

Automotive Engineering Change: The Key to Cost Reduction for Competitive Advantage

The automotive industry has seen significant change over the last couple of decades, but looking to the future, there will be even more significant changes. With possibilities for cars that drive themselves and run far more cleanly in the not too distant future, automotive companies will be in a global race to come out on top. Meanwhile, costs must be managed so as not to push car prices to even more unaffordable levels. R&D and engineering are key to making this happen. Adopting Best-in-Class product development practices will help companies improve their efficiency so that they may incorporate more innovation into their vehicles, while still meeting budgets. One of the areas automotive companies struggle with that will help them improve their efficiency is change management. Based on the experiences of 230 respondents, this report identifies best practices for change management to help automotive companies innovate, yet reduce development costs to bring to market the automobiles of the future.

Sector Insight

Aberdeen's Sector Insights provide strategic perspective and analysis of primary research results by industry, market segment, or geography

Product Development Is Key for Cost Cutting

As anyone who has been in the market for a new car knows, cars have gotten very expensive. In the US, after insurance and taxes, a person can expect to pay \$30,500 for a new car. When that is contrasted with the median household income of \$51,000, it is easy to see the dilemma automotive companies are in. New cars, once considered a symbol of a successful middle class, have become unaffordable for the vast majority. However, given the bankruptcies in the automotive industry in 2009, it is clear automotive companies are not rolling in profits. So why are cars so expensive?

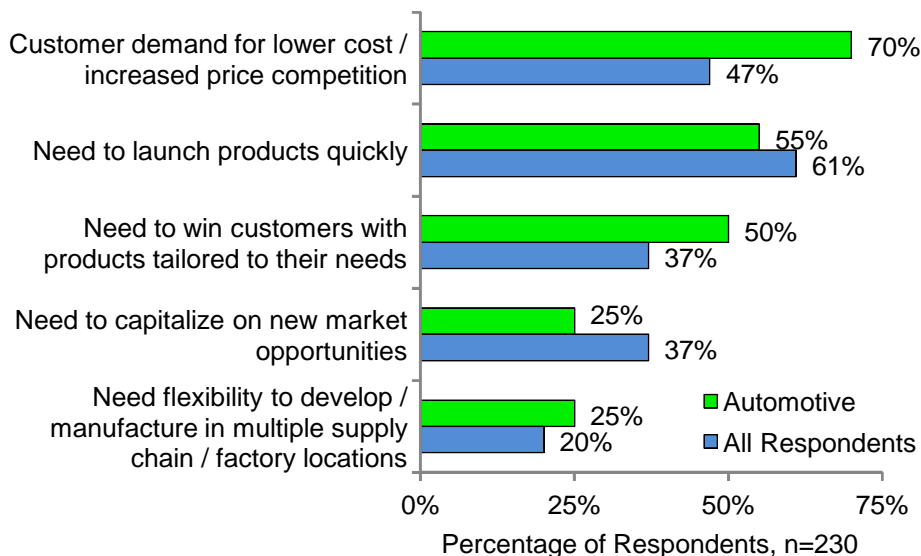
Global competition, regulations, and customer preferences have driven much innovation within the automobile industry. As a result, our cars are safer, more dependable, and more fuel efficient than ever before. However, developing all of this innovation requires significant engineering effort. New cars now have a mind boggling amount of software. In fact, Ford Motor Company considers itself as much a software company as an automobile manufacturer. The new Ford Fusion has 16 million lines of code, but some higher end cars can go all the way up to a 100 million lines of software code. To put this in perspective, the space shuttle had 400,000 lines of code. Video games can be about 3 million lines of code and Windows Vista is estimated to be about 50 million. Add to that the hundreds of thousands of components including 70 microprocessors connected to hundreds of sensors and actuators, and we can see how automobiles have evolved into some of the most sophisticated engineered products available.

As a result, designing automobiles requires teams of engineers across multiple disciplines — including mechanical, electrical, and software. There also must be engineers who specialize in the vehicle's comfort and driving experience — noise, vibration, harshness, etc. There are also teams working on the chassis and body, suspension, drivetrain, control systems, and other major subsystems that all must interact seamlessly. Then add the infotainment system, which has become increasingly important to today's buyer.

Further aggravating the situation, cars sold today are expected to last at least 10 years, if not 15. There is so much competition that new cars brought to market that do not meet these criteria will fail. When considering all of this, the price tag of a new car suddenly becomes understandable. However, it also emphasizes how critical the engineering and development process is for automotive companies. Today's car represents thousands of hours of research, design, engineering, and testing. Those companies who invest in their product development process will increase their opportunities to take cost out of the vehicle, making them more affordable and therefore more competitive.

With this in mind, it makes sense that when automotive companies are asked about the business pressures driving improvements into their product development process, they are 49% more likely than other industries to indicate that cost is the top pressure driving them to change how products are developed (Figure 1). Other top pressures, such as need for development efficiency and offerings tailored to customer needs, were also top focuses for other companies.

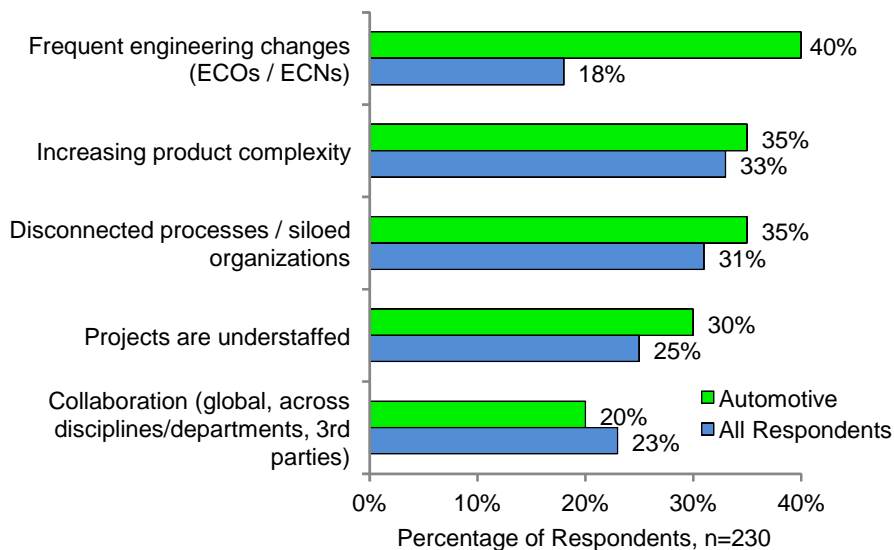
Figure 1: Top Pressures Driving Improved Product Development



Source: Aberdeen Group, April 2012

As automotive companies seek to remove cost, improve efficiencies, align to customer preferences (often needing to predict what customers will want three to five years into the future), take advantage of new opportunities, and adapt to supply chain fluctuations, they must consider the challenges that make the development process difficult (Figure 2).

Figure 2: Top Product Development Challenges



Source: Aberdeen Group, April 2012

Given how complex today's cars are, it is impossible to plan everything perfectly from the very outset. The complexity makes it very difficult to predict performance. In addition, the length of the development cycle means markets will change, new technologies become available, gas prices fluctuate, and new regulations are passed. All of these things mean there will inevitably be changes. The complexity of the vehicle makes it that much harder to understand the impact of a change or implement the change without impacting other parts of the car. As a result, automotive companies are 2.2 times more likely than other industries to rate frequent changes as a top challenge (Figure 2). As difficult as it is now, looking forward, change will become even more critical. With new fuel efficiency regulations in the US requiring an [average fuel economy of 54.5 mpg in 2025](#) and [tighter European emission standards by 2020](#), automotive companies will need to drastically redesign the car. All this redesign will mean even more changes. The investments will be significant, so managing the development process, especially the change process, will continue to be critical to keep costs manageable.

Engineering changes represent a considerable cost contributor, as they take engineers away from new work, slowing down the process. In addition, the later the change, the more difficult it is to implement because more of the design is locked down. This means there are fewer options available to implement the change, and typically, the solution will be whatever has the

least impact on schedules, even if it is not the most cost effective solution. Inefficient change processes mean engineers and suppliers waste efforts working on outdated CAD models and other engineering information. All of this causes delays and drives up cost. This means investment in the change process is a way to take cost out of the vehicle.

Maturity Class Framework

To understand the steps with the greatest immediate impact on product development success, Aberdeen benchmarked the performance of study participants using metrics indicating design efficiency and revenue generation. Aberdeen categorized participants as Best-in-Class (top 20% of performers), Industry Average (mid 50%), or Laggard (bottom 30%).

Table I summarizes the aggregate performance these companies and automotive companies.

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

Definition of Maturity Class	Mean Class Performance	Automotive
Best-in-Class: Top 20% of aggregate performance scorers	<ul style="list-style-type: none"> 88% of product launch dates met 84% of product revenue targets met 85% of product cost targets met 86% of product quality targets met 22% reduction in development time 	<ul style="list-style-type: none"> 74% of product launch dates met 76% of product revenue targets met 71% of product cost targets met 76% of quality targets met 11% reduction in development time
Industry Average: Middle 50% of aggregate performance scorers	<ul style="list-style-type: none"> 68% of product launch dates met 67% of product revenue targets met 71% of product cost targets met 75% of product quality targets met 11% reduction in development time 	
Laggard: Bottom 30% of aggregate performance scorers	<ul style="list-style-type: none"> 42% of product launch dates met 46% of product revenue targets met 46% of product cost targets met 59% of product quality targets met 1% reduction in development time 	

Source: Aberdeen Group, August 2012

Automotive companies generally report as good or better performance than Industry Average performers. However, given the complexity of automobiles and the supply chain, they need to be. Of particular interest for automotive companies is the ability of the Best-in-Class to meet cost targets without sacrificing quality or schedules. By learning from the Best-in-Class, automotive companies can adopt the same practices to improve their own process, enabling them to be more successful in this fiercely competitive industry.

Given the cost pressures faced by the automotive industry, combined with the challenges of engineering change, this report will focus on the change management practices that the Best-in-Class are more likely to adopt than their lesser performing peers.

Best Practices in Change Management

Best-in-Class performers employ several stand-out capabilities that are not adopted by automotive companies. The Best-in-Class take a four-pronged approach with change management supported by technology:

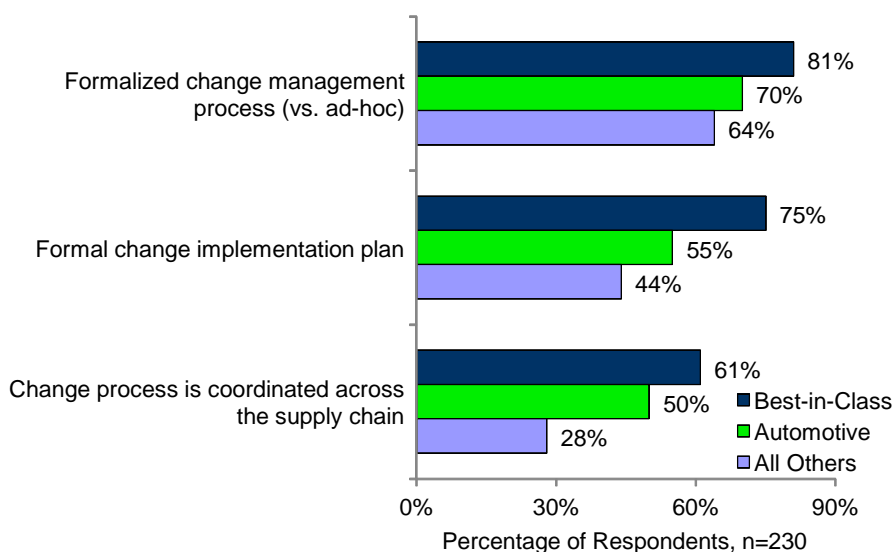
- Change processes
- Supporting change decisions
- Continuous improvement
- Technology enablers

Through the adoption of this framework, Best-in-Class enjoy a competitive advantage. Instead of driving up costs, their change management practices enable them to adapt to changes without slowing down, sacrificing quality, or blowing budgets.

Change Processes

Figure 3 shows the change processes Best-in-Class companies are more likely to adopt than their competitors.

Figure 3: Best-in-Class Change Management Processes



Source: Aberdeen Group, April 2012

Given the complexity of today's automobile and the supply chain, a formal change management process is needed. This defines such things as the workflow, who's involved, and the approval process. With such large,

Best-in-Class Benefits

In addition to the performance gains defining the Best-in-Class, Aberdeen's research revealed that these leaders have experienced the following improvements related to time to market:

- ✓ **18% reduction** in overall product cost since implementing current product development system
- ✓ **81% of product development budgets** met
- ✓ **81% of lifecycle costs** met
- ✓ **10% reduction** in time to execute a change order
- ✓ **15% reduction** in change orders after release to manufacturing

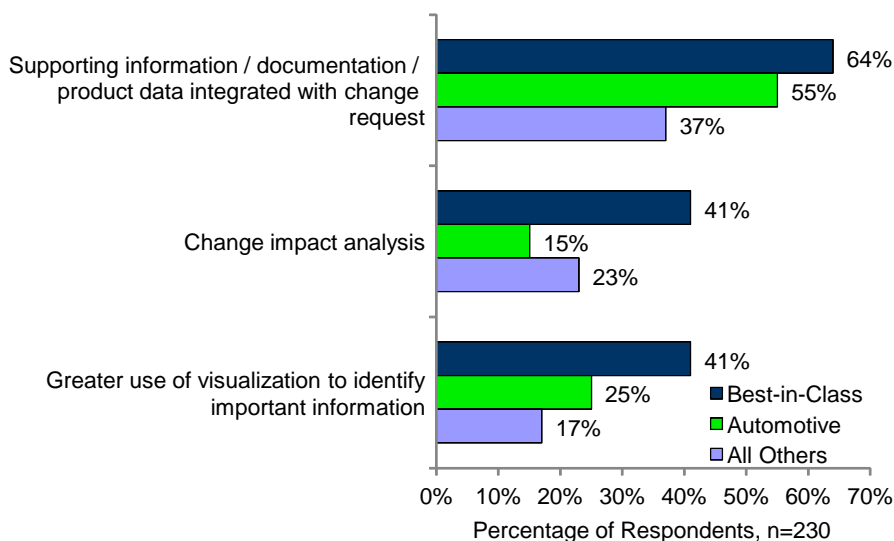
disparate teams and hundreds of thousands of components, the formal process provides a guideline so that the right decisions are made about whether to approve a change and then that it is properly communicated. Without this, it would be too easy for things to slip through the cracks. However, while formalized change management processes constitute a core Best-in-Class practice, it is only a first step.

There is also a formal implementation plan for the change and, especially critical for the automotive industry, that change is coordinated across the supply chain. This makes sure all those who are impacted by a change are made aware. When this doesn't happen, there is risk suppliers may be working on outdated CAD files that will need to be done, driving up costs and adding time. These processes contribute to the Best-in-Class's ability to meet 88% of their launch dates. Because a consistent process is followed they are more efficient with their changes and therefore are better positioned to avoid unexpected delays.

Supporting Change Decisions

Going hand in hand with process, it is also critical to ensure the right decisions are made about changes (Figure 4).

Figure 4: Best-in-Class Practices to Support Decisions



Source: Aberdeen Group, April 2012

“With the higher level of data integration in PLM there are efficiencies gained with faster and better access to highly relevant data for other projects and maintaining existing ones.”

~ Engineering manager,
Automotive Supplier

While having a process in place is important, ensuring the right decisions are made about the change is critical to meeting business targets. The Best-in-Class accomplish this with several capabilities. They incorporate all supporting information within the change request, including CAD files, BOMs, and requirements, which helps to assess the impact of the change. Visualization tools further help by providing a visual method for filtering design information so that the change's impact can be easily understood at a glance. All of these capabilities enable the Best-in-Class to assess a change,

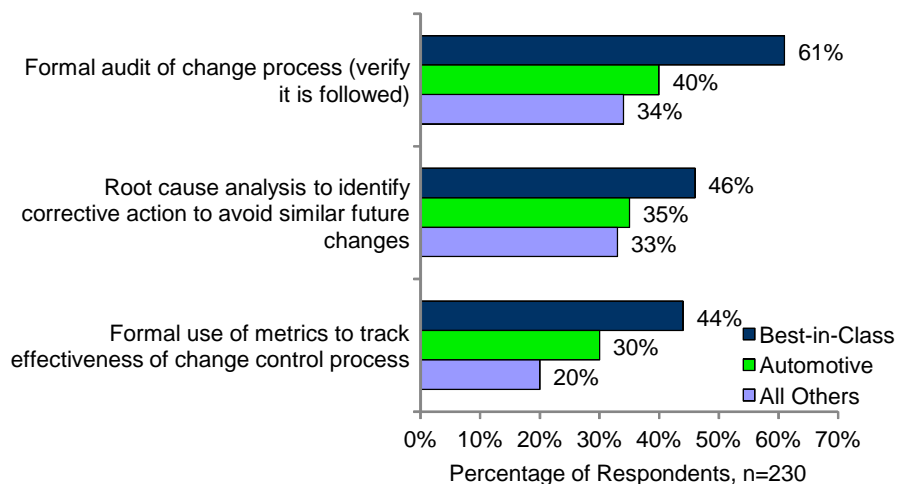
understand the implications of implementing it, and decide the best course of action. These capabilities improve the change decision process, helping Best-in-Class companies meet 85% of cost targets.

The later in the development process, the more expensive it is to make changes. This is because if the design is further along, more components will be impacted. The more components that must be changed, the more time it takes, which can cause delays and drive up costs. The Best-in-Class better understand the impact and therefore the cost, and can then make better decisions about when to approve a change and then how to implement it.

Continuous Improvement

While the Best-in-Class have practices in place to manage the change process and support decision making, they do not stop there. Ever looking to stay on top, they have several capabilities to help them continuously improve (Figure 5).

Figure 5: Best-in-Class Methods for Continual Improvement



Source: Aberdeen Group, April 2012

Having established standard practices for change management, the Best-in-Class then audit the process to ensure it is followed. This helps to ensure compliance to the process, but when it is not followed, they have visibility to it. They can then investigate why and take corrective action. This could involve better training for employees or updating standard processes to accommodate situations that need to be treated differently. Combined with metrics to track the effectiveness of their procedures, the Best-in-Class can ensure they continually evolve to improve and minimize bottlenecks in order to keep the change process efficient and effective.

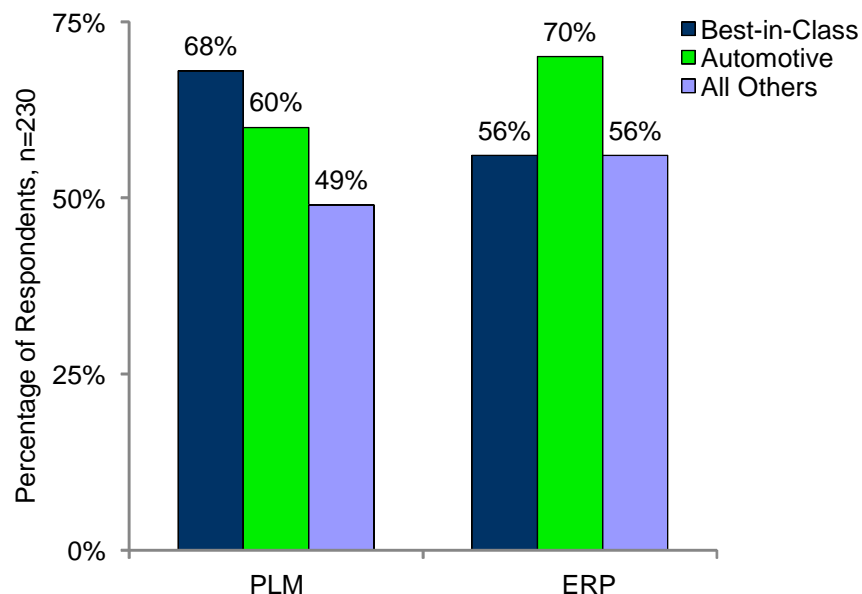
The Best-in-Class also use the change process as a way to improve their development processes. When a change happens because of a design error or misunderstanding the requirements, they examine the reasons why and

use that to improve. For example, for clarity, perhaps updates are needed to standardize how requirements are defined. Another example could be updating simulation models and tests to look for similar problems in the future. Maybe design standards require tighter tolerances when a hole is at a given diameter. The result of this is better quality from the start, which helps the Best-in-Class meet 86% of their quality targets.

Technology Enablers

To support and enable these capabilities, the Best-in-Class also use technology. Given the complexity and amount of data involved with a car, Figure 6 shows enterprise solutions that the Best-in-Class use.

Figure 6: Technologies Best-in-Class Use to Manage Product Development Processes and Data



Source: Aberdeen Group, April 2012

It is interesting to note that ERP is used by many to manage product development information and 70% of automotive companies use it. However, Best-in-Class companies as well as their lesser performing competitors are equally likely to use it. So while it is a very common and, in many cases, critical tool, it is not a Best-in-Class differentiator. Where there is differentiation is with Product Lifecycle Management (PLM) solutions. Best-in-Class companies are 39% more likely than their competitors to use it. PLM and ERP often play complementary roles, which are discussed in Aberdeen's April 2012 report, [*Product Development Single Source of Truth: Integrating PLM and ERP*](#), especially when integrated together. PLM tends to be better suited for managing the complex engineering data and processes while ERP owns much of the business data.

PLM Definition

Product Lifecycle Management (PLM) is the methodology for managing the product development processes and associated data from product concept through end of life. PLM tools are the technology solutions that support various stages of the methodology.

ERP Definition

Enterprise Resource Planning (ERP) software is designed to be the system of record for operating and managing a business. It is typically the transaction engine for an enterprise and is used to maintain business processes in areas such as account payable/receivable, order management, material planning, etc.

Aberdeen's October 2012 report, [*Engineering Change Management: Avoiding Bottlenecks for Competitive Advantage*](#), explores some of the benefits that Best-in-Class companies realize by using PLM to support engineering change. However, PLM is a very broad solution, without always a consistent definition across companies. Table 2 shows the top capabilities that automotive companies report must be part of a PLM solution.

Table 2: Top PLM Capabilities Automotive Companies Value

PLM Capabilities	Automotive Companies
Product data management (PDM)	90%
BOM management	85%
Requirements management	85%
Project / program management	80%
Change management	80%
Workflow management	80%

"Integrating PLM with our other enterprise systems tied in CAD PDM with BOM management to eliminate data entry redundancy and errors."

~ Engineering manager,
Automotive Supplier

Source: Aberdeen Group, April 2012

Automotive companies exploring PLM solutions should focus on these capabilities. Given the challenges of change management, automotive companies can benefit from having all the product data, including CAD and analysis files, BOM and requirements, across their programs, together. Using PLM, it will be easier to understand dependencies across components and subsystems as well as the impact on requirements when a change is made. Workflow management automates required change notifications. Engineers or even third party suppliers are notified of changes impacting them with links to the respective files. This improves collaboration on a change and makes it easier to manage the implementation of that change, saving time and reducing cost.

Key Takeaways

Automotive companies struggle with the rising costs of new automobiles. This leaves them scrambling to find ways to reduce product costs. Aberdeen's research indicates that engineering change represents a critical development challenge for automotive manufacturers and a major cost contributor.

By adopting a Best-in-Class approach to change management, automotive companies will reduce development costs and ultimately allow them to profitably offer cars at an attainable price point. Best-in-Class approaches to change include:

- Standard processes including implementation plans as well as coordination with suppliers
- Support for better change management decisions

- Continuous improvement practices to evolve the change process as well as improve future cars
- Technology such as a PLM solution to support and automate the change process

For more information on this or other research topics, please visit www.aberdeen.com.

Related Research

[*Keeping Automotive Competitive with Embedded Systems*](#); August 2013

[*Engineering Change Management: Avoiding Bottlenecks for Competitive Advantage*](#); October 2012

[*Making Better Product Development Decisions with Analytics*](#); April 2012

[*ERP for Automotive Suppliers 2012: A Roadmap to Being a Leader*](#); August 2012

[*Product Development Single Source of Truth: Integrating PLM and ERP*](#); April 2012

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