

Embracing Design for Reliability at Advanced Energy

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Introduction

The Design for Reliability (DfR) process drives reliability into products during design and manufacturing phases. This paper discusses industry trends driving demand for increased quality and capacity as well as the DfR process, its elements, and the benefits of its application during the product life cycle. We also describe Advanced Energy's (AE's) application of DfR and our commitment to our customers' success.

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Market Trends and Impacts

Medical

The medical market space is dramatically transforming and the decision criteria for the designs of integrated circuits and engineered materials are changing. Companies are increasingly using more technology to support innovation and, ultimately, superior patient experience. For example, Apple and Stanford Medicine enrolled more than 400,000 participants in the Apple Heart Study since its launch in November 2017 — making it the largest study on atrial fibrillation (AFib) ever conducted (Lineaweaver 2018). The study will help Apple explore how the Apple Watch can be used to identify AFib, a common type of irregular heartbeat that heightens the risk of stroke and can indicate cardiovascular disease. AFib detection has been one of Apple's strategic focuses in healthcare thus far — the tech giant released the Watch Series 4 with an FDA-cleared AFib detection feature in September 2018. AFib costs the U.S. around \$6B and is responsible for about 130,000 deaths and 750,000 hospitalizations in the U.S. every year, according to the CDC (CDC 2017).

Reliable components, including the microprocessor chip, in the Apple Watch are essential to delivering precise functionality required to identify AFib. AE's power products play a critical role during the manufacturing of these chips, a process demanding high reliability and robust performance of AE's products. Thus, DfR practice at AE has a direct impact on end-user product reliability and robustness.

Semiconductor & Data Storage

As companies embrace emerging technologies, such as artificial intelligence, the Internet of Things, streaming video, etc., more data is being created and consumed by both companies and individuals. The ever-increasing volume of information requiring real-time access drives demand for data storage. Data storage supply and demand worldwide from all industries is presented in Figure 1 (Statista 2019).

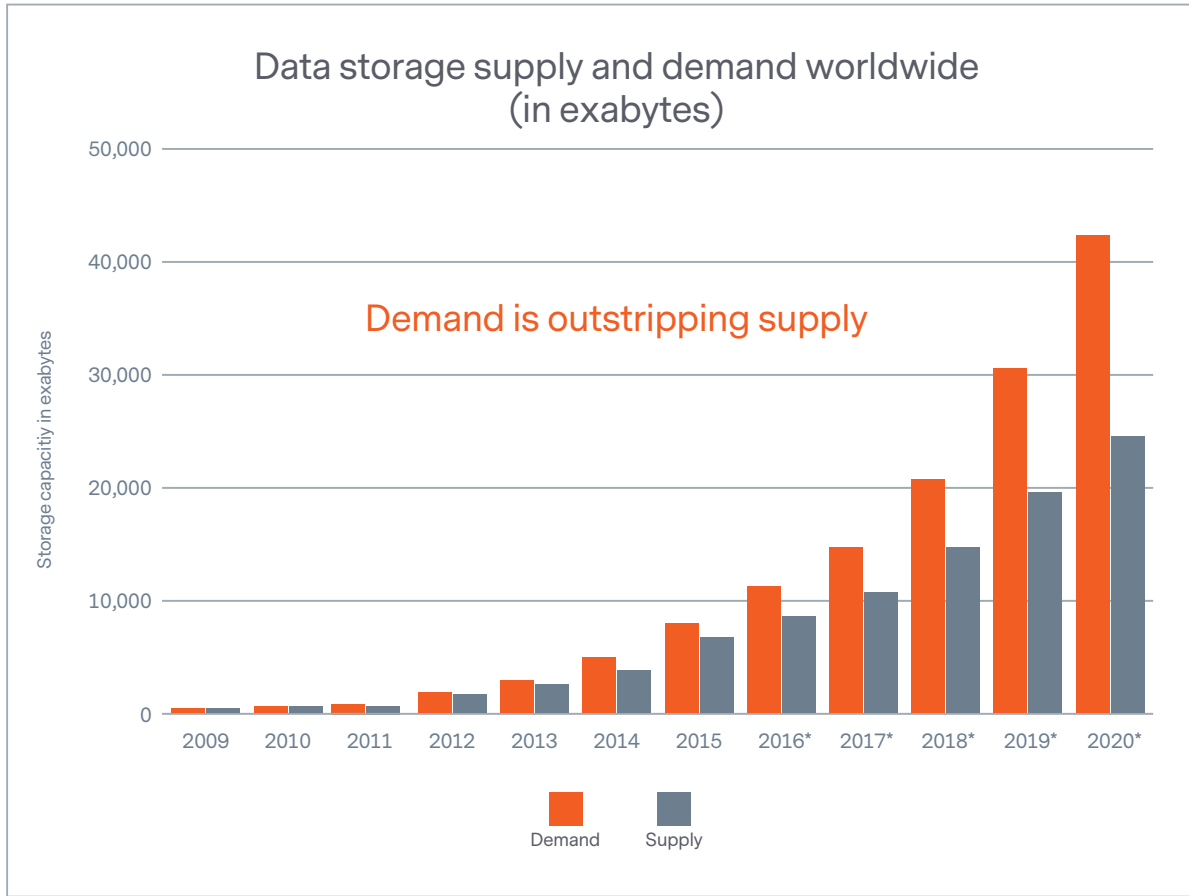


Figure 1. Data storage supply and demand worldwide

This astronomical change in the data storage demand creates demand for electronic storage devices manufactured with reliable chips and increasingly complex architectures. AE views this as an opportunity to deliver superior products and services in chip manufacturing by leveraging its proven technology and design practices, including DfR.

AE is poised to help customers keep pace with current and future market trends to build and deploy superior reliability processes for designing and manufacturing robust products. The DfR process is already being executed at AE, complementing the solid foundation in reliability engineering currently used during design and development.

Design for Reliability

DfR is not a new concept and has advantages over the traditional reliability engineering paradigm that many companies use. The American Society for Quality (ASQ) defines reliability as “the probability that a product, system, or service will perform its intended function adequately for a specified period of time, operating in a defined operating environment without failure.”

This definition has a significant mathematical relevance, and it is confined to testing, analyzing data, estimating, and predicting reliability. The traditional approach to reliability will fall short when we aspire to build a robust product that provides competitive advantage for the company and high customer satisfaction. Instead, if the DfR process and methodologies are applied appropriately with a renewed paradigm (which is discussed later), robust, cost-effective products can be built.

AE has initiated a global program applying DfR principles throughout the product lifecycle, from product concept selection to the product obsolescence, connecting all DfR activities, from defining product requirements to design and development to manufacturing and product commercialization. See Figure 2 to visualize the DfR process at AE.

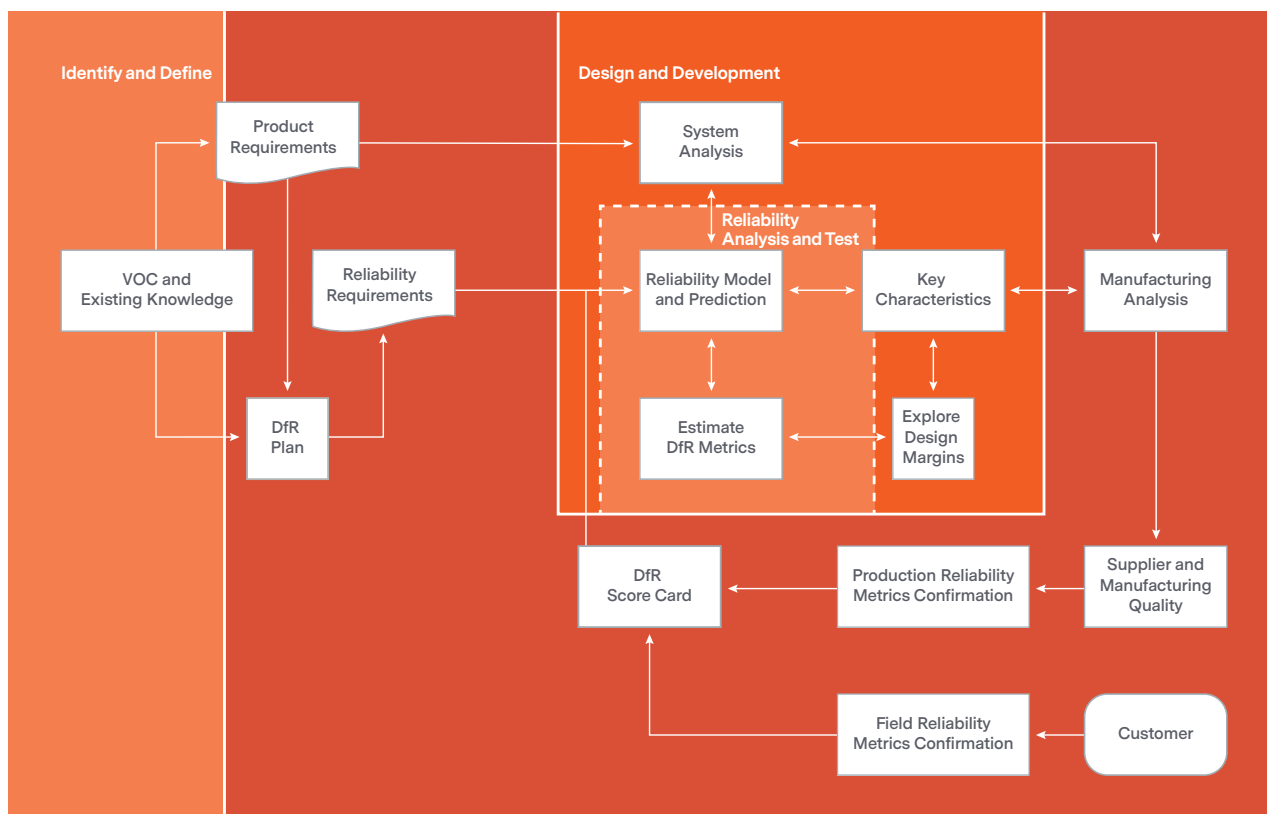


Figure 2. The DfR process at AE

The following is the premise AE employs to build robustness into products:

- Reducing product performance variability during design and development, manufacturing, and use
- Prolonging the product performance with high reliability
- Predictably addressing failures at use

AE's DfR goal is to delight customers with products that have been engineered with high reliability under a solid governance of processes and people, as shown in Figure 3.

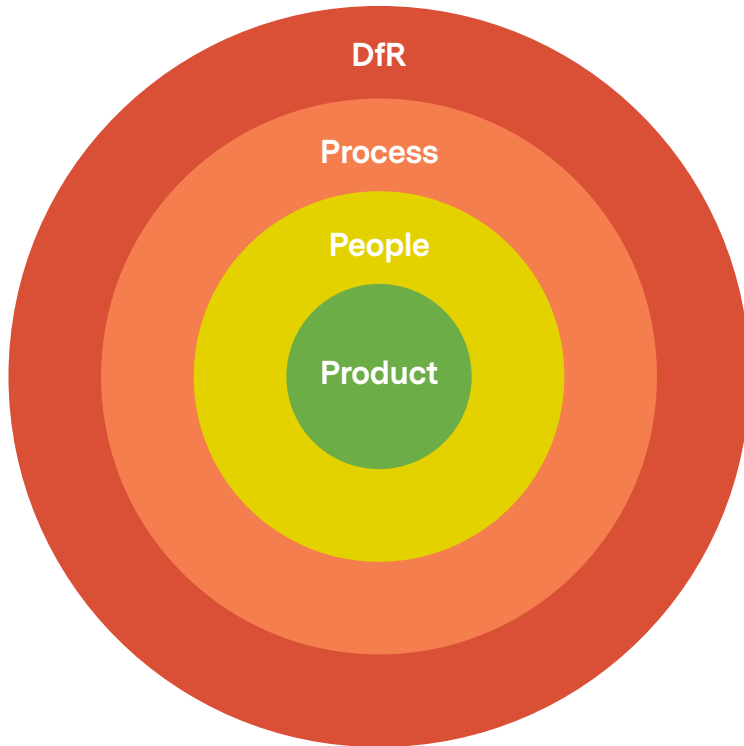


Figure 3. AE's DfR goal

Industry proven processes, methodologies, and tools in the DfR domain play a critical role in AE's DfR strategy. AE's DfR process drives increased focus on all the activities that are necessary to build robustness of the product during its useful life.

EMBRACING DESIGN FOR RELIABILITY

The tools in a traditional reliability development process are limited. With DfR, the mosaic of these tools is expansive (see Figure 4).



Figure 4. DfR tools; tools in different colors signify their typical use at various phases of product development

Conclusion

AE shapes and transforms how power is used, delivered, and managed by some of the world's leading semiconductor and industrial manufacturers.

We design and manufacture highly engineered precision power, measurement, and control solutions for mission-critical applications and processes. Our power solutions enable innovation in complex semiconductor and thin film plasma processes, high and low voltage applications, and temperature-critical environments. From the multiple screens you use daily to life-saving medical equipment and techniques, our products and solutions enable their development and advancement.

With deep applications know-how and responsive service and support, we build collaborative customer partnerships. Our solutions anticipate evolving industry developments, propel growth, and power the future of technology.

As Dr. Edward Deming, renowned engineer and pioneer of the “Quality Revolution” said, “It is not enough to do your best; you must know what to do, and then do your best.” By assessing the scope of the new design or proposed change, AE applies tools and performs activities in a manner defined in our documented DfR procedure. This practice is steadily gaining momentum companywide. Applying DfR principles throughout the product lifecycle, from product concept selection to the product obsolescence, will help us deliver best-in-class, reliable products that meet current and future market demand.

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ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.

PRECISION | POWER | PERFORMANCE

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