

Accelerate Innovation by Improving Product Development Processes

Getting from concept to shipment as fast as possible is the goal of virtually every product development team. Business imperatives constantly pressure development teams to improve their simulation tools, cut design cycle times, and reduce test time to bring products to market faster.

Spiral design techniques, popularized by software developers, are being adopted as hardware and software development merges. A spiral model (Figure 1) reflects the fact that most new product developments borrow from existing product designs and utilize software modules from multiple sources. For simplicity, Figure 1 only shows one prototype phase but multiple iterative prototype phases are typical.

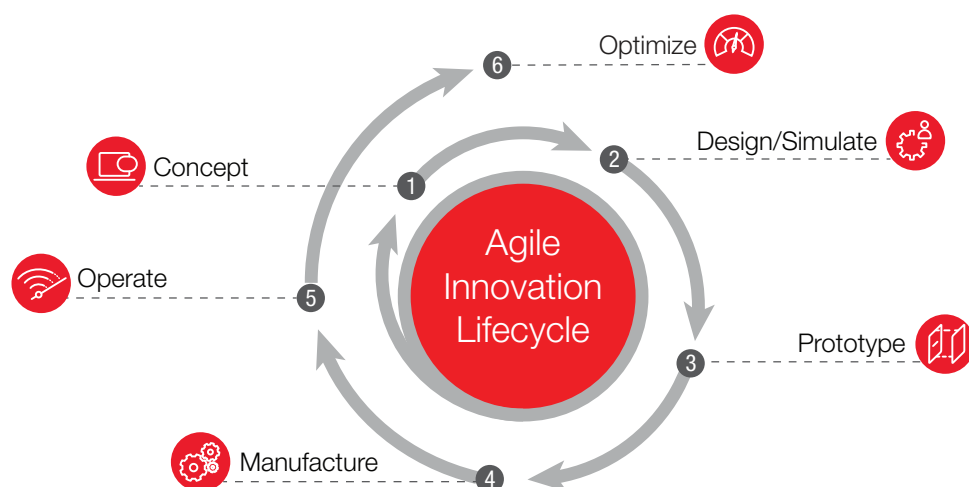


Figure 1. Agile Innovation Lifecycle: simplified view of a modern product development process.

Agile techniques such as **Scrum** bring short development sprints to track project progress and re-planning, not just for software development but also for the hardware changes that need to accommodate their features. Using the Agile model, a development team translates a product concept into a specific, manufacturable design that meets all relevant requirements (functionality, regulatory, supply chain, manufacturing, etc.).

Research by Tech-Clarity found that the most successful companies are more than twice as likely to consistently follow a new product development process. The study also found that only about half of the companies surveyed actually do this. One obvious way to improve your product development efficiency is to establish and use a suitable process.

Product Development Tools

The speed of any process is limited by the speed of the tools the team uses. As you proceed around the innovation cycle, the objective is to get to phase 6 (i.e., having a high-quality product that meets all requirements) as fast as possible: moving from high ambiguity (just an idea) to a state where every detail is determined and documented.

Figure 2 illustrates the three main phases of product development. Each phase has its own set of primary tools that work well for the tasks of that phase but may not be well-coordinated with the other phases.

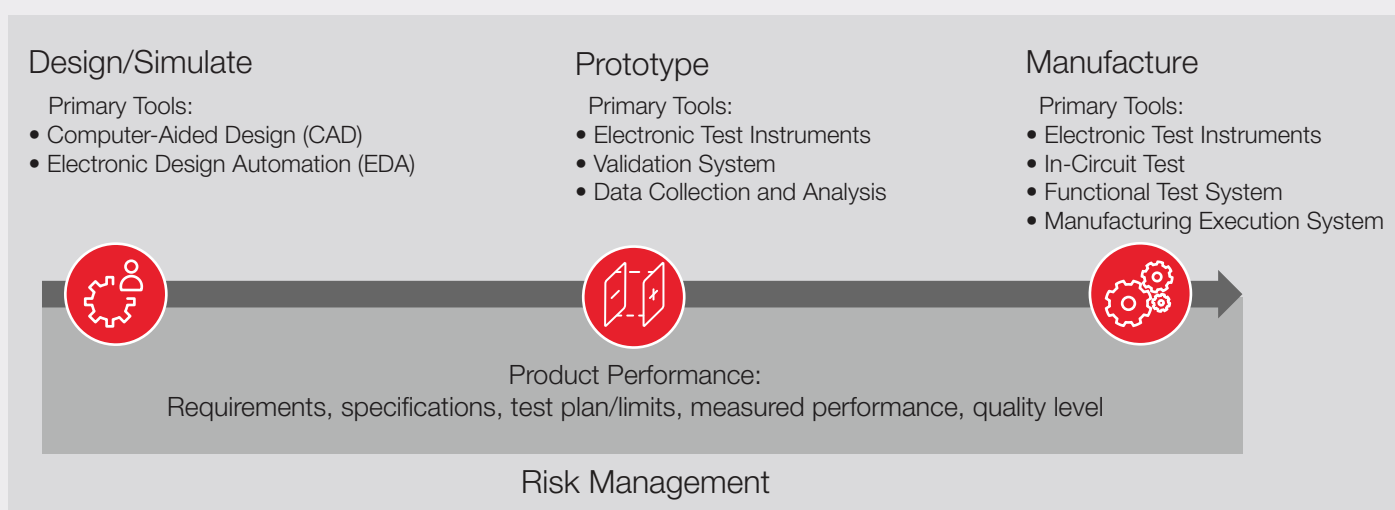


Figure 2. The three main phases of product development

Transferring design information between phases is critical and should include requirements, specifications, net lists, bill of materials, printed circuit assembly drawings, test plan, test limits, measured performance, quality level, etc. As the design moves into manufacturing, this information needs to be compatible with or translated into the manufacturing systems that run the manufacturing process, ensuring that the correct material can be ordered and the production runs can be planned and executed. There is a strong human element in this process: engineering teams are directly involved in handling and evaluating the data, making judgments about the status of the design and whether it is ready to proceed to the next phase.

This process embeds risk management as a key element. Each phase of the lifecycle reduces risk in anticipation of the next phase. For example, the design/simulate phase provides a robust design for build in the prototype phase with a minimal number of problems. The prototype phase validates the design before full manufacturing starts. This is not a pristine process – you often compromise to expedite getting to market – the key point is to consciously manage the risks involved for a successful product launch.



More Data, More Locations

The product development process generates a lot of data, and that data is increasingly complex and in a wide variety of formats. Each type of design/measurement tool tends to have its own set of data formats, which is fine when using that tool in isolation but hinders compatibility and consistency with other tools in the lifecycle. You may generate more data in all phases, but that doesn't necessarily yield more information and insight.

The use of simulation continues to grow and integrates tightly into the design process. Engineers implement the design, simulate it, and use the results to optimize their design choices. As compute power and digital storage have increased, engineers create more extensive simulations to check out every operating point of their design. Similarly, in the prototype phase, as devices become more complex, the number of measurements increases. Memory depth of a typical measurement increases in size, creating larger datasets that must be stored and managed. Customers report they are swimming in data and struggling to gain insight from it.

Data management is even more difficult for geographically-separated teams who often use a "follow the sun" development model. Teams in different locations may turn on different prototype builds and compare results. Working with multiple development partners and contract manufacturers means sharing data across organizational boundaries. Sometimes datasets are captive in organizational silos (e.g., the design team can't access manufacturing data).

“

“We need to handle and correlate test data from multiple sites around the world. We need a common data validation approach between design, design validation, and production.”

- Engineering Manager, Global Component Manufacturer

”

Many customers are getting by with rudimentary data management tools. They use common office tools such as Excel and Word to capture or document the data, which is then stored on a local file or on a shared drive. Revision control is usually weak and information is often transferred via email.

“

“We have one person in our team who spends nearly all his time managing the data and producing the graphs and reports that we use to drive decisions. He should be doing engineering, but he’s consumed with this IT work. And if he is not on site, we can’t hold our staff meetings because he’s the only person who knows how to use the homegrown tool.”

- Vice President, Validation Engineering, US Semiconductor Manufacturer

”

“

“I’d like to be able to spend more time on real engineering work but I often get pulled off to deal with data management problems. It takes a lot of effort to pull together our measurement results and figure out how well the chip is working.”

- Design Validation Engineer, US Semiconductor Manufacturer

”



Transferring and sharing data between the major phases of a project and across organizational boundaries is often a problem. Whenever the data collection systems or data formats are different, the chance for errors and rework increases. All too often we see engineers manually taking data from one system and entering it into another, perhaps with slightly different formatting.

“

“When our manufacturing team identified production measurement problems, they often come back to us requesting validation data. We don’t have confidence in this data and we resort to re-measuring the data on our archived hardware prototypes.”

- Integrating Manager, Validation Team, US Semiconductor Manufacturer

”

Engineering teams often resort to creating their own software tools to collect and analyze data. Sometimes this is done with Excel or another standard tool but proprietary software systems may be developed in-house. These systems seem like an efficient way to go, but they consume resources that could be used for more important tasks.

“

“I struggle to handle data from our contract manufacturing partner even as I am in charge of optimizing manufacturing yield and turn-around time. The CM provides data in the form of CSV files and my team struggles to develop and maintain tools for analysis that enable sharing/collaboration. The tools also require maintenance and evolution as our processes change – and this is very time consuming. I also lack methods for analysis that can help me identify trends, issues and predictive analysis that would benefit our business.”

- Manufacturing/NPI Team Manager, Global Semiconductor Manufacturer

”

Accelerating Development

A recent research paper found that design engineers waste more than eight hours a week doing non-productive tasks associated with simply finding and using data they need. That same report found that almost half of the product design teams do not have a formal product data management system, especially smaller companies. Larger companies tended to have more established systems. Another study found that ~15% of their technical staff wastes time on non-product data management tasks. About one quarter of the companies report wasting more than 20% of their technical time on nonproductive data management tasks. That's one full day per week. This may seem excessive, but many of our customers have reported similar inefficiencies.

The study found a variety of data management problems (Figure 3), with search and retrieval of data being the most common. The problems reported are largely basic data management issues (i.e., keeping data organized, accessible, and under revision control.)

It is tempting to think that one big monolithic system engulfs the entire data management challenge. However, given the size and complexity of modern electronic product enterprises, flexible, adaptable software systems with well-designed APIs that allow efficient interaction between systems offer better options. CIMdata calls this the platformization of product lifecycle management, perhaps better referred to as a product innovation platform. Because no one system solves every need, a well thought out “system of systems” approach is ideal. Established companies have entrenched enterprise systems that can't easily be replaced, so any new data management system must be able to interoperate with legacy and other systems.

There are three main ways to speed up product development:

- Shorten each individual phase (design/simulate, prototype, manufacture)
- Speed up the hand-offs between phases
- Optimize the overall development cycle (e.g., do some phases in parallel or require fewer cycles)

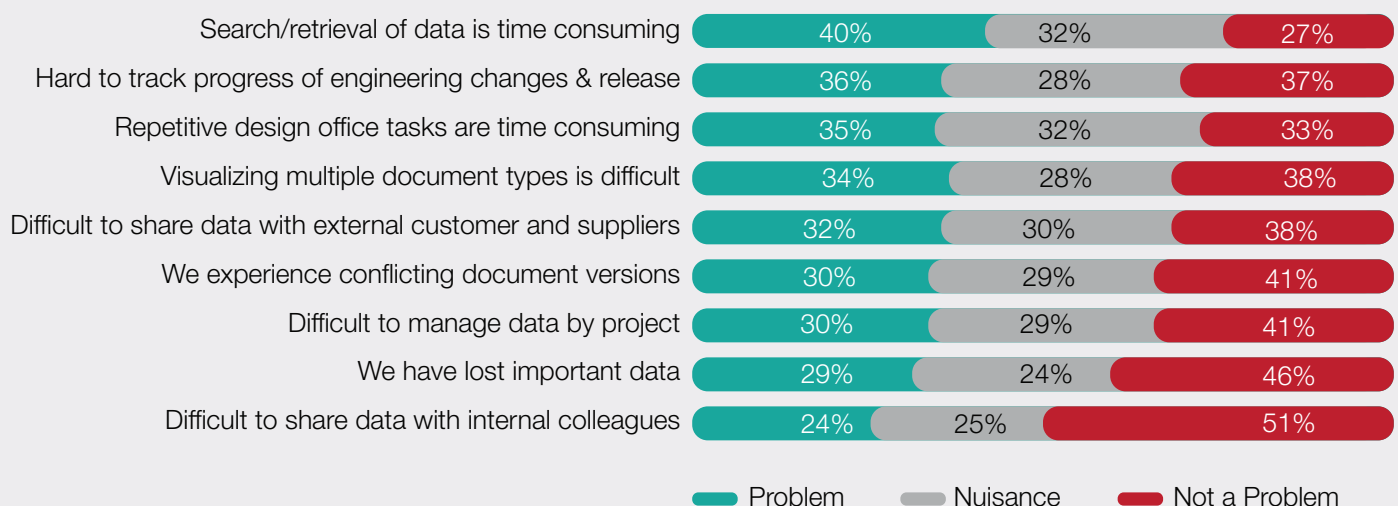


Figure 3. Reported data management problems (Figure courtesy of Tech-Clarity and used with permission).

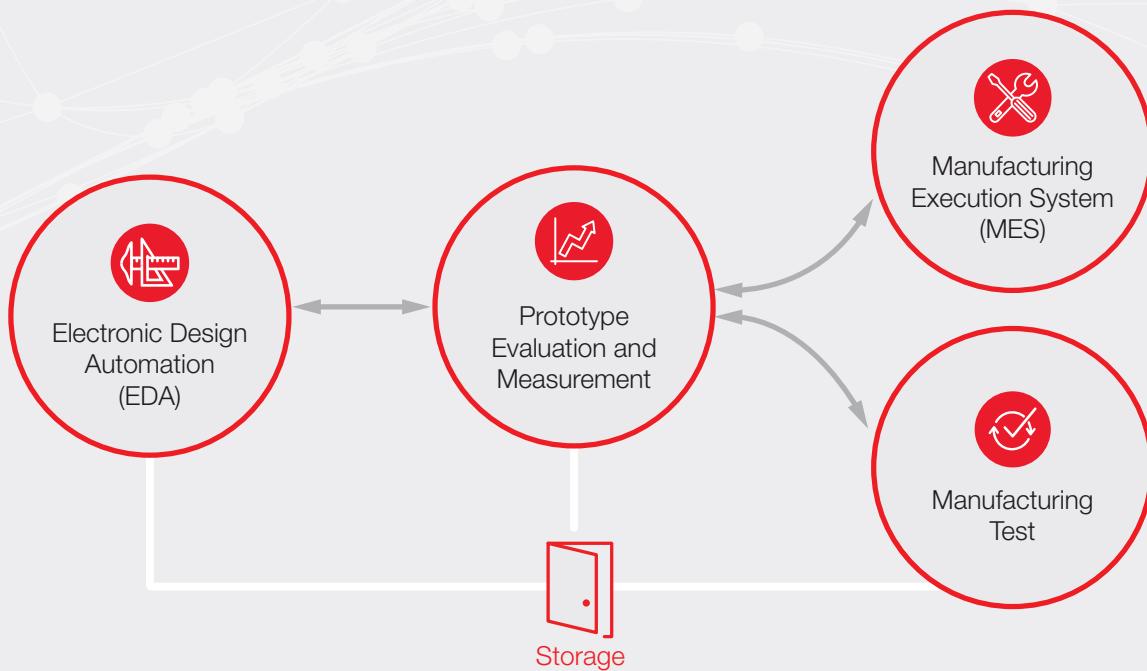


Figure 4. Management of product development data must be integrated into the enterprise systems.

Figure 4 shows a conceptual diagram of a system that allows efficient sharing of information across the enterprise.

As a major technology trend, many enterprise systems deploy cloud computing. A cloud-based solution has the inherent benefit of easy sharing of data within and between organizations. Companies concerned about security and low-latency access to data can deploy an on-premises private cloud. Creating a data management solution that is web-based and cloud-oriented enables access across different platforms.

An ideal data management solution is an open system that ensures minimal vendor lock-in and offers maximum flexibility when interoperating with other enterprise systems. With a “system of systems” approach, each system has a strong set of well-defined APIs so that anyone can enhance the functionality of the system. Similarly, all stored data is accessible with easy-to-use import/export tools to ensure that intellectual property is not held hostage.

Optimizing the Lifecycle for Faster Development

Another major technology trend is the deployment of advanced data analytics capabilities.

First, companies must solve the basic management of product development data before applying analytics. As shown in Figure 5, basic data management is foundational. Once that capability is in place, you can then apply descriptive and diagnostic analytics. Engineers need effective visualization of the data to help them understand the performance and diagnose problems. For example, a key specification (jitter, bandwidth, etc.) of many samples of a device can be plotted as a histogram with test limits to indicate which samples are outside the spec.

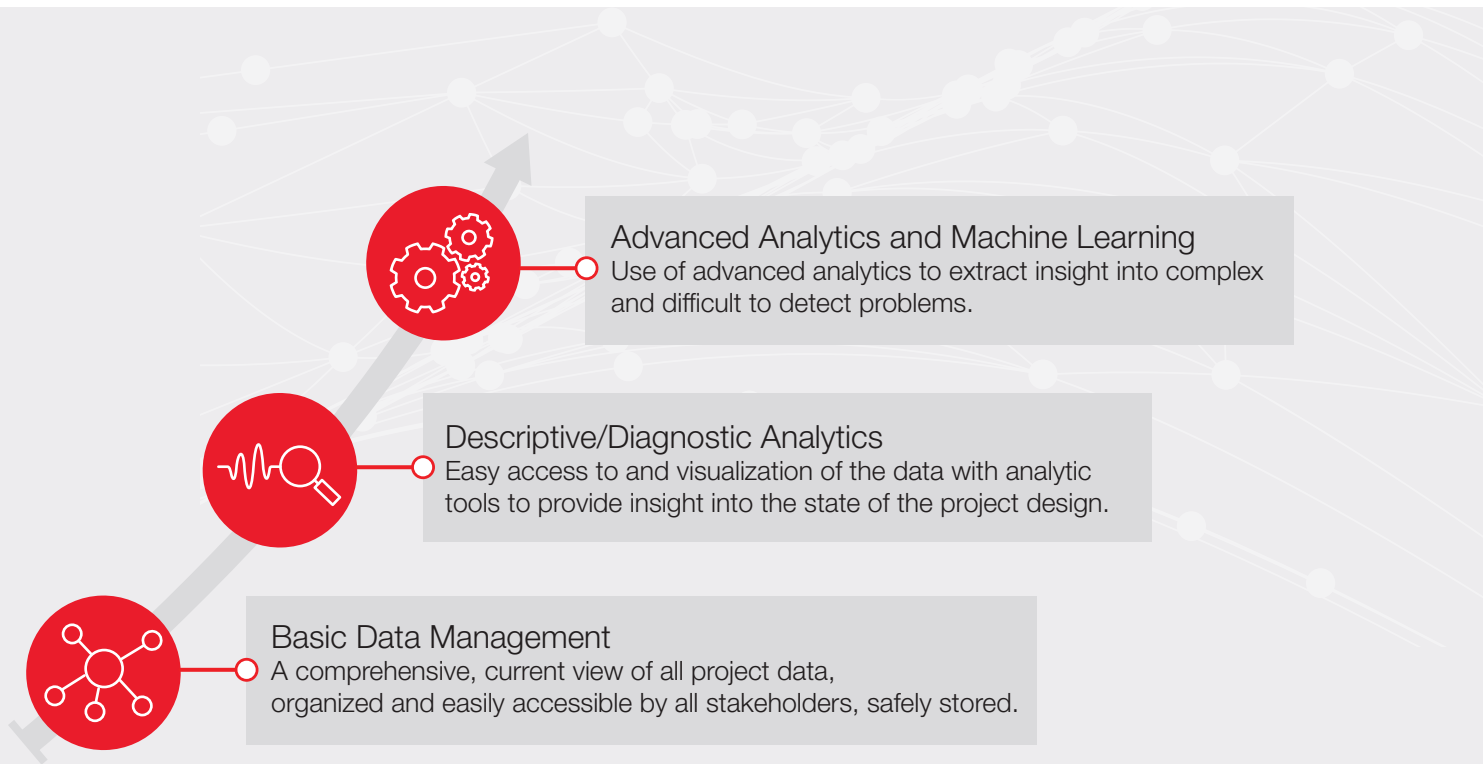


Figure 5. The analytics maturity model shows two levels of analytics capability built on top of basic data management.

Moving further up in maturity, you can use advanced analytics and machine learning to add additional value. For example, a key specification of the device can be correlated to variation in operating conditions (such as clock speed, power supply voltage, temperature, etc.). Understanding the contributing factors to out-of-spec devices drives design improvements for the next prototype. Essentially, this means improving the accuracy and robustness of the simulation used in design so that it does a better job of predicting actual performance in the manufacture phase. This has the potential of taking an entire cycle out of the innovation cycle, which is a big lever on speeding up the process.

“

“We have two main levers, speeding up the design/sim/validation cycle and reducing the number of times we need to go around the cycle. This is where data analytics can help us. Improved process and data management can be the difference between three proto cycles and two!”

- Vice President, Validation Engineering, US Semiconductor Manufacturer

”

Engineers look for continuity and consistency across the lifecycle so that design decisions in the simulated world match what they see in prototypes and manufactured units. With improved simulation, you shorten the entire lifecycle.

Recommendations

There are three principal areas that can deliver faster time to market and improved efficiency in product development.

Use a product development process.

If you don't have a defined product development process, this is an obvious place to start. The challenge is establishing a process that fits your organization's business model and culture so that it really gets used. Remember, this is all about managing the risk in the project.

Manage the data flow in the development process.

Adopt a set of software tools that effectively manage your product development data. Reduce the amount of time your engineers are spending on just managing data, which may be as high as 20%. Eliminate wasted effort by sharing the design/test/measurement data easily across the organization. Ensure your system is low maintenance and easy-to-use otherwise the hidden costs creep back in. Adopt open system components to maintain flexibility, easy data import/export and portability.

Use insight from the data to shorten the innovation cycle.

Significant improvements can be made by shortening each phase of product development and the hand-offs between each phase, but the bigger payoff is likely to come from skipping entire design/prototype cycles. This payoff comes from applying data analytics across the product development cycle. A key factor here is establishing continuity and consistency between the tools used in the lifecycle so that design decisions and physical reality match. Maintaining and improving that match enables better design decisions, shortening the innovation cycle.

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

