PERFORCE + Automotive iQ

2021 State of Automotive Software Development Survey Results

2021 State of Automotive Software Development

Introduction

Welcome to the 2021 State of Automotive Software Development.

We're excited to bring you the results of the 2021 State of Automotive Software Development Survey.

This year, we surveyed over 600 professionals working in the automotive industry. They shared their top concerns in automotive software development today. And they shed some light on the impact of new trends (connected/autonomous vehicle development) and longstanding requirements (ISO 26262 compliance).

We hope this information will help your development team innovate faster and improve quality — while maintaining compliance for safety and security.

Thank you to everyone who participated in the survey!

Tim Russell
Chief Product Officer, Perforce

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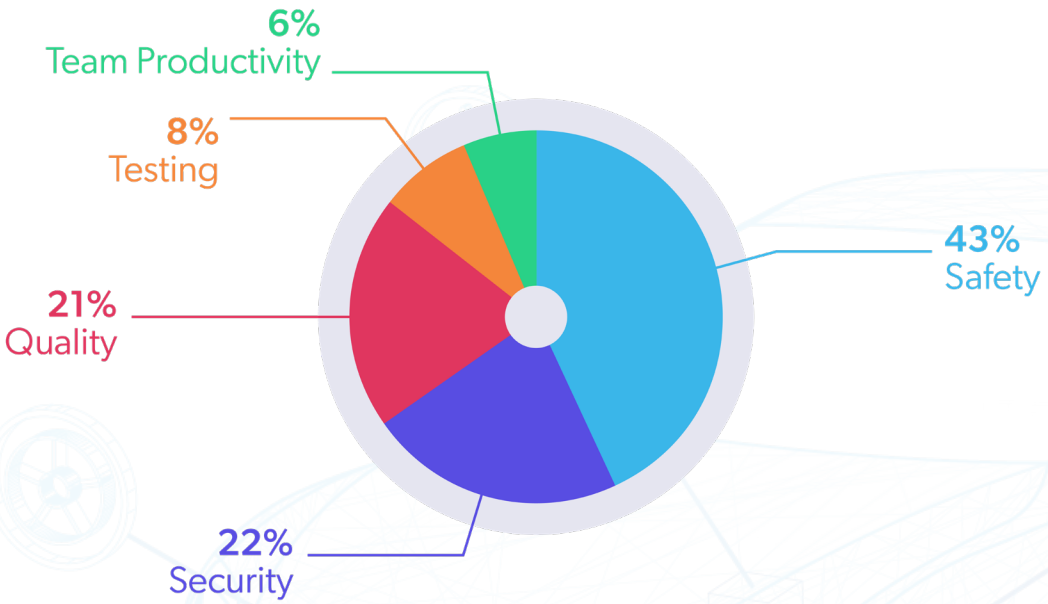
What Is Keeping Automotive Software Developers Up at Night?

Software — now more than ever — drives automotive development.

Which means that the teams who are building that software have plenty to be concerned about.

Here are the top concerns from the software development professionals we surveyed:

WHAT IS YOUR BIGGEST CONCERN IN AUTOMOTIVE SOFTWARE AND TECHNOLOGY DEVELOPMENT TODAY?



#1 Concern: Safety

43% of those we surveyed cited safety as their top concern in automotive software development. This does not come as a surprise as more software and technology is added, the more it becomes essential that vehicles — no matter how they are powered or the level of autonomous driving — remain safe and reliable.

In addition, the number of automotive software recalls have steadily risen over the past several years. This makes it vital that the safety of automotive software can be guaranteed before the vehicle's rollout.

The biggest safety concern is focused on how customers are expected to comply with a safe coding standard — such as MISRA (cited by 40% of those concerned with safety). MISRA is a set of coding standards used in the development of safety-critical systems, and has become a cornerstone of automotive development.

Other teams expressed concerns with how difficult (and time-consuming) it is to fulfill every ISO 26262 requirement (38%) and that they were struggling to ensure safety across their supply chain (11%). The smallest group expressed concerns about how tool qualification for compliance takes too long.

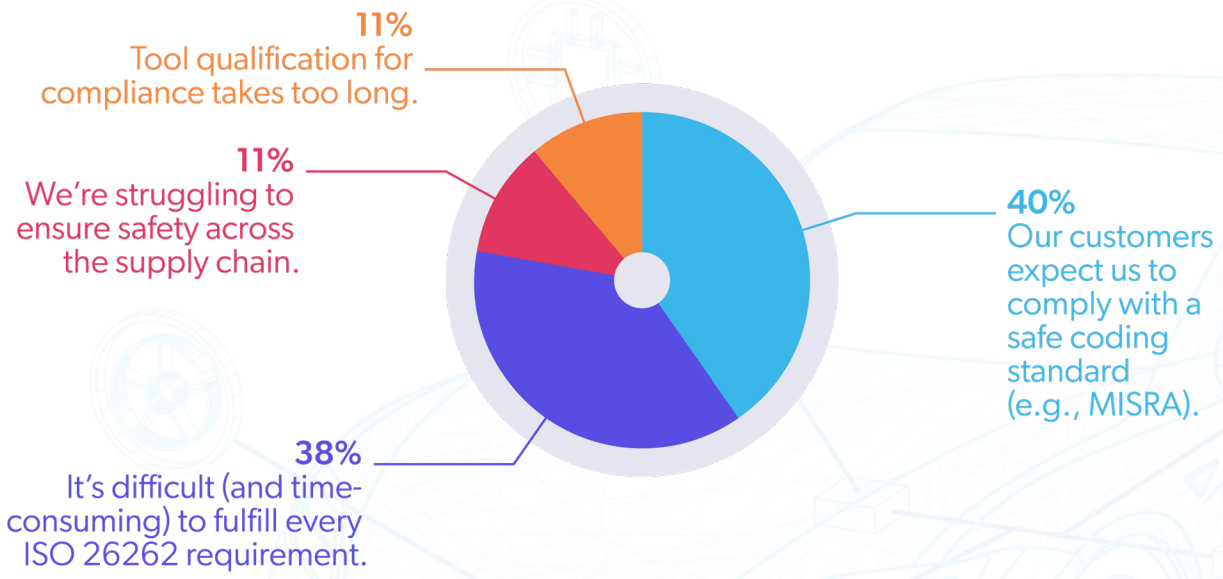
Many of these concerns can be effectively addressed by using certified software development tools — such as static code analysis — to accelerate compliance process.

RESOURCE

Guide to MISRA Compliance:2020

How to Accelerate ISO 26262 Compliance

WHICH BEST DESCRIBES YOUR SAFETY CONCERNS?



#2 Concern: Security

22% of those that we surveyed cited security as their top concern in automotive software development. As more software comes onboard a vehicle, there is a greater risk that hackers could infiltrate onboard/offboard systems. In fact, the number of cyberattacks on connected automobiles have increased by 99% from 2019 to 2020.

The most common security concern by far was the unauthorized access onboard/offboard systems (cited by 46% of those concerned with security.)

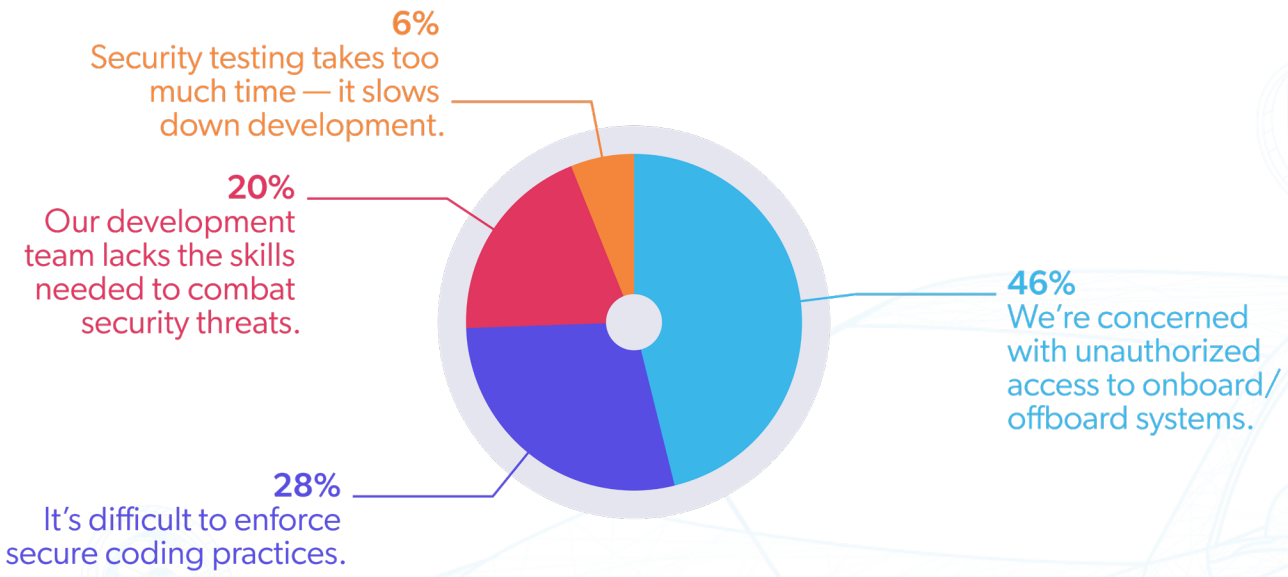
Other teams expressed concerns with enforcing secure coding practices (28%) and lacking the skills needed to combat security threats (20%). Some also noted that security testing takes too long and it slows down development (6%).

By using the right AST (Application Security Testing) tool — such as SAST — you are able to find/detect and remediate software security vulnerabilities that allow hackers to access the system, as well as enforce secure coding practices.

RESOURCE

Secure Coding Standards Overview

WHICH BEST DESCRIBES YOUR SECURITY CONCERNS?



#3 Concern: Quality

Quality is the top concern for 21% of those we surveyed. Customers expect their vehicle to be high quality and feature the maximum amount of functionality and connectivity. With the growing demand for electric and autonomous vehicles, this puts development teams under pressure to deliver innovative technology in shortened development cycles.

However, quality should never come at the expense of speed as the number of software-based electronic defects have been steadily rising over the past several years. In fact, 2019 set a record for software-based electronic defects.

33% of those we surveyed cited that the difficulties of enforcing coding best practices were their leading concern. The second most common concern was that their testing efforts are not exhaustive enough and that they do not have more time for further tests (30%).

Other teams expressed concerns with the complexity of their codebase (25%) and that their peer code reviews were inconsistent (12%).

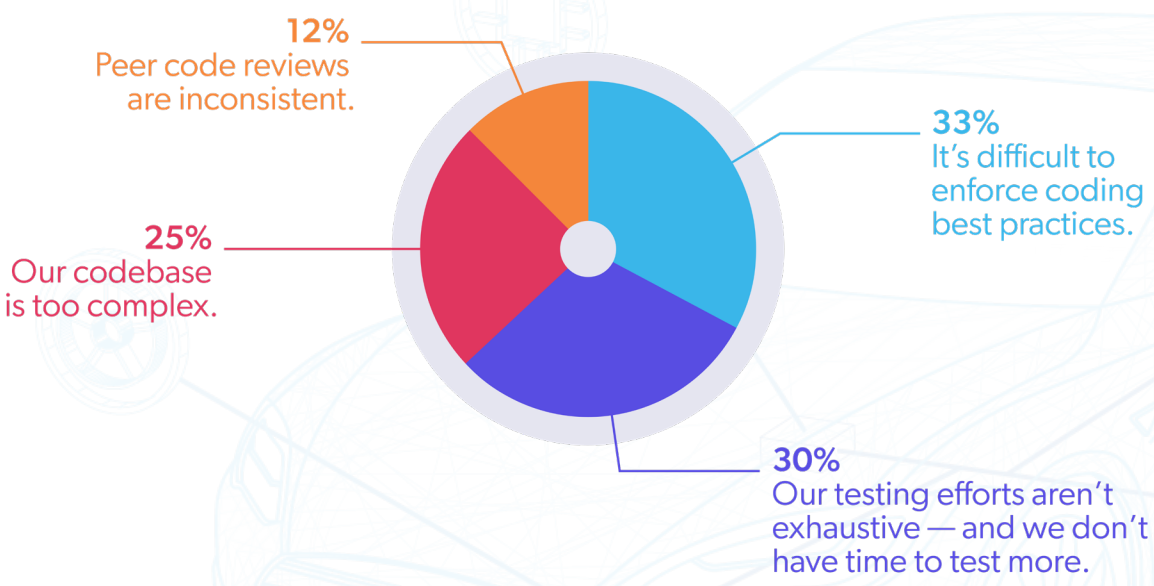
An important step to improving software quality is being able to accurately measure it. While there's no one way to measure code quality, using a static code analysis tool is one of the most effective practices.

RESOURCE

How to Optimize and Measure Automotive Software Quality Metrics

How to Measure and Improve Code Quality

WHICH BEST DESCRIBES YOUR QUALITY CONCERNS?



#4 Concern: Testing

8% of those we surveyed are most concerned about testing. The leading concern for those surveyed cited that they were struggling to test efficiently — specifically that testing and software validation were time-consuming (the top cause of concern for 45% of those concerned about testing).

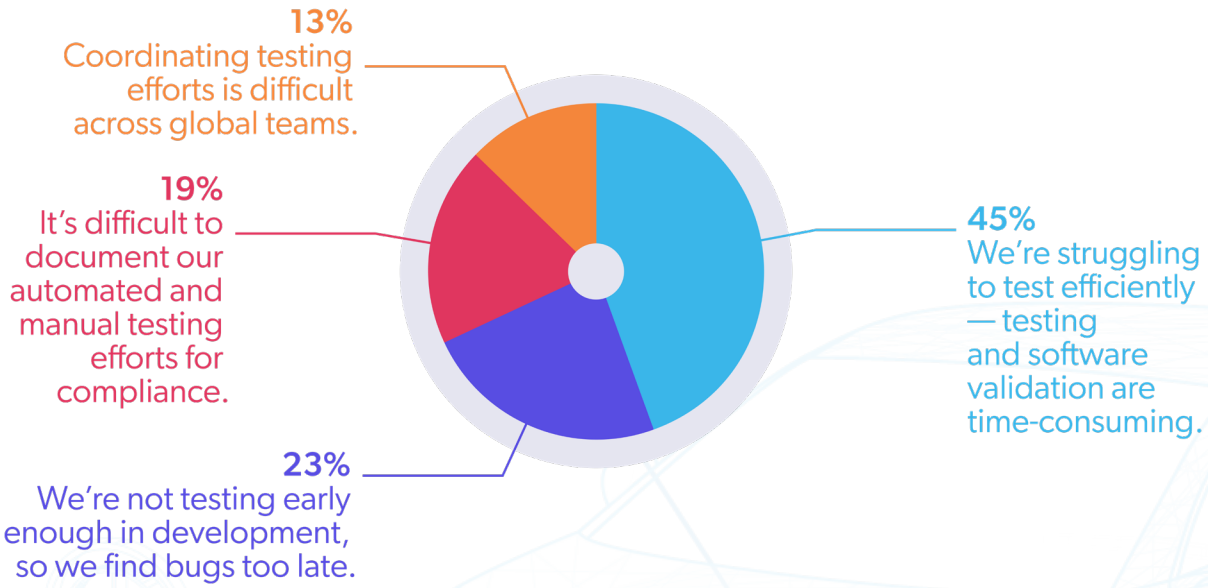
As the testing process is time-consuming, it often does not happen early enough in development, so bugs are found too late (23%). It is difficult to document automated and manual testing efforts (19%), as well as coordinate efforts across teams (13%).

Using the right software development tool — such as test case management — can help you better manage your testing process.

RESOURCE

Key Software Testing Methods

WHICH BEST DESCRIBES YOUR TESTING CONCERNS?



#5 Concern: Team Productivity

6% of those surveyed are most concerned about team productivity. The top concern for those surveyed is managing the lack of integration or alignment between disparate teams in parallel development (58%). Managing design and IP assets across hardware and software teams as well as facilitate reuse (19% of those concerned with team productivity). Waiting for testing to be complete because QA cycles are long was also the concern of 19% of those surveyed. The smallest group's leading concern was having to extend release cycles due to merge conflicts and broken builds (3%).

Using the right version control tool can help you improve productivity across teams. In addition, you can use it to manage and share digital assets across teams — while securing IP.

RESOURCE

How Version Control Helps Manage Assets and IP

WHICH BEST DESCRIBES YOUR TEAM PRODUCTIVITY CONCERNS?

How Much Are Developers Really Affected by Electric and Autonomous Vehicles?

Electric Vehicles are Becoming the Norm

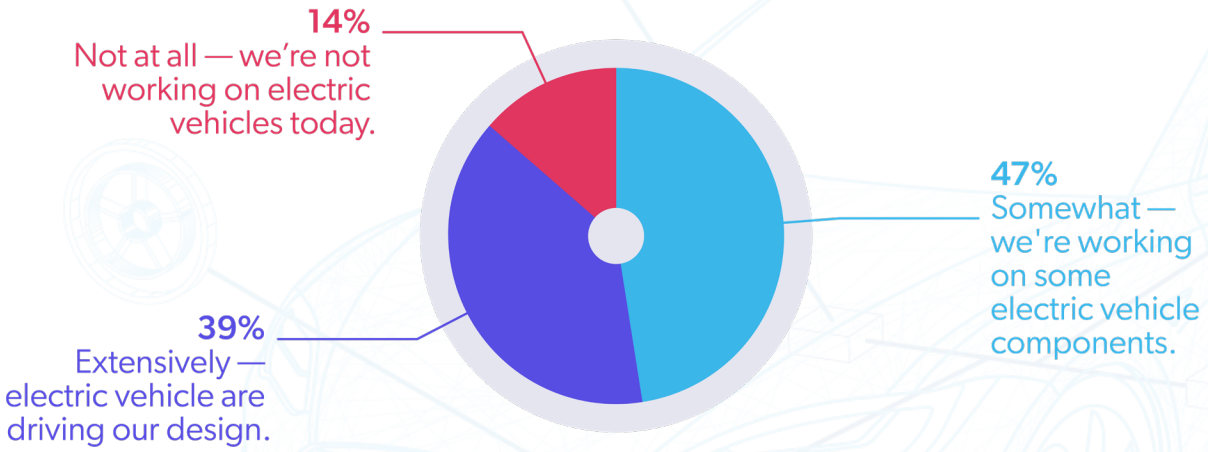
The electric market has been steadily growing over the past several years and it is poised to markedly increase in the near future.

Of those surveyed:

- 47% are working on some electric vehicle components.
- 39% are working extensively on electric vehicle components.

Surprisingly, 14% responded that they are not working on electric vehicles at all. However, this is likely to change in the next 5-to-10 years. By 2025, it is expected that 20% of all new cars sold globally will be electric, 40% by 2030, and nearly 100% by 2040.

TO WHAT DEGREE HAS ELECTRIC VEHICLE DEVELOPMENT IMPACTED YOUR PRODUCT DESIGN?

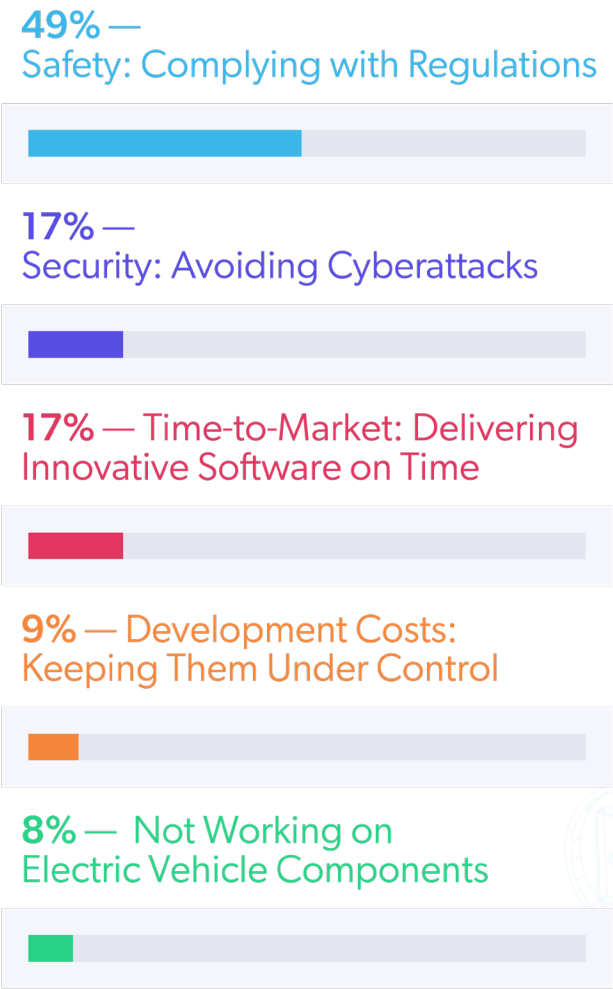


Concerns About Electric Vehicle Development

The automotive software development professionals that we surveyed have some concerns about electric vehicle development.

Complying with regulations to ensure safety was the top concern of 49% of those we surveyed. This is followed by 17% who are concerned with security and avoiding cyberattacks, and 17% are worried about delivering innovative software on time. Only 9% cited that their top concern was keeping development costs under control.

LEADING ELECTRIC VEHICLE DEVELOPMENT CONCERN



Connected Vehicles Continue to Grow

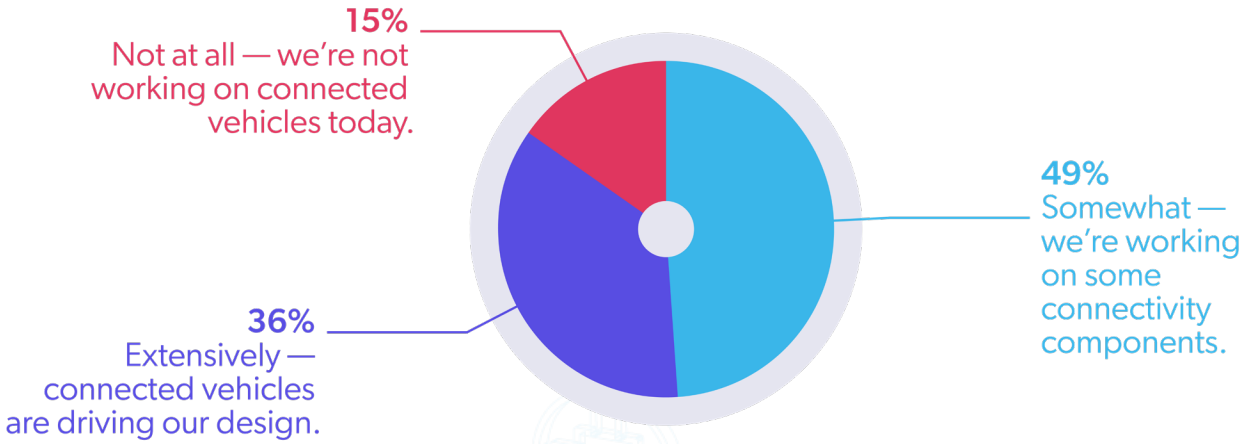
Within the last few years, there has been a great increase in connectivity in vehicles — such as Wi-Fi and Bluetooth. In fact, the global automotive industry estimates that it will release more than 76 million connected cars by the end of 2023. However, connectivity components are not currently a focus for every team.

Many of those who responded to the survey are working on connectivity components:

- 49% are working on some connectivity components.
- 36% are focused on designing connected vehicles.

Only 15% are not working on connected components today. As connectivity in vehicles grow, this is likely to decrease.

TO WHAT DEGREE HAVE CONNECTED VEHICLES IMPACTED YOUR PRODUCT DESIGN?



Autonomous Vehicles Are (Still) Coming

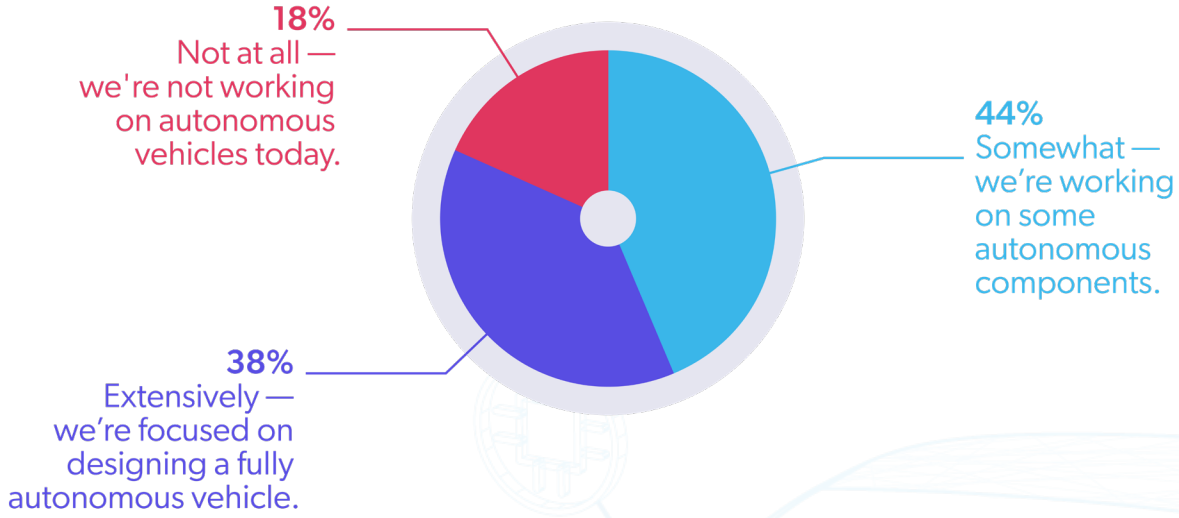
While there have been advancements in the development of autonomous vehicles over the past few years, fully autonomous vehicles are not yet in the mainstream. This is expected to change as an estimated 33 million autonomous vehicles are expected to be on the road by 2040.

Many of those who responded to the survey are working on autonomous components.

- 44% are working on some autonomous components.
- 38% are focused on designing a fully autonomous vehicle.

That leaves 18% who are not working on autonomous components today. This is also likely to decrease as autonomous vehicles become more mainstream.

TO WHAT DEGREE HAVE AUTONOMOUS VEHICLES IMPACTED YOUR PRODUCT DESIGN?

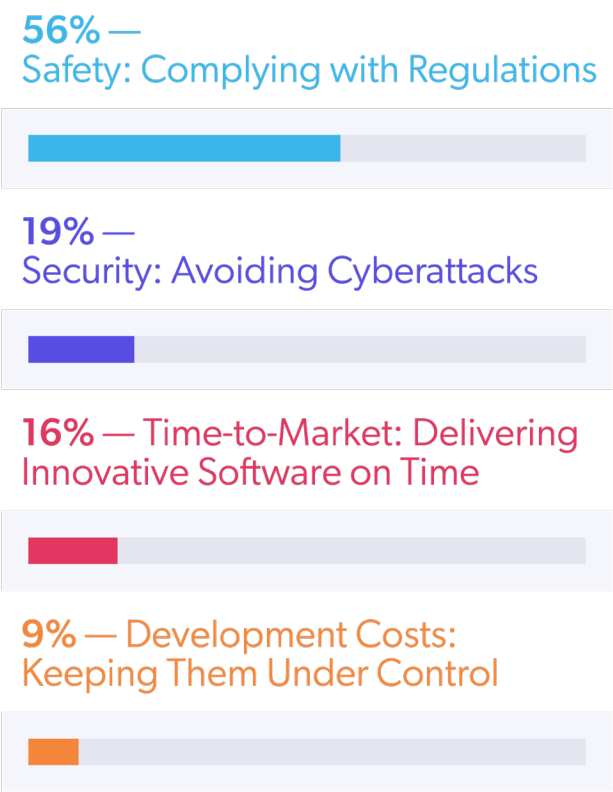


Concerns About Connected/Autonomous Vehicles

The development professionals we surveyed have some concerns about the development of connected and autonomous vehicles.

The top concern for the software development professionals we surveyed is safety (56%). This is followed by 19% whose top concern is about security and avoiding cyberattacks, and the top concern for 16% is delivering innovative software on time. Only 9% named keeping development costs under control as their top concern.

LEADING CONNECTED/AUTONOMOUS VEHICLE DEVELOPING CONCERN



AI and Machine Learning Deliver Advantages

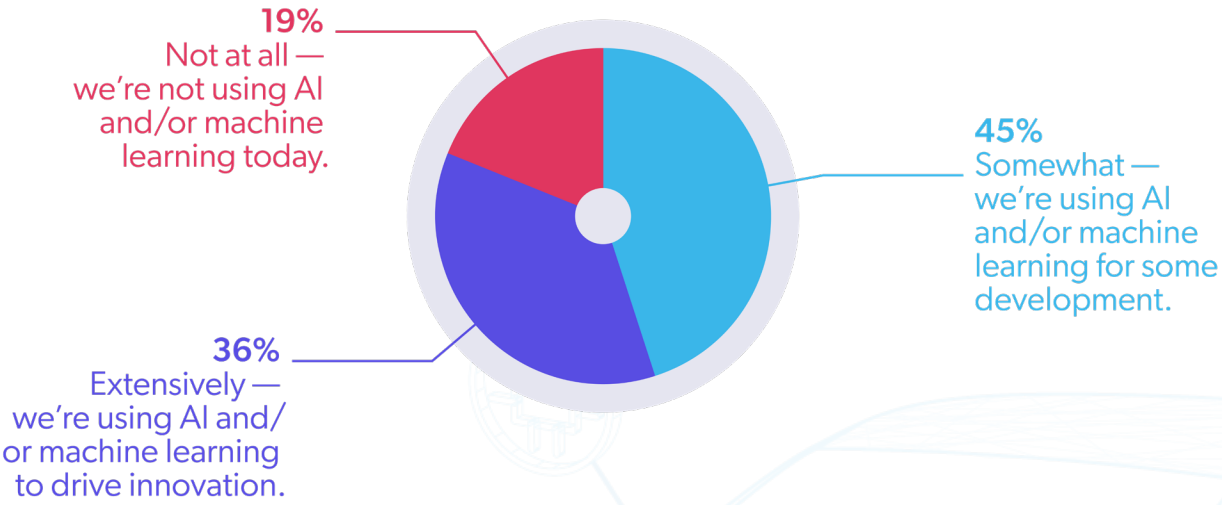
AI and machine learning deliver advantages to development teams. Leveraging AI and machine learning has the potential to transform the industry.

Most of those we surveyed said AI and machine learning are impacting product design:

- 45% are using AI and/or machine learning for some development.
- 36% are using AI and/or machine learning extensively to drive innovation in development.

19%, however, are not using AI or machine learning today. However, as demand continues to rise for enhanced user experience and convenience features, that number may decrease.

TO WHAT DEGREE HAVE AI AND/OR MACHINE LEARNING IMPACTED YOUR PRODUCT DESIGN?



Why Standards-Compliant Software Remains Vital

The Automotive Industry is Highly Regulated

Complying with those regulations is paramount for many reasons, including maintaining a strong reputation among consumers and avoiding a costly recall.

Common automotive standards include both functional safety and coding standards.

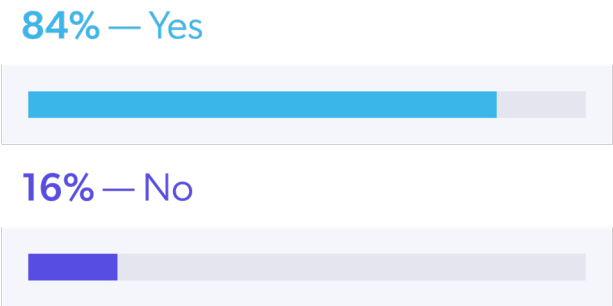
ISO 26262 Remains Important

ISO 26262 has been a key functional safety standard for the automotive industry for around a decade. A majority of those we surveyed — 84% — are required to comply with ISO 26262.

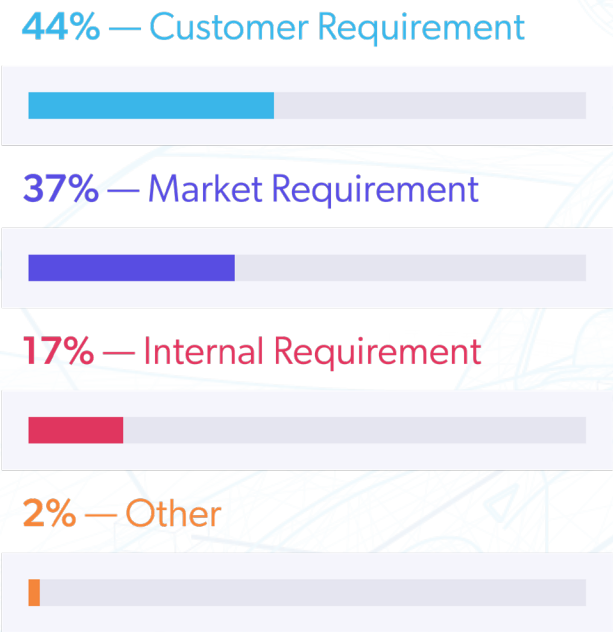
For those who need to comply with ISO 26262:

- 44% need to comply due to a customer requirement.
- 37% need to comply due to a market requirement.
- 17% have an internal requirement.

ARE YOU REQUIRED TO COMPLY WITH ISO 26262?



WHY DO YOU NEED TO COMPLY WITH ISO 26262?



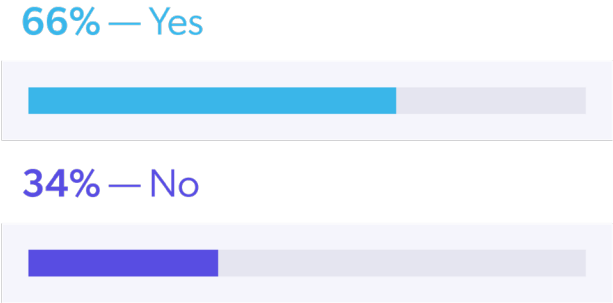
SOTIF (ISO 21448) Has Become Important

SOTIF (ISO 21448) was developed to address the additional safety challenges that autonomous (and semi-autonomous) vehicle software developers were attempting to manage. A majority of those we surveyed — 66% — stated that SOTIF (ISO 21448) is a part of their software development process.

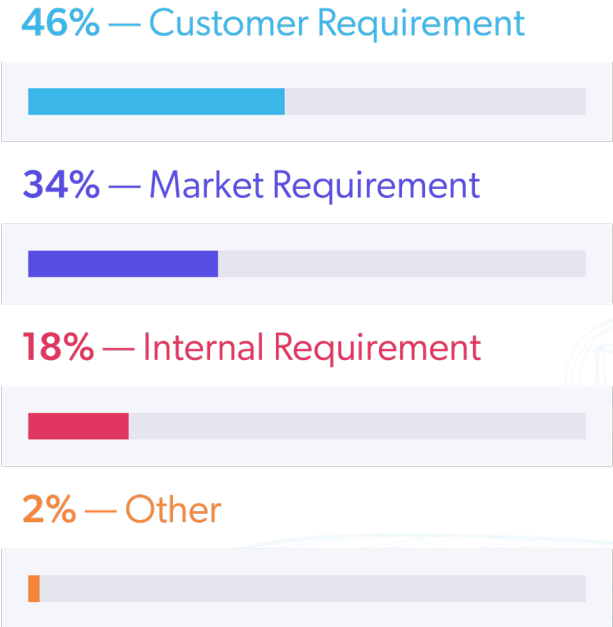
For those who need to comply with SOTIF (ISO 21448):

- 46% need to comply due to a customer requirement.
- 34% need to comply due to a market requirement.
- 18% have an internal requirement.

IS SOTIF (ISO 21448) PART OF YOUR PROCESS?



WHY DO YOU NEED TO COMPLY WITH SOTIF (ISO 21448)?



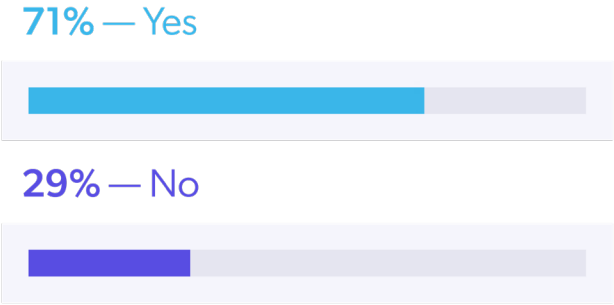
ISO 21434 Will Be Essential

ISO 21434 is a forthcoming automotive standard that focuses on the cybersecurity risk in road vehicle electronic systems. Even though it has not come into force yet, 71% will be required to comply with ISO 21434.

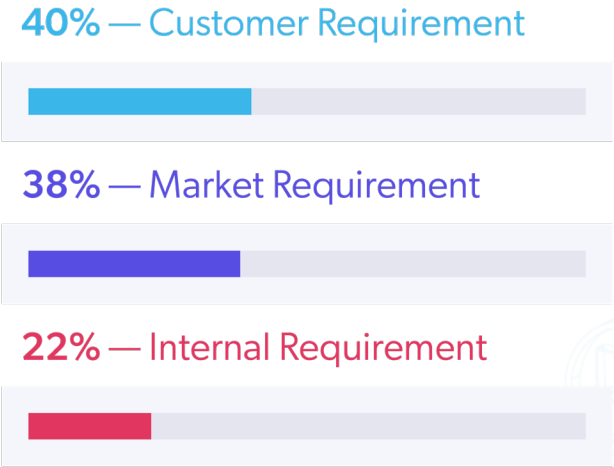
For those who will need to comply with ISO 21434:

- 40% need to comply due to a customer requirement.
- 38% need to comply due to a market requirement.
- 22% have an internal requirement.

WILL YOU BE REQUIRED TO COMPLY WITH ISO 21434?



WHY DO YOU NEED TO COMPLY WITH ISO 21434?



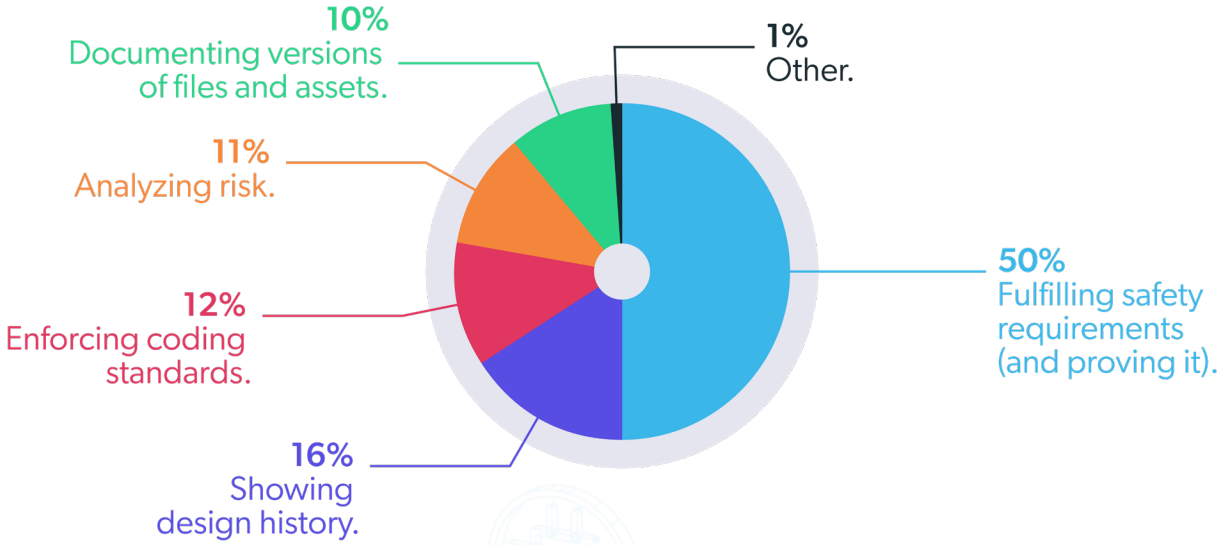
What They Struggle to Prove

Proving compliance with automotive standards — such as ISO 26262 — can be a challenge.

Most of those surveyed (50%) struggle to fulfill safety requirements — and prove that those requirements have been fulfilled.

Others struggle with showing design history (16%). While others struggled with enforcing coding standards (12%), analyzing risk (11%), and documenting versions of files and assets (10%).

WHAT IS YOUR BIGGEST CHALLENGE IN PROVING COMPLIANCE?



Most Use Coding Standards

88% of those surveyed are using a coding standard. The use of a coding standard is important for ensuring safe, secure, and reliable code. It is highly recommended and, for some software developers, a customer requirement.

Which Coding Standards Do They Use?

Many teams are using multiple coding standards.

Most of those surveyed (47%) use MISRA© — followed by 39% who use AUTOSAR.

Some of those surveyed use the following standards:

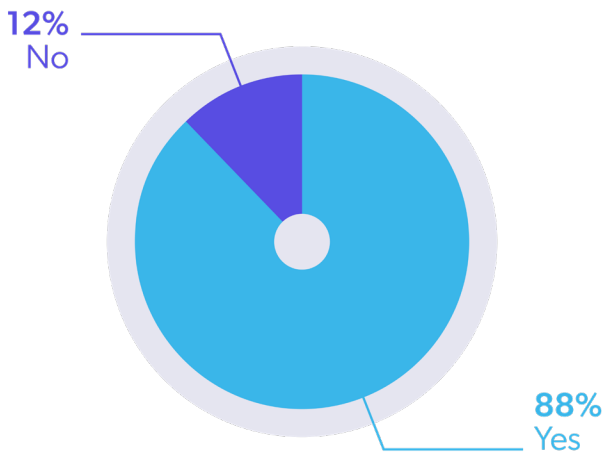
- 39% use C++ Core Guidelines.
- 34% use Embedded C (Barr Group).
- 27% use High Integrity C++.
- 15% use CERT.
- 12% use Google C++ Style Guide.

A few of those we surveyed stated that they do not know which coding standard they use.

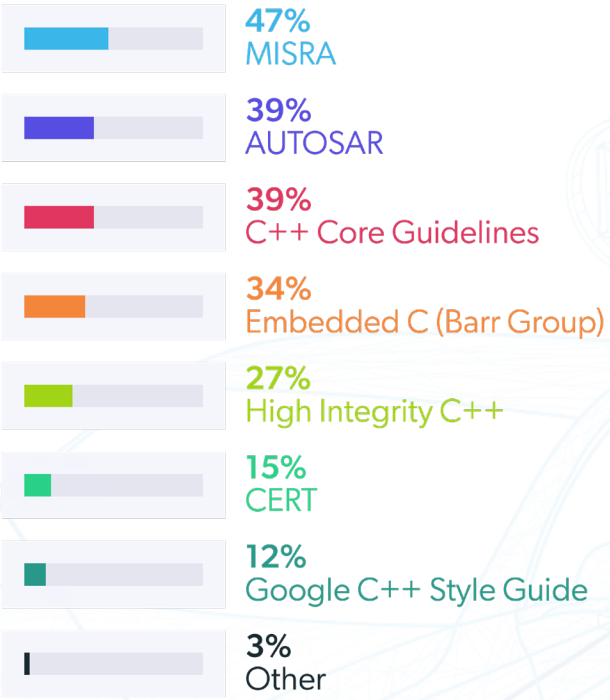
RESOURCE

How to Choose a Coding Standard

DOES YOUR TEAM USE A CODING STANDARD TODAY?



WHICH CODING STANDARD(S) DO YOU CURRENTLY USE?



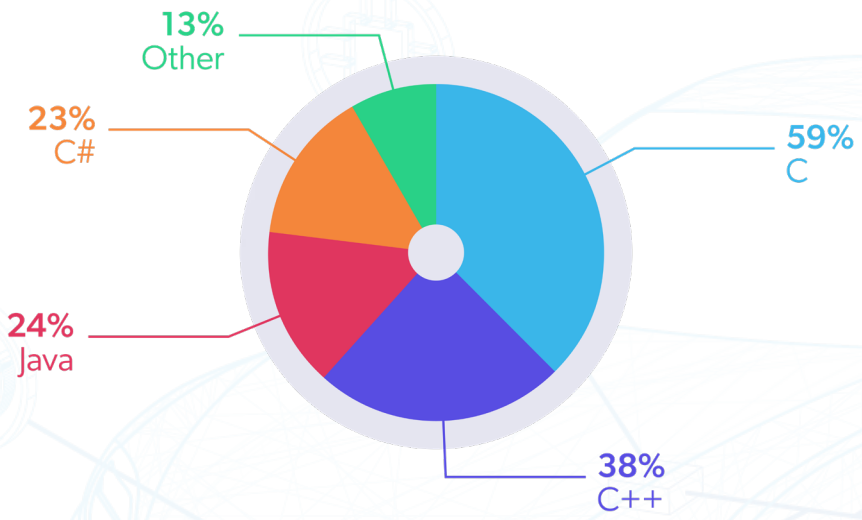
How Development Teams Manage Their Work

Most Use C/C++ Programming Languages

Although for many years, C has been the predominant programming language in the automotive industry, across those that we surveyed C++ use has increased. There is also use of C# and Java that reflects the increase of autonomous components — and, our survey results reflect that.

There are other teams who are using primarily Java and C#, with Python being the most common write-in.

WHICH PROGRAMMING LANGUAGES(S) DOES YOUR TEAM CURRENTLY USE?



Many Teams Leverage Faster Methods and Processes

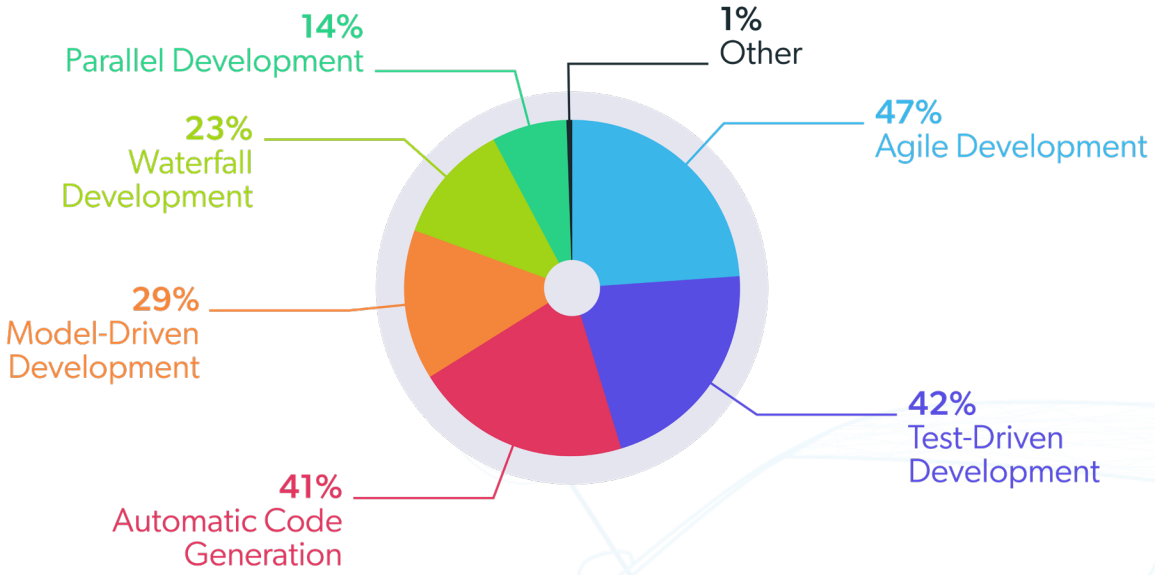
Many development teams are adopting methods and processes that will help them quickly adapt and develop quality software faster. Agile development was the top method utilized across those that we surveyed.

Along with Agile development processes, far more development teams are using automatic code generation and test-driven development. This makes sense, as automotive development continues to shift from hardware to software, and software development teams aim to maximize productivity.

RESOURCE

Switching to Agile ALM

WHICH DEVELOPMENT METHODS AND PROCESSES ARE YOU USING TODAY?



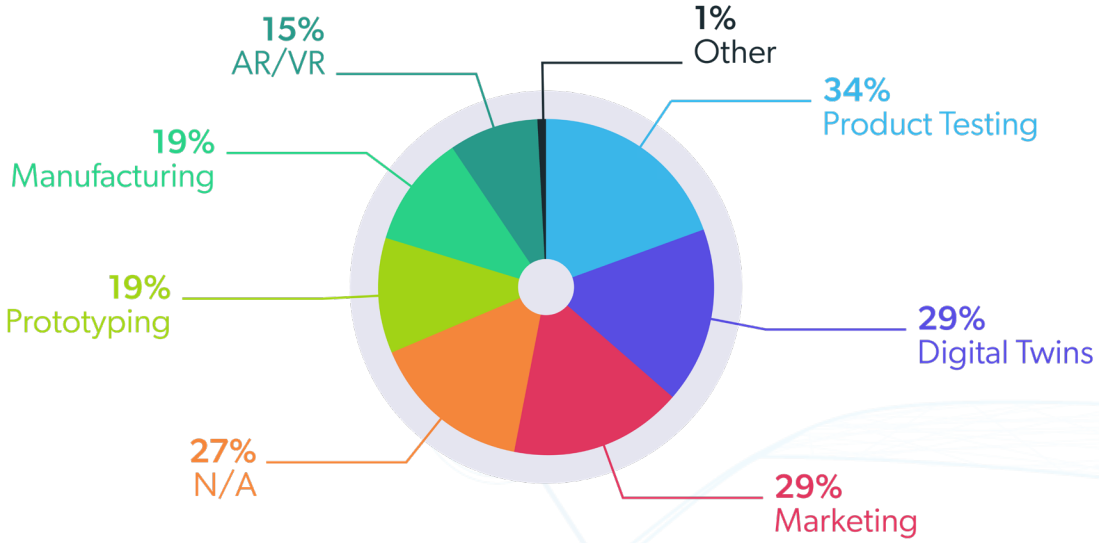
Teams are Starting to Leverage Game Development Technology

As more software is being added to vehicles, some automotive software development teams are finding new ways to test and build their vehicles — such as leveraging game development technology.

Of those we surveyed that are using game development technology, this is how they are leveraging it:

- 34% are leveraging game development technology for product testing.
- 29% are leveraging game development technology for digital twins.
- 19% are leveraging game development technology for prototyping.
- 15% are leveraging game development technology for AR/VR.

HOW ARE YOU LEVERAGING GAME DEVELOPMENT TECHNOLOGY — LIKE UNREAL AND UNITY — IN YOUR DEVELOPMENT PROJECTS OR BUSINESS?



Game Engines Soon To Be Common Tool

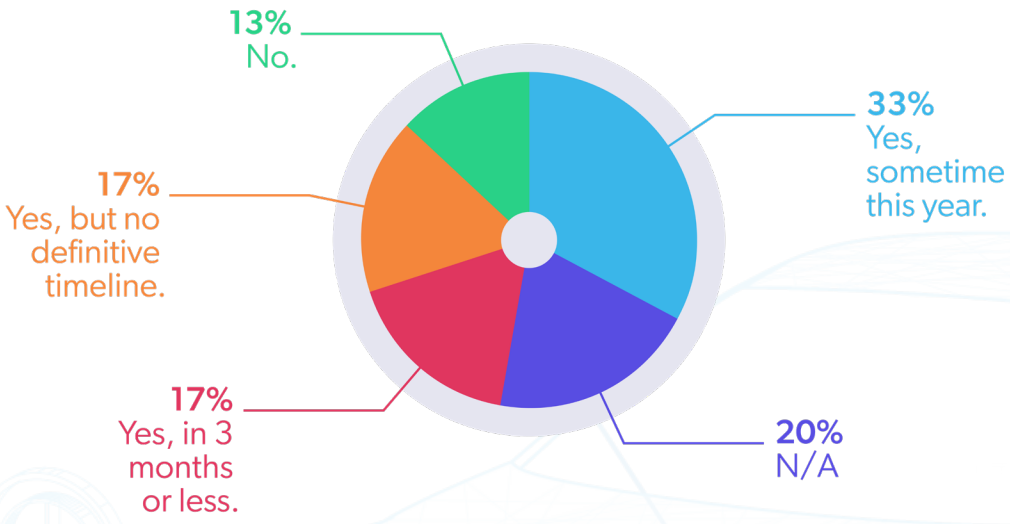
While not every automotive software development team is currently using game engines, a majority are planning on using them in the near future.

Of those surveyed:

- 33% said that they would begin using game engines sometime within the year.
- 17% said that they would begin using game engines within the next three months.
- 17% said that they would begin using game engines, but they had no definitive timeline.

Only 13% responded that they do not plan on using game engines in the future. However, that is most likely to change as the use of gaming engines rise in the automotive industry. With the increased use of game engines, each of these organizations will be faced with challenges created by having much larger binary assets. Forcing them to look for new tools to scale with them, without slowing down development.

IF YOU ARE NOT USING GAME ENGINES LIKE UNREAL OR UNITY, DO YOU PLAN ON USING THEM IN THE FUTURE?



How Hardware and Software Teams Work Together

With the growing prevalence of electric and autonomous vehicles, the automotive industry continues to shift from hardware to software. For that reason, it is important that development teams can effectively manage both hardware and software design and code assets. However, that can lead to some challenges.

The most significant challenge was effectively integrating engineering design and test tools (cited by 30% of those that we surveyed).

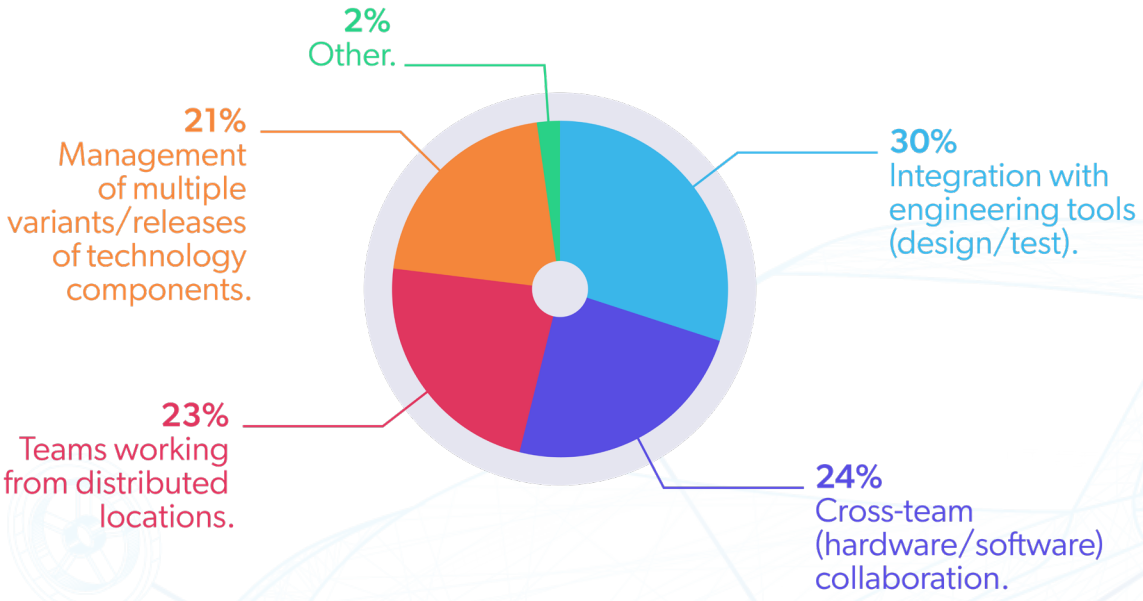
That challenge can be further exasperated by collaborating across teams (24%) — especially when working with distributed teams (23%). In addition, managing multiple variants of all the technology components involved — hardware and software — was also cited as a leading concern (21%).

However, by using the right version control software it can help these teams solve these challenges and unite global teams.

RESOURCE

Solve Top Challenges For Hardware/ Software Teams

WHAT IS YOUR SINGLE BIGGEST CHALLENGE IN MANAGING HARDWARE AND SOFTWARE DESIGN AND CODE ASSETS?



The Right Development Tools Improve Quality

As the automotive industry continues to move away from the traditional combustion engine and the role of software continues to grow, development teams will need to innovate in order to stay competitive. At the same time, they cannot lose sight of safety, quality, and security.

WHICH TOOLS THEY'RE USING

Using the right development tools is the key to success. The top tools for those we surveyed are:

- Static code analysis (39%).
- Project management (40%).
- Static application security testing (SAST) (44%).
- Version control (45%).
- Application lifecycle management (47%).

Perforce offers development tools in each of these key areas:

- Helix QAC is the preferred static code analysis tool for tightly regulated and safety-critical industries that need to meet rigorous compliance requirements.
- Klocwork is an enterprise static code analysis and SAST tool built for DevOps and DevSecOps that scales to large projects, deployments, and distributed teams.
- Hansoft is an Agile project management tool best-suited for infotainment developers.
- Helix Core is the best version control tool for large global teams with complex development needs.
- Helix ALM is an application lifecycle management tool that helps teams document that requirements have been fulfilled, tests have been run, and bugs have been resolved.
- Methodics IPLM is a comprehensive IP lifecycle management (IPLM) platform. It provides full traceability of IP and design assets, creates a single source of truth, and enables IP and variant sharing and reuse.

HOW THESE TOOLS HELP

A majority (33%) of those we surveyed said that using software development tools have helped accelerate their time to market. Some remarked the biggest benefit was improving their software quality (23%). Eliminated safety and security risks as well as simplified the compliance process were both cited by 19% as being the leading benefit. Finally, 6% of those we surveyed said that the biggest benefit was reduced cost.

LEADING BENEFIT OF DEVELOPMENT TOOLS

Why Static Code Analysis Is an Essential Tool for Automotive Software Developers

A static code analysis tool ensures safe, secure, and reliable software, which is essential for automotive development. Choosing the right static code analysis tool is important.

Based upon the survey responses, the leading concerns across multiple areas of automotive development are safety and security. One of the most effective methods to mitigate the potential functional safety issues and safeguard against security vulnerabilities is to use a static code analysis tool — specifically Helix QAC and Klocwork.

For over 30 years, Helix QAC has been the trusted static code analyzer for C and C++ programming languages. With its depth and accuracy of analysis, Helix QAC has been the preferred static code analyzer in tightly regulated and safety-critical industries that need to meet rigorous compliance requirements. Often, this involves verifying compliance with coding standards — such as MISRA and AUTOSAR — and functional safety standards, such as ISO 26262.

Helix QAC is certified for functional safety compliance by TÜV-SÜD, including IEC 61508, ISO 26262, EN 50128, IEC 60880, and IEC 62304. In addition, it is also certified in ISO 9001 | TickIT plus Foundation Level, which is one of the most widely adopted standards to ensure that your requirements are not only met but exceeded as well.

WATCH THE HELIX QAC DEMO

Klocwork static code analysis and SAST tool for C, C++, C#, and Java identifies software security, quality, and reliability issues helping to enforce compliance with standards.

Built for enterprise DevOps and DevSecOps, Klocwork scales to projects of any size, integrates with large complex environments, a wide range of developer tools, and provides control, collaboration, and reporting for the entire enterprise. This has made Klocwork the preferred static analyzer that keeps development velocity high while enforcing continuous compliance for security and quality.

WATCH THE KLOCWORK DEMO

About the Survey

We surveyed over 600 professionals working in automotive software development in May 2021. Participants represent a range of experience. However, a majority are veterans of the automotive industry who have seen a dramatic change over the past decade. Those who participated in the survey work primarily for Tier 1 and Tier 2 suppliers, as well as OEMs and Tier 3 suppliers. Their teams produce a range of automotive products, which include driver assistance systems, ECU/ECM, and chassis/safety systems.

Have comments or suggestions for next year's report? Share with us by emailing info@perforce.com with subject line "Auto Software Dev 2022".