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The Secret of Designing Products Customers Love: Manage Requirements Effectively

Today's modern products are reaching new levels of innovation, but to accomplish this, they have become more complex and sophisticated than ever before. Many products have evolved into something that could actually be defined as an integrated system consisting of components that require the expertise of multiple engineering disciplines. Aberdeen examined the development practices of this evolving trend for today's products in [*System Engineering: Top Four Design Tips to Increase Profit Margins for Mechatronics and Smart Products*](#), October 2009. One of the central themes that emerged from this study is the need to properly manage product requirements. This Analyst Insight explores this topic further.

How Market Demands Are Changing Product Development

One of the top pressures facing engineering executives today is increasing market demand to build "smarter" products, as found in Aberdeen Group's June 2008 report, [*Engineering Executive's Strategic Agenda*](#). Further supporting this growing need, Aberdeen's November 2008 report, [*Engineering Evolved: Getting Mechatronics Performance Right the First Time*](#), found that 66% of the products developed last year contained embedded systems. Clearly developing smart products is an important trend manufacturers must pay attention to in order to be competitive in today's market. While this is an exciting trend that offers a lot of new opportunities for innovation, at the same time, it is inherently difficult. Getting it right requires new approaches to developing products. To understand which approaches should be implemented, let's first look at what makes developing today's modern products challenging.

What Makes Developing Today's Modern Products Difficult?

The need to develop smarter products has increased the complexity of today's products. To meet customer needs, products often consist of an integrated system of mechanical components, electronics, and software. This requires the involvement of multiple engineering disciplines, which leads to system engineering. Figure 1 displays the top challenges of system engineering. Respondents were asked to pick their top three challenges.

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

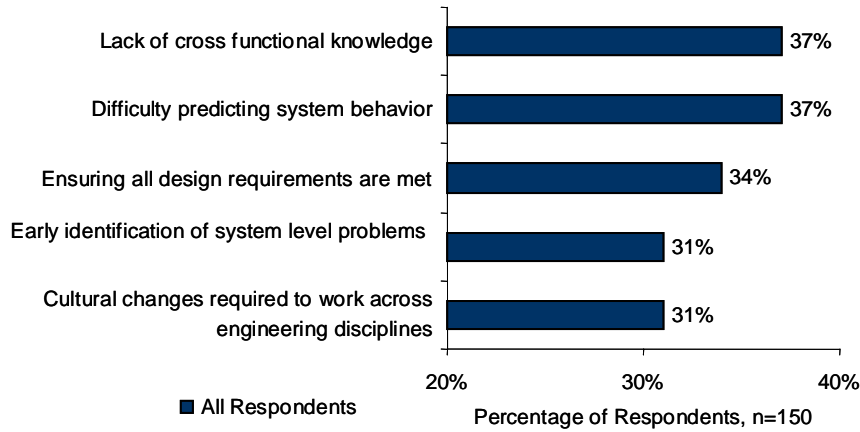
Key Takeaways for Success

Requirements management is critical to the successful development of today's modern products. To achieve success, companies must be able to:

- ✓ **Manage product requirements** throughout the development lifecycle
- ✓ **Provide visibility into requirements and their status** to the entire product development team
- ✓ Be able to **truly evaluate the impact of changes** on both the requirements and the design

Companies that do this will be **more efficient**, see **lower costs**, and become **more profitable** with products that are in customer demand.

Figure 1: Top Challenges of System Engineering



Source: Aberdeen Group, October 2009

Fast Facts

When compared to the Industry Average, successful system engineering, which includes requirements management, enables Best-in-Class companies to:

- ✓ Earn profit margins that are **2.3-times** higher
- ✓ Take **three-times** more cost out of products
- ✓ Experience development cycles that are **6.2-times shorter**

These challenges clearly point to a need to improve communication across engineering disciplines which involves making it clear what each is responsible for. The challenges also reveal that there is a strong need to understand system behavior which starts with defining what that behavior should be. Finally, there is a strong need to manage requirements throughout the development process so that there will be greater confidence that what was originally intended is what is actually built. This means being able to trace the impact of changes on the requirements and which parts of the design are affected.

The Performance Advantage of Best-in-Class Approaches to Addressing the Challenges

While the challenges of developing today's modern products create obstacles for many companies, some are extremely successful. They have discovered the secrets that lead to more successful development practices that ultimately result in greater profitability. To identify these practices, Aberdeen benchmarked the performance of over 150 companies and categorized them as either Best-in-Class (top 20% of performers), Industry Average (mid 50%), or Laggard (bottom 30%). The performance gaps and the success of the Best-in-Class can be seen in Table I.

Table I: Top Performers Earn Best-in-Class Status

Definition of Maturity Class	Mean Class Performance
Best-in-Class: Top 20% of aggregate performance scorers	<ul style="list-style-type: none"> ▪ 83% of products met product launch deadlines ▪ 13% reduction in development time ▪ 10% reduction in product cost ▪ 8% increase in product profit margins

Definition of Maturity Class	Mean Class Performance
Industry Average: Middle 50% of aggregate performance scorers	<ul style="list-style-type: none"> ▪ 69% of products met product launch deadlines ▪ 2% reduction in development time ▪ 5% increase in product cost ▪ 3% increase in product profit margins
Laggard: Bottom 30% of aggregate performance scorers	<ul style="list-style-type: none"> ▪ 36% of products met product launch deadlines ▪ 10% increase in development time ▪ 13% increase in product cost ▪ 3% decrease in product profit margins

Source: Aberdeen Group, October 2009

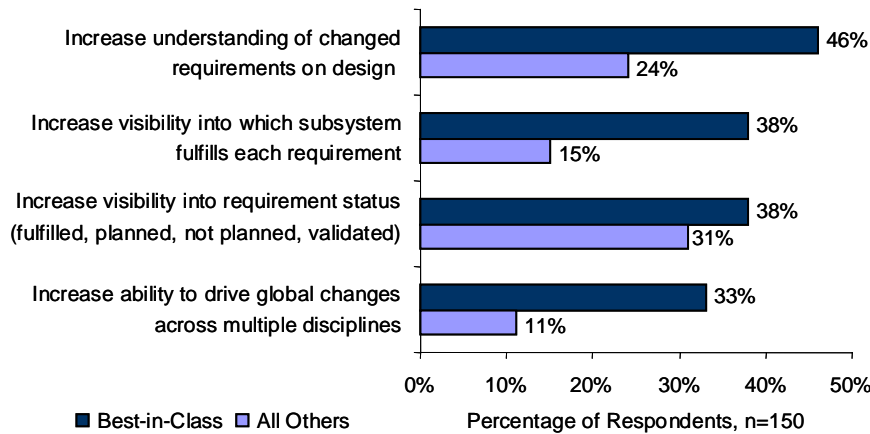
Based on the results in Table I, the Best-in-Class successfully reduce the time required to develop their products. This means they successfully get their products to market faster so they can start recognizing revenue sooner. They are also better positioned to capture market share from competitors. The Best-in-Class also do a better job of delivering products that their customers want. With more customer demand for their products, the Best-in-Class have the luxury of charging higher premiums which means greater profitability. Also adding to greater profitability, the Best-in-Class are more successful at taking cost out of their products.

Clearly there is a lot of opportunity for success and greater profitability with best practices. On the flip side, not following the lead of the Best-in-Class can be extremely expensive for a company and puts them at a competitive disadvantage. The question is, what practices have those Best-in-Class companies deployed that lead to their success?

The Practices that Lead to Best-in-Class Performance

The Best-in-Class do a far better job of addressing the top product development challenges and as a result, they are more successful. Central to their ability of addressing the challenges is their focus on requirements. By focusing on requirements from the beginning and throughout the lifecycle of the project, the entire project has a better chance of success. Top strategies deployed by the Best-in-Class are shown in Figure 2. These strategies enable them to realize significant performance advantages compared to their competitors.

Figure 2: Best-in-Class Strategies to Improve System Design



Source: Aberdeen Group, October 2009

Two main themes can be seen in these strategies deployed by the Best-in-Class that really set them apart from their competitors:

- They manage the requirements on an ongoing basis throughout the development process with better visibility into them
- They ensure they can support changes and understand how they impact the requirements and design

Increased visibility into which subsystem fulfills each requirement is critical to improving communication across engineering disciplines, and improved communication is key to overcoming the lack of cross functional knowledge, the top challenge. Better visibility into which requirements have been implemented also enables these companies to have the opportunity to validate the requirements earlier in the process. This addresses another top challenge of identifying system level problems earlier. Improved visibility also provides the ability to trace the relationships between customer needs, requirements, and the design. This, in turn, results in the ability to implement the second theme of the strategies - manage changes.

One of the top things the Best-in-Class do is incorporate superior change management into their requirements management strategy. They make sure they have the ability to trace the affect of changed requirements on the design and across all engineering disciplines as well as the affect of design changes on the requirements. This traceability is critical to fully understand the impact of the change. Being able to trace it throughout the design also helps to ensure the requirements are met in the final product, another top challenge. Without understanding the impact of the change, the change will not be implemented correctly as everything will not be updated correctly. This contributes to the challenge of the system not working as intended. Finally, the ability to trace the impact of changes means that the change can be communicated to all affected members of the development team so that no one is wasting time working on requirements that are no longer valid.

"Companies that desire to be Best-in-Class should consider better requirements definition early on. This includes all aspects of requirements management such as better process, tools, workflows, ownership, traceability, change management, and the ability to use multiple formats. Requirements should also be linked to customer needs, which reduce drastic scope change later on. By achieving this desired state, we believe it will lead us to have more competitive solutions for our customers and more predictability in development costs and timelines (fewer overruns)."

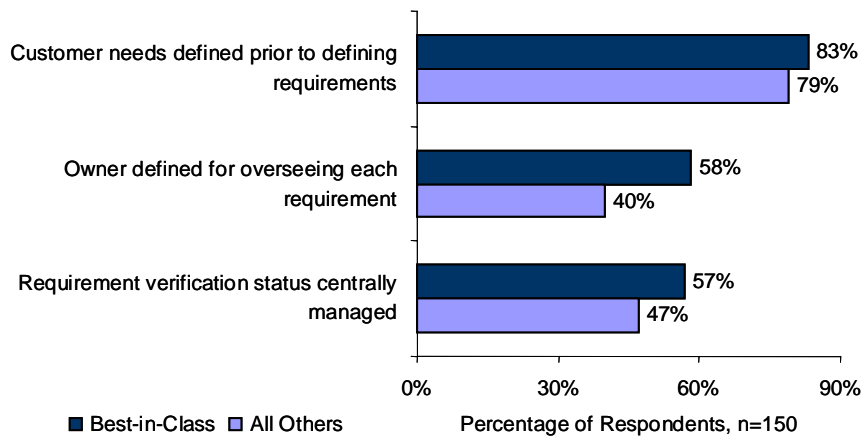
~ Maryane Chapman, Director,
Integrated Systems Engineering,
Pitney Bowes

It is the combination of these strategies that results in the higher performance achieved by the Best-in-Class. All of the improvements to communication lead to more efficient development practices which reduces the overall development time, helping the Best-in-Class get to market sooner. They have a better understanding of which requirements have been implemented and validated so that they can catch problems earlier on, avoiding the extra expense associated with finding problems much later, keeping product cost down. They can also be sure the requirements have been met which means customers are getting what they want, which leads to greater demand for products and higher levels of profitability.

How the Strategies are Executed

Implementing the strategies to manage the requirements throughout the development process as well as improve visibility to them requires a combination of capabilities. These capabilities, that set the Best-in-Class apart from their competitors, are shown in Figure 3.

Figure 3: Best-in-Class Capabilities to Manage Requirements

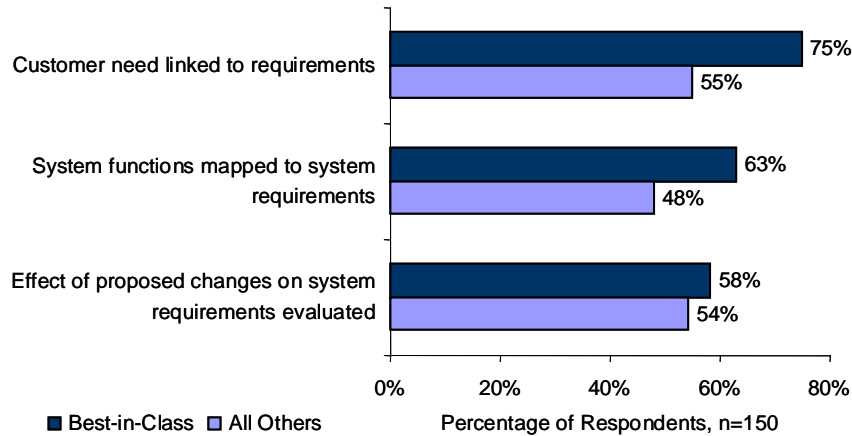


Source: Aberdeen Group, October 2009

Understanding what customers want is a critical first step for developing products that have greater market demand. Most companies do this, but it is the combination of the other capabilities that ensure the Best-in-Class are able to transition those needs into product requirements that make it into the final product. Assigning ownership for requirements provides accountability for making sure the requirements are met as intended. Finally, central management of the verification status provides the needed central visibility of the status of the requirements to improve communication and identify potential problems as early as possible.

While these capabilities are important to manage requirements, what is more important is that they establish the foundation for managing changes and providing traceability. By not doing this correctly, the result is significant problems that drive up cost. The capabilities the Best-in-Class leverage that really boost their performance above their competitors are shown in Figure 4.

Figure 4: Best-in-Class Capabilities to Support Requirements Traceability



Source: Aberdeen Group, October 2009

As was seen in Figure 3, most companies focus on understanding what their customers want. It is then linking those needs to specific requirements that really help the Best-in-Class ensure they are developing the right product. This makes it possible to trace the impact of a change on what the customer wants, enabling a more educated decision about how to implement the change. Mapping system functions to requirements provides further traceability, making it possible to truly understand what is expected from the requirement and understand the impact of changes. Most companies do try to evaluate the effect of proposed changes on requirements; however, without the traceability, it is virtually impossible to truly obtain the needed insight to evaluate the impact.

To implement these Best-in-Class capabilities, a requirements management solution that enables them is required. The next section discusses the experience of one company and the improvements they have realized with their requirements management solution, Contour from Jama Software.

Case in Point: IntraPace®

IntraPace® is a medical device company, founded in 2001. It is the maker of the abiliti™ system, an implantable medical device to treat obesity. The device is implanted via standard laparoscopic instruments and detects when a person consumes food or drink. The system then delivers a series of low-energy electrical impulses to the stomach, which is intended to create a feeling of fullness. These electrical impulses are customized to the needs of each individual patient. The system also collects the output of the food detection and activity sensors which are intended to provide a detailed picture of food consumption and exercise trends. This information can then be downloaded at the physician's office and may be used by patients and their healthcare providers to reinforce healthy behaviors and activities that

lead to weight loss. The abiliti system is an investigational device and is currently in clinical trials.

While the abiliti system delivers some very impressive technology, creating such an intelligent product requires a sophisticated system of sensors, hardware, electronics, and software. Initially, IntraPace used MS Word to manage the requirements. This worked well to define the requirements, but once changes needed to be made, the process of managing the requirements became extremely tedious. It was virtually impossible to determine how many things were affected by a change and exactly which requirements and marketing specifications were impacted. In addition, each requirement must have a test case that needs to be evaluated to see if it is still valid. While this process of tracing requirements in itself was arduous, the requirements management process was further complicated because the integrated nature of the system meant requirements crossed multiple engineering disciplines. In addition to managing complex product requirements, the FDA mandates extensive documentation to document how requirements are met and which test processes validated each requirement. Just generating these compliance reports took two weeks. All of this extra work was taking engineers away from design work. Clearly, a better way was needed to facilitate the requirements management process to enable engineers to focus on what they do best – engineer great products.

IntraPace began looking for a requirements management solution that would minimize the time consuming nature of the requirements management process. Not only did the solution need to be able to manage complex product requirement and support the ability to meet FDA regulations, it was very important that it be easy to use and have a very straightforward user interface. Flexible reporting was also needed. The FDA defines very specific requirements about what must be in compliance reports. Also, the format for the reports needed to be flexible enough so that departments such as Quality Control, got the information they needed in the format they wanted. To address all of this, IntraPace selected Jama Software's Contour.

"Managing the requirements was not a fun thing and we had to make it easier," says Mace Volzing Manager of Software Development at IntraPace. "Contour met all of our needs and made the whole process of managing the requirements throughout the development process easy. It really was a perfect fit."

After selecting Contour, IntraPace was able to bring 30 people on board in just three weeks, proving how easy the product is to use. With Contour, they have found that defining requirements is just as easy as it was when using Word, but now they have the ability to understand the impact of changes and can automate reports. Those reports that used to take two weeks, now take only a day. "Even more important, we now have so much more confidence that all the testing was completed and all the requirements were covered across software and hardware," adds Volzing. They have complete control over what is in their reports so it is very easy to do a gap

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~ Mace Volzing Manager of
Software Development,
IntraPace

analysis and understand which relationships between specifications, requirements, and test cases were broken by a change request. They can now identify those areas quite easily and focus on them rather than waiting until the end of the development process and trying to track down the problems. As a result, the entire development process is accelerated.

“Contour is now the best tool in our arsenal of design tools,” states Volzing.

Key Takeaways

Requirements management is critical to the successful development of today's modern products. To achieve success, companies must be able to:

- Manage product requirements throughout the development lifecycle
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For more information on this or other research topics, please visit www.aberdeen.com.

Related Research

[*System Engineering: Top Four Design Tips to Increase Profit Margins for Mechatronics and Smart Products;*](#)
October 2009

[*Engineering Executive's Strategic Agenda;*](#) June 2008

[*Engineering Evolved: Getting Mechatronics Performance Right the First Time;*](#)
November 2008

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