are handling expensive prototypes or making a large number of design changes requiring multiple iterations. Faster development, testing, and analysis all contribute to an overall decrease in time-to-market, enabling companies to get new products out the door in less time and with fewer costs. This greater speed of innovation at a lower cost helps companies deliver high-quality products to their customers despite reduced development budgets.



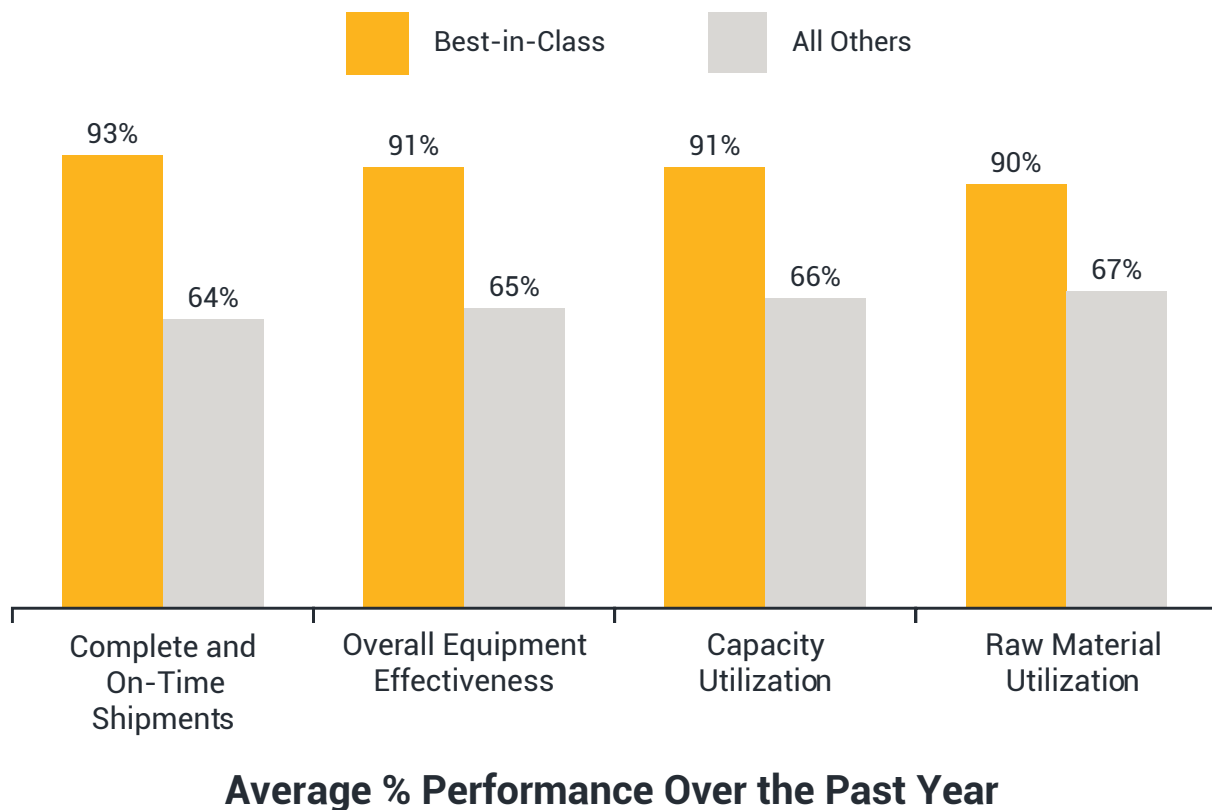
ENHANCING MANUFACTURING PROCESSES WITH SIMULATION

The next step in the product life cycle that simulation influences is manufacturing. The ability to run more tests at little to no extra cost allows engineers to perfect their designs before sending them to manufacturing, which reduces the number of engineering change orders. Late stage change orders can be extremely expensive, and preventing them with simulation tools makes a big difference for companies looking for areas to cut costs.

Companies using simulation capabilities are seeing a 33% greater decrease in the number of engineering change orders (ECOs) compared to those not using simulation.

In addition to ECOs, simulation also has connections to improvements in key manufacturing operations metrics (Figure 2)

Figure 2: Best-in-Class Results for Manufacturing Processes



n = 407, Source: Aberdeen, September 2020



Detailed simulation models allow engineers to accurately relay the materials and systems required for production to manufacturing teams. Having a more comprehensive bill of materials (BOM) helps optimize raw material utilization, and greater efficiency in design phases spills over into manufacturing by improving complete and on-time shipment rates. Simulation usage minimizes the iterations within the manufacturing cycle and helps businesses launch new product lines in a timely manner, ultimately gaining customer trust and influencing future sales..



IMPACT OF SIMULATION AT, AND POST, PRODUCT LAUNCH

Companies with simulation capabilities are 79% less likely to be concerned with the risk of product recalls.

Companies that use simulation see clear positive impact on their product launch metrics (Table 2).

Table 2: Impact of Simulation on Product Target Achievement

Late stage target	% of products currently meeting targets		% Difference	P-Value
	Companies with simulation capabilities	All others		
Product launch dates	73%	63%	+15.2%	0.00004
Product cost targets	72%	64%	+11.7%	0.00144
Quality targets at design release	73%	66%	+11.0%	0.00232

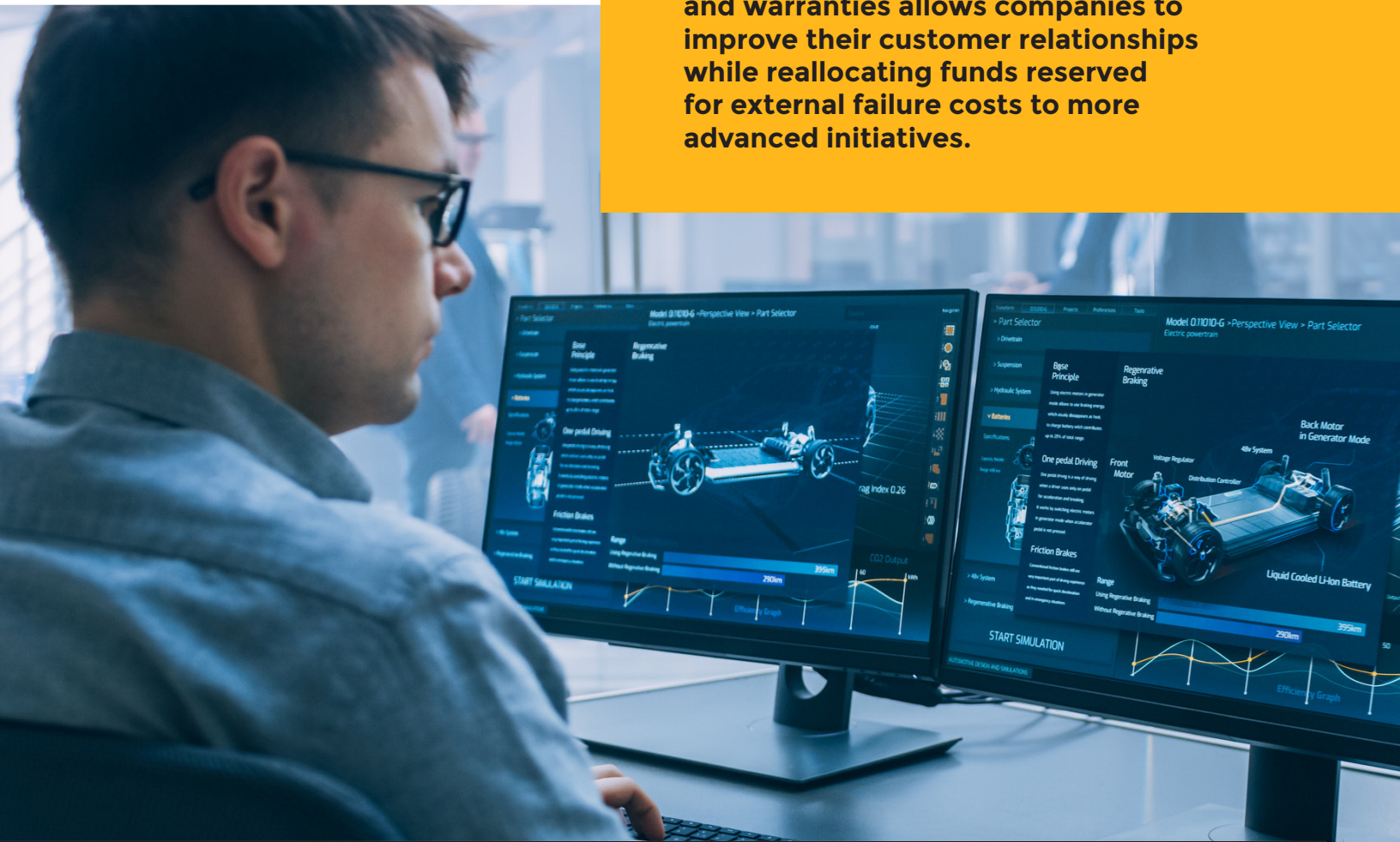
The faster time-to-market associated with simulation comes to fruition with the greater percentage of products meeting launch dates. Minimizing delays in early design phases, eliminating the time required to generate and work with physical prototypes, and optimizing manufacturability all contribute to getting products launched on schedule. Reducing costs throughout design and manufacturing processes influence the greater improvements in cost and revenue targets. Simulation also impacts quality targets, as products are more carefully designed and tested in virtual environments before moving to production.



And the impact of using simulation persists throughout the post launch life cycle of the product resulting in a significantly lower likelihood of product recalls and external failures. For long life cycle, highly engineered products that operate in relatively harsh environments, a company's ability to realize these cost savings can be the difference between corporate success and failure.

Companies with simulation capabilities are experiencing 14% greater year-over-year cost savings from external failure costs (returns, warranty, recalls, etc.)

Avoiding immediate unnecessary costs within the factory as well as future unnecessary costs from returns and warranties allows companies to improve their customer relationships while reallocating funds reserved for external failure costs to more advanced initiatives.

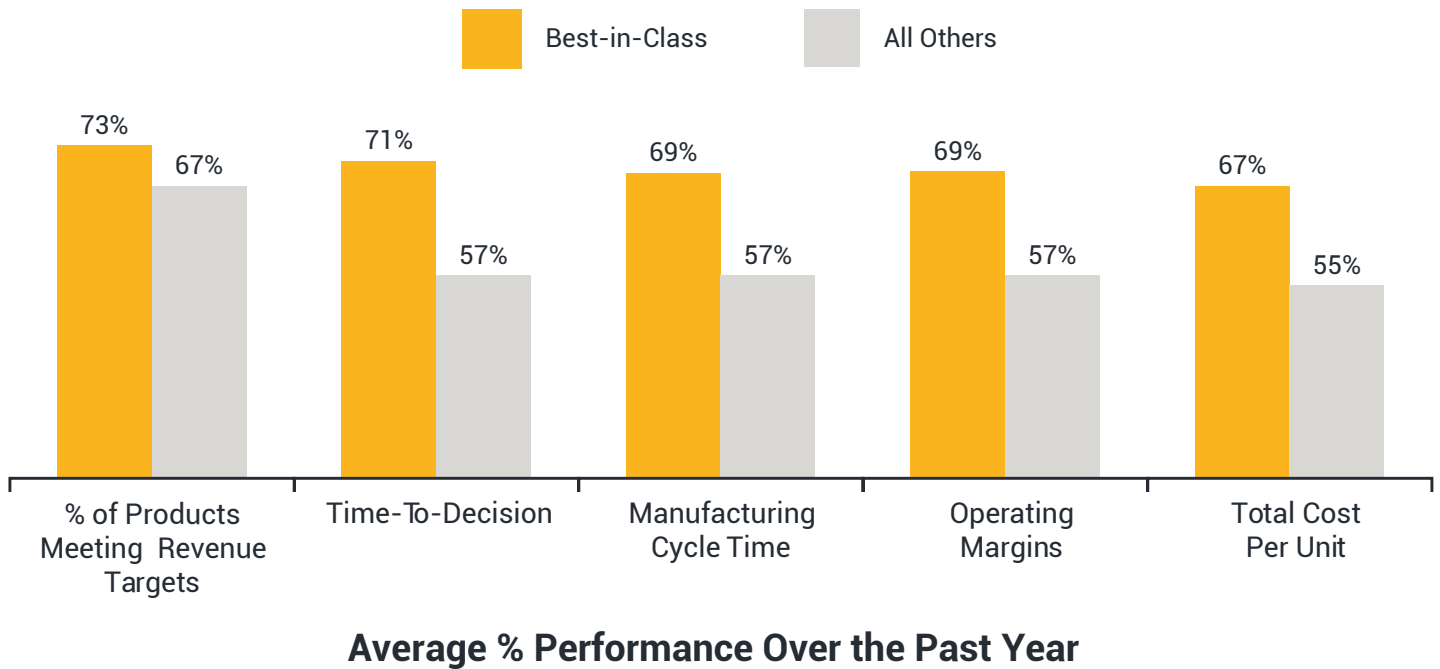


THE HOLISTIC IMPACT OF SIMULATION ON KEY PERFORMANCE INDICATORS

As the previous data have revealed, Best-in-Class companies that systematically deploy 3D and multiphysics simulation capabilities across the entire product life cycle realize significant and material benefits at each stage.

When consolidated, these individual impacts manifest at the business level, delivering a clear advantage when measured by critical business key performance indicators (Figure 3)

Figure 3: Business Results for Simulation Users



n = 407, Source: Aberdeen, September 2020

Business leaders at companies with simulation capabilities are better able to plan and make decisions around new products and release plans based on efficiently created, comprehensive design plans. The differences in operating margins and total cost per unit are connected to the overall cost savings associated with simulation. Decreases in the number of physical prototypes in design phases, increases in capacity and material utilization in manufacturing processes, and decreases in warranty and service fees combine to lower the total cost of generating a single unit. As each unit experiences a 22% greater decrease in cost per year, companies can significantly cut down on their development and operating costs, resulting in higher operating margins.

CONCLUSION

The overarching benefit of simulation is that it reduces time, cost, effort and risk by identifying issues before they materialize in the physical world. The ability to predict the performance of products, processes and systems in a virtual environment and determine how they would behave in certain scenarios provides engineers with the opportunity to fix problems before proceeding with the rest of the development process. From ideation, to design and analysis, to manufacturing and operations, and through product launch and service, the cost and time savings associated with preventing these design failures are evident at each stage in the process and when consolidated make a significant impact on the critical business key performance indicators of an organization. In today's economic environment It has never been more evident that leveraging the power of simulation, like the Best-in-Class do, enables companies to not only address immediate operational cost control imperatives but ensure they emerge stronger and more competitive than ever before.

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