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Thought Leadership Paper
Commissioned By Qt

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Smarter Products Need Smarter Development

Increase Innovation And Drive Growth By
Modernizing Digital Product Delivery

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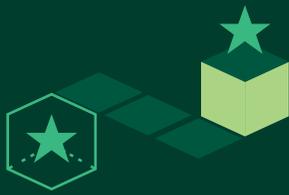
Contributing Research:

Forrester's Application
Development and Delivery
research group

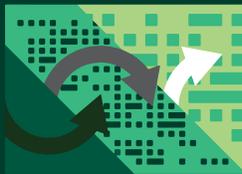
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Development and delivery must shift from traditional embedded development to smarter development processes.



79% of decision-makers say challenges with smart product development and delivery negatively impact their firms in delivering digital products; 95% say it causes delays.

Executive Summary

Digital, connected products are a mandate for success today. They improve customer experience (CX), automate digital operations, and create economic opportunity. However, traditional development practices impede the design, development, and delivery of modern, digital products. To be successful, firms must put the customer at the center of the digital product delivery process and then adjust culture, organization, process, skills, technology, and measurement practices in response.

Qt commissioned Forrester Consulting to evaluate current connected product development practices. Forrester conducted an online survey with 262 embedded device and connected product development decision-makers at global enterprises to explore this topic.

KEY FINDINGS

- › **Traditional embedded development practices are insufficient when building smarter, digital products.** Customer expectations for easy-to-use, continuously improved, and connected products put pressure on development teams to quickly create and launch innovative digital products. To keep up, development and delivery must shift from traditional embedded development processes to smarter development practices that adapt to supply chain shocks and keep product delivery moving forward.
- › **Organizational and cultural challenges hinder firms' digital product development.** As the products that businesses create become a fundamental part of an ongoing customer engagement strategy, product delivery teams encounter organizational and cultural challenges. Firms struggle with lack of collaboration and shared objectives, slow processes, developer burnout due to unrealistic requests, and difficulty maintaining and scaling their software across multiple hardware targets. Eight in 10 (79%) decision-makers say these issues negatively impact their firms' ability to deliver digital products; for 31%, it means delays that can last from seven to more than 12 months.
- › **Putting the customer at the center of the product delivery process is key to smarter development.** Solving digital product delivery challenges requires putting the customer at the center of the product delivery process and then adjusting culture, organization, process, skills, technology, and measurement practices in response. Decision-makers in our study are placing increased importance on CX in their product development cycles by prioritizing improving customer experience, using CX as a measure of success, and seeking technologies to improve customer experience.

As Software Eats The World, The Pressure To Innovate With It Grows

When Marc Andreessen observed that “software is eating the world” 10 years ago, he was referring to the rising complexity curve of software at major internet properties.¹ Today, that complexity pervades most industries: A new car today typically contains more than 100 million lines of code. By 2025, the average US home will have 20 internet-connected devices.² Between now and 2025, the US market for connected medical devices will grow by almost 19% CAGR.³

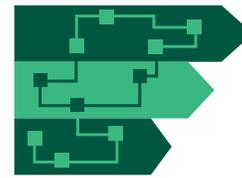
As demand for connected “smart” products grows, the pressure to quickly create and launch innovative digital products also increases. And it’s easier said than done because customers have increasing expectations from the products they buy:

- › They expect products that are simple to set up and easy to use.
- › They are disappointed when their products are no longer supported by the manufacturer.
- › They increasingly expect new features that further enhance the products they’ve already bought.
- › They expect their connected products to work together, be controlled from their smartphones, and be customizable to their own desires.

Connected, embedded, and digital products and software are clearly a mandate for success. They can improve customer experience, automate digital operations, and create economic opportunity.⁴ To get an idea of how modern manufacturing organizations are adapting to new demands for innovation and faster delivery of smarter products, we surveyed 262 embedded device and connected product development decision-makers at global enterprises. We found that agility across the development cycle is important to:

- › **Serve customers.** Eighty-three percent agree that quick software development and collaboration are crucial to meet customer needs quickly.
- › **Remain competitive.** Eighty-two percent agree that they need to quickly introduce new smart or connected products and services to maintain or grow market position.
- › **Accelerate go-to-market.** Eighty-two percent agree that higher-level software tools and development frameworks are crucial to accelerate new product development.

But building smarter digital products requires development and delivery processes, tools, and organizations that go beyond traditional embedded development. With today’s digital products, the software doesn’t stop at the firmware layer; it includes over-the-top services and over-the-air updates. It demands compelling user experiences and collaboration on a global scale. Smarter development practices can adapt to supply chain shocks and semiconductor shortages and keep the pace of product delivery moving forward.

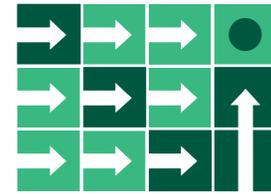


Smarter development processes can adapt to supply chain shocks and semiconductor shortages and keep the pace of product delivery moving forward.

The Challenges To Smarter Product Development Span Technology, Process, And Organization

Forrester’s research shows that most Fortune 500 companies don’t have the right operational models to build and deliver next-generation digital experiences.⁵ Their development practices were set up and organized to deliver traditional applications and/or embedded systems, not modern, connected products that rely on and integrate both. Today’s digital products break organizational and process boundaries. Survey respondents confirm these challenges:

- > Lack of collaboration and shared objectives.** European and APAC decision-makers say a lack of geographical cohesion is their biggest organizational challenge, while a lack of shared objectives and rising costs top the list of challenges for North America. Everyone sees skills deficits as a top-three concern (see Figure 1).
- > Slow, inconsistent processes with a lack of iteration.** From a process perspective, C-level decision-makers single out slow processes from design through development and different ways of working across software teams as primary challenges. Vice president and director-level respondents concur with the challenge of different ways of working, while vice president-level respondents also cite a lack of iteration during development (see Figure 2).



Only 15% of respondents say they experience no technological challenges with respect to producing smart products.

Figure 1

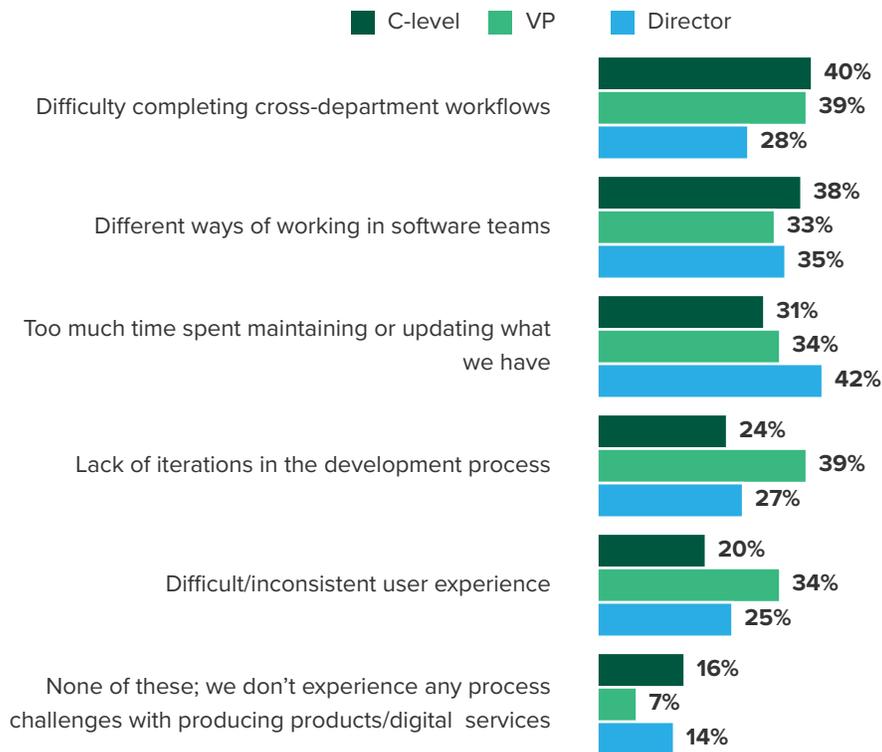
Top Three Organizational Challenges When Producing Products/Digital Services



Base: 262 embedded device and connected product development decision-makers at global enterprises
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

Figure 2

“What process challenges does your organization experience with producing products/digital services?”



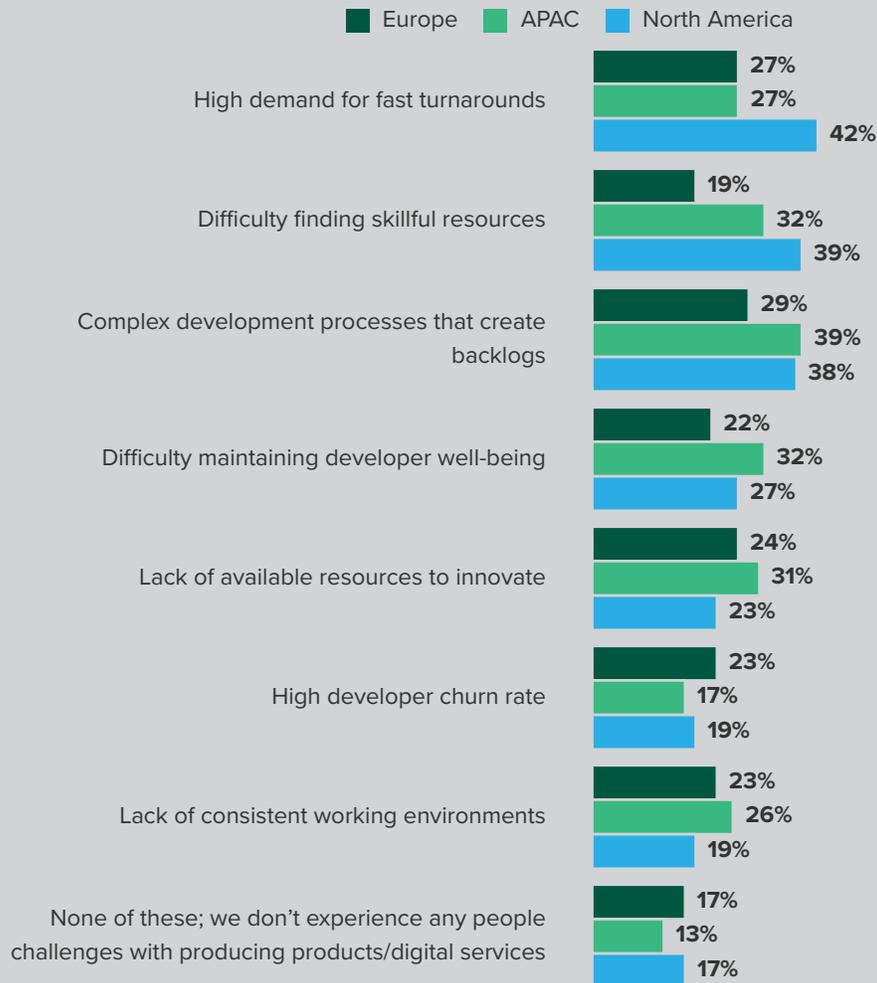
Base: 201 embedded device and connected product development decision-makers at global enterprises
Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

› **Developer burnout due to complex processes and tight turnarounds.**

Decision-makers across regions struggle with complex development processes and high demand for fast turnaround (see Figure 3). And nearly one in three APAC respondents struggles maintaining developer well-being. That concern extends worldwide — with almost two-thirds of respondents indicating they are extremely or very concerned about their developers’ well-being (see Figure 4). In addition, North American and APAC respondents say finding the right resources is a top-three issue for their firms.

Figure 3

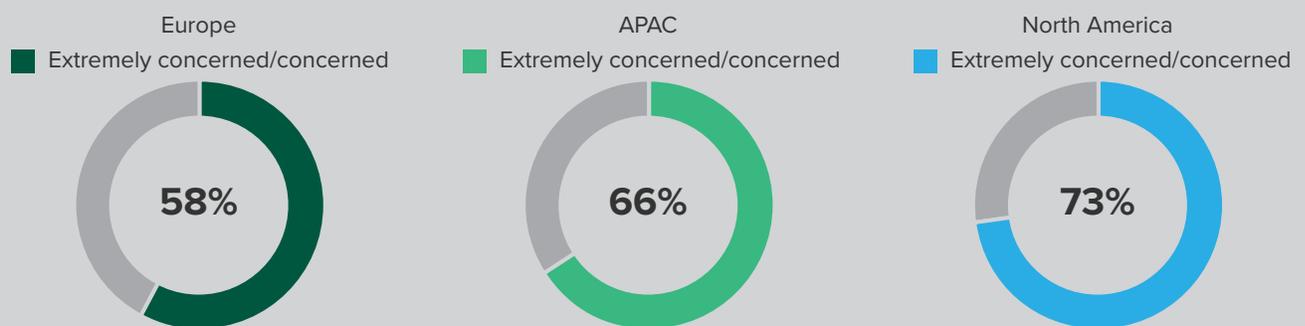
“What people challenges does your organization experience with producing products/digital services?”



Base: 262 embedded device and connected product development decision-makers at global enterprises
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

Figure 4

“As a result of the people challenges your organization faces with producing products/digital services, how concerned are you about your developers’ well-being?”

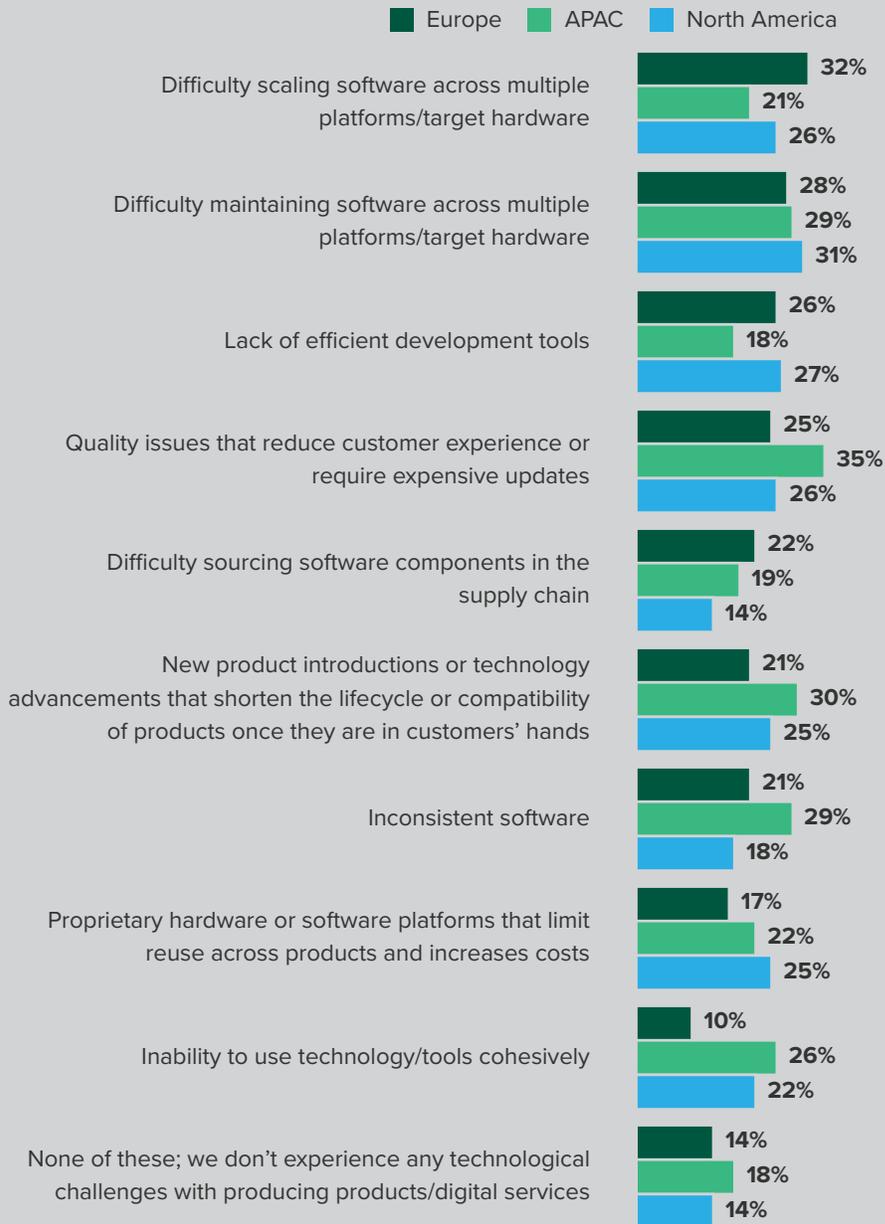


Base: 218 embedded device and connected product development decision-makers at global enterprises who experience people challenges with producing digital products/services
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

> **Multiplatform challenges.** Maintaining and scaling the software teams deliver across multiple hardware targets is the biggest technology hurdle firms face (see Figure 5). Quality issues that impact the customer experience or require expensive updates are a top-three challenge globally — and the top challenge for APAC firms.

Figure 5

“What technological challenges does your organization experience with producing products/digital services?”



Base: 262 embedded device and connected product development decision-makers at global enterprises
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

Overall, decision-makers in our study are less challenged by individual technology concerns compared to organizational, process, or people concerns. But that does not mean the challenges don't exist: Only 15% of respondents say they experience no technological challenges with respect to producing smart products.

The challenges respondents describe aren't entirely surprising. Forrester's research shows that organizational and cultural practices are a perennial problem that businesses face when attempting a digital transformation.⁶ As the digital products that businesses produce become more integrated with a company's customer engagement strategy, they encounter similar transformation challenges. Smarter digital products must integrate with core systems of engagement, service, and provide data that enhance system intelligence. Embedded development teams that used to have minimal post-sale interactions with customers are now part of customer-care teams that offer after-sale upgrades and integration with over-the-top features like navigation, product diagnostics, and real-time telemetry delivered via public cloud infrastructure. In a digital product world, "one-and-done" product sales get replaced by ongoing engagement around add-ons and accessories like filters, skins, and themes.

THE CURRENT SEMICONDUCTOR SHORTAGE IS AFFECTING SMART PRODUCT DEVELOPMENT

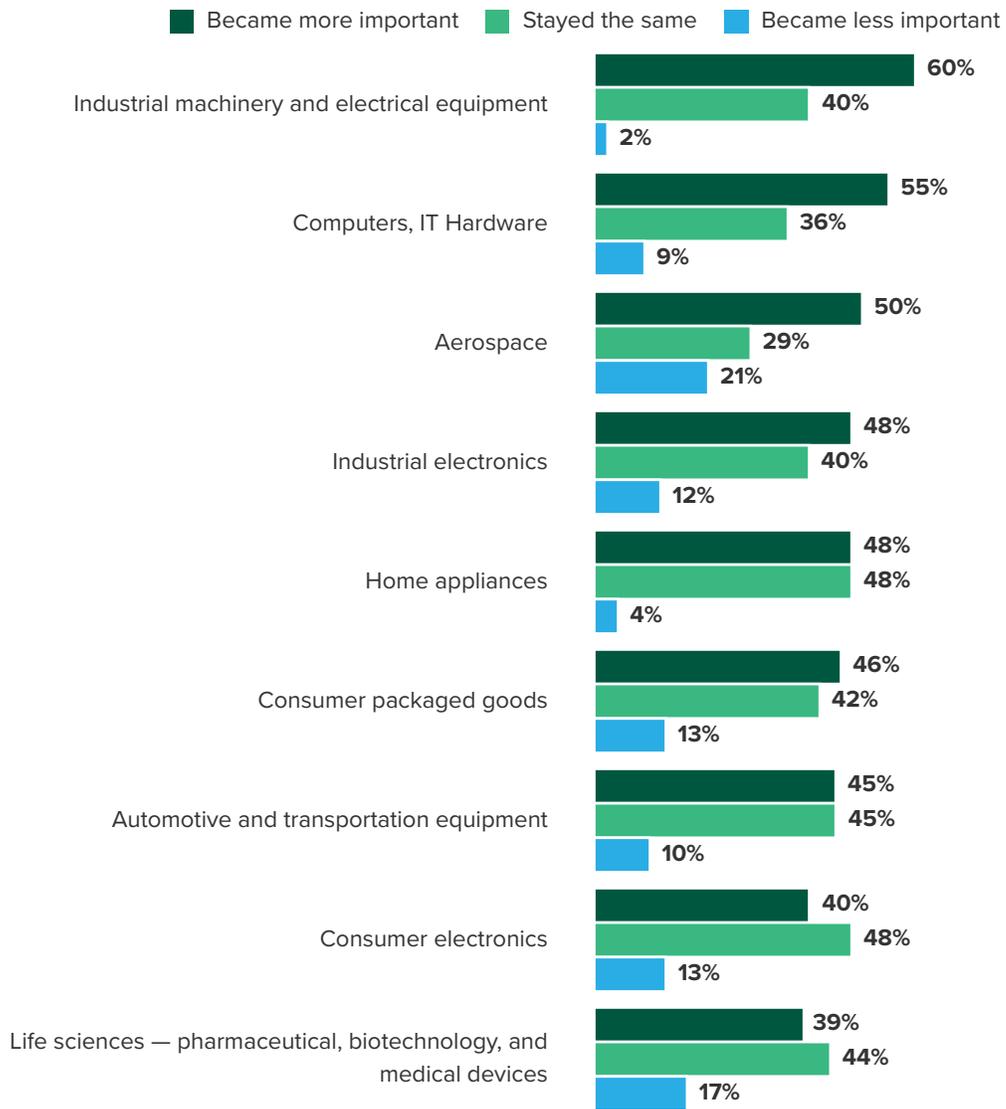
In addition to the cultural, process, and technology delivery challenges firms experience, the current semiconductor shortage is adding another layer of complexity to digital product development cycles. We found that:

- › **The semiconductor shortage is felt on a global scale ...** More than six in 10 respondents (61%) agree or strongly agree that the current semiconductor shortage has negatively impacted their ability to deliver new products. The IT hardware industry segment feels the impact of this shortage most acutely as 71% of respondents in this sector agree or strongly agree that scarcity has negatively impacted their firms.
- › **... and organizations are more focused on ensuring an adequate supply.** Consequently, half our survey respondents indicate that ensuring an adequate supply of semiconductors and key hardware components has become more important this year. Respondents in computer and IT hardware and industrial machinery and electrical equipment are particularly focused on their supply chain issues (see Figure 6).

The semiconductor shortage is slowing down smart product development.

Figure 6: Growing Importance In Semiconductor Supply

“Ensuring we have an adequate supply of semiconductors and other key hardware components for our products”



Base: 262 embedded device and connected product development decision-makers at global enterprises
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

THE CONSEQUENCE: NEW PRODUCT INTRODUCTIONS SUFFER

The challenges teams face when creating smarter digital products are reflected in how they perform. We found that these challenges have serious implications on:

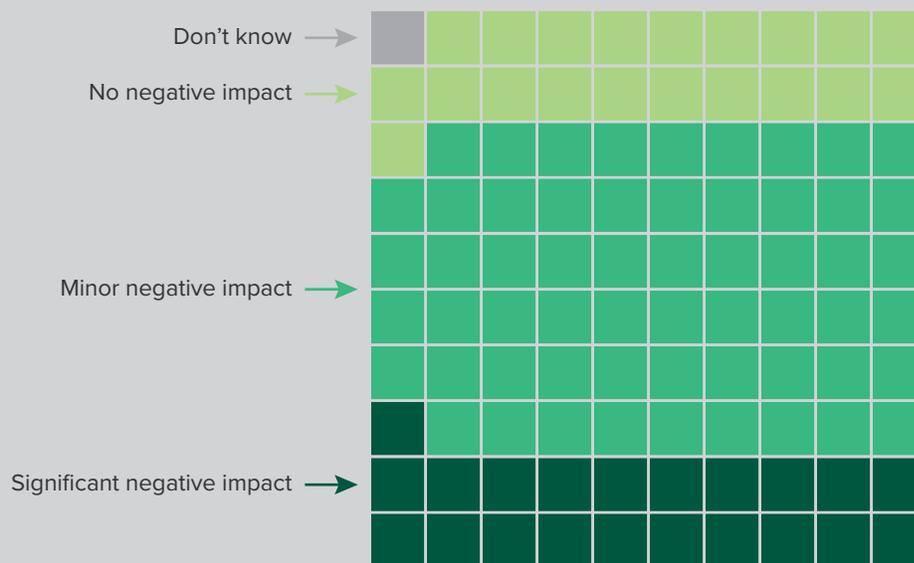
- › **Product delivery.** Four in five teams see negative impacts on their product delivery efforts. For most teams, the impacts of the challenges described above are minor. But for more than one in five respondents, they create a significant negative impact on their ability to deliver smart products (see Figure 7). The higher a respondent is in an organization, the more likely they are to bear the brunt of these challenges. Almost a third of C-level executives report that the challenges of smart product development come with significant negative impacts.
- › **Delays.** Delays are endemic to smart product delivery. Only 5% of survey respondents say they don't experience any delays in product delivery as a result of the challenges they face. More than two-thirds are delayed by at least a month, and almost a third are delayed by more than six months. Respondents in the industrial electronics sector see the worst delays: Half say their projects are delayed by six months or more.

What it means: These repercussions prevent firms from keeping pace with digital innovation and meeting customer needs.

95% of respondents say their firms experience delays because of their product development challenges. And for 68%, those delays can last from one to 12 months.

Figure 7

“What impact, if any, do organizational, technology, process, or people challenges have on your organization’s ability to produce products/digital services?”



Base: 262 embedded device and connected product development decision-makers at global enterprises
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

Smarter Product Development Starts With A Focus On Customer Experience

Solving the digital product delivery challenges above requires a systemic approach to improving product development and delivery. It starts by putting the customer at the center of the product delivery process and then adjusting culture, organization, process, skills, technology, and measurement practices in response. Decision-makers in our study agree and are placing increased importance on customer experience by:

- › **Making an improved customer experience their biggest strategic priority.** Just under half (48%) of respondents call out improving CX as a critical priority, more than improved collaboration (40%), reducing costs (39%), better product telemetry (36%), or faster time-to-market (19%).
- › **Creating intuitive and consistent user experiences.** Fifty-five percent of respondents think creating compelling user experiences has become more important over the past year.
- › **Using customer experience as a measure of success.** Seven in 10 respondents call out CX as the number one measure of success (see Figure 8). It's the top measure across all regions, with product reviews (a more distilled measure of customer experience) a distant second at 62%.
- › **Seeking technologies that can improve CX.** While digital product decision-makers expect many benefits from cross-platform design and development tools, the number one benefit they look for is the ability to improve customer experience (61%). It's particularly important for survey respondents in the automotive sector (66%), life sciences (67%), and consumer packaged goods (71%).

Seven in 10 respondents call out CX as the number one measure of success.

Solving digital product delivery challenges requires putting the customer at the center of the product delivery process and then adjusting culture, organization, process, skills, technology, and measurement practices in response.

Figure 8
“How do you measure the success of your products/digital services?”



Base: 262 embedded device and connected product development decision-makers at global enterprises
Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

IMPROVING THE CUSTOMER'S EXPERIENCE REQUIRES A WHOLE PRODUCT FOCUS

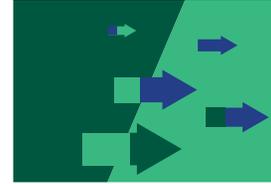
When it comes to building great customer experiences for smarter digital products, development teams need to do more than just focus on the initial installation, user interface, and product packaging. Survey respondents call out three high-priority items that lead to success over a product's lifetime:

- › **A commitment to quality and product reliability.** Even more important than pixel-perfect buttons or top-quality packaging, products need to work as expected, and keep working. This is why, for 80% of respondents, quality and reliability is the number one requirement to develop a successful product.
- › **Products that perform.** Customers' expectations for instant responses set firms' pace with product development. Laggy interfaces and intermittent connectivity can quickly sink satisfaction and product perceptions. And while throwing more powerful hardware at performance problems is always a brute-force option, it increases costs and supply chain risk due to component availability. Together, speed and performance are key to develop a successful product for nearly 70% of decision-makers.
- › **Ease of maintenance.** Sixty-eight percent of decision-makers say maintenance is important for effective development. Products that are difficult to fix, impossible to update in the field, or have a reduced duty cycle disappoint customers and reduce profit margins due to increased break-fix costs and warranty claims. That's one reason 78% of decision-makers assess support for over-the-air upgrades as a critical or high priority. It's also driving 76% of respondents to focus on remote diagnostics and troubleshooting.

PRODUCT TEAMS MUST INVEST IN BETTER WAYS OF WORKING TOGETHER

Delivering successful products also requires organizations to change how their teams organize, staff, collaborate, and automate. To drive improvement in their delivery capability, firms must:

- › **Accelerate collaboration to serve customers.** Eighty-three percent agree that quick software development and collaboration are crucial to meet customer needs quickly. This is why 83% are making it a high or critical priority to improve collaboration in product development.
- › **"Shift-left" on product testing.** Testing earlier in the product design process helps validate designs and identify potential performance issues. Given this, it's unsurprising that 78% of decision-makers are prioritizing shifting testing upward into product design phases. Using prototypes and simulation to identify issues earlier in the design cycle is also of interest. Collectively, these tactics compress the time it takes to introduce new products while reducing the risks associated with an accelerated delivery schedule.



Quality, speed, and maintenance are the most important factors to develop a successful product/service.



Delivering successful products requires organizations to change how their teams organize, staff, collaborate, and automate.

- › **Embrace software product line thinking.** For years, product manufacturers have used hardware platforms and product line thinking to create entire product families and boost component reuse. While software product line thinking is commonly used in some industries (e.g., automotive), it's still an evolving practice in others (e.g., life sciences). Enabling scalability across product lines supports product line thinking, which is why respondents in automotive (41%), consumer electronics (43%), industrial electronics (48%), and industrial machinery and equipment (49%) view it as a critical initiative for building smarter products.

SOFTWARE DEVELOPMENT TECHNOLOGY INVESTMENTS SHOULD ACT AS A FORCE MULTIPLIER

When technology investments aren't aligned with strategic goals, they can often add complexity and costs without returning significant business value. But when technology investments are aligned with investments in cultural, organizational, and process changes, they act as force multipliers. To successfully build smarter products, decision-makers in our survey are investing in:

- › **Higher-level tools and frameworks to accelerate customer-centricity.** Eighty-two percent agree that to speed up new product development, they need higher-level software tools and development frameworks. Doing so will enable them to meet customer expectations for speed and quality.
- › **Cross-platform frameworks and tools that increase flexibility and reduce costs.** Eight out of 10 decision-makers are prioritizing investing in cross-device tools and frameworks that support multiple classes of hardware. This encourages product line thinking, increases supply chain flexibility, and reduces the cognitive load of developers, who are trying to complete multiple hardware targets.
- › **A more customizable user experience.** As customers increasingly reject "one-experience-fits-all" approaches to connected product development, decision-makers are investing in user experience customization. Eighty-four percent say it's a high or critical priority to update and customize the user experience with options like language packs, UI themes, and third-party application support.

Technology investments that are aligned with investments in cultural, organizational, and process changes act as force multipliers to build smarter products.

Key Recommendations

Want smarter products? You must invest in smarter development. Forrester's in-depth survey of embedded device and connected product development decision-makers about smart product development yielded several important recommendations:



Put the customer at the center of your efforts. Creating an effective, performant, durable customer experience is the most important priority for smart product decision-makers. Measure improvements to customer experience as an important indicator of your progress.



Plan for longer, more engaging product lifecycles. With customer experience as the top measure of success, it's important to focus on engagement beyond a product "unboxing." As connected product decision-makers focus on improving quality, creating new over-the-top features, and customizing user experiences with updates, the ability to support a long, ever more valuable product experience will increasingly define successful digital product organizations.



Invest in technologies that support product, skill, and supply chain flexibility. Technology investments in modern development tools and cross-platform frameworks reinforce process and culture improvements by abstracting, automating, and widening the aperture of usable components and applicable skills. That's why 80% of smart product decision-makers are investing in cross-platform design and development tools.



Blunt the effects of the semiconductor shortage with cross-platform frameworks. Until the global semiconductor shortage eases, digital product decision-makers will need to remain flexible and use what can be sourced, when it can be sourced. Investing in flexible software tools and platforms that support a wide variety of silicon can reduce the impact of critical supply chain shortages.

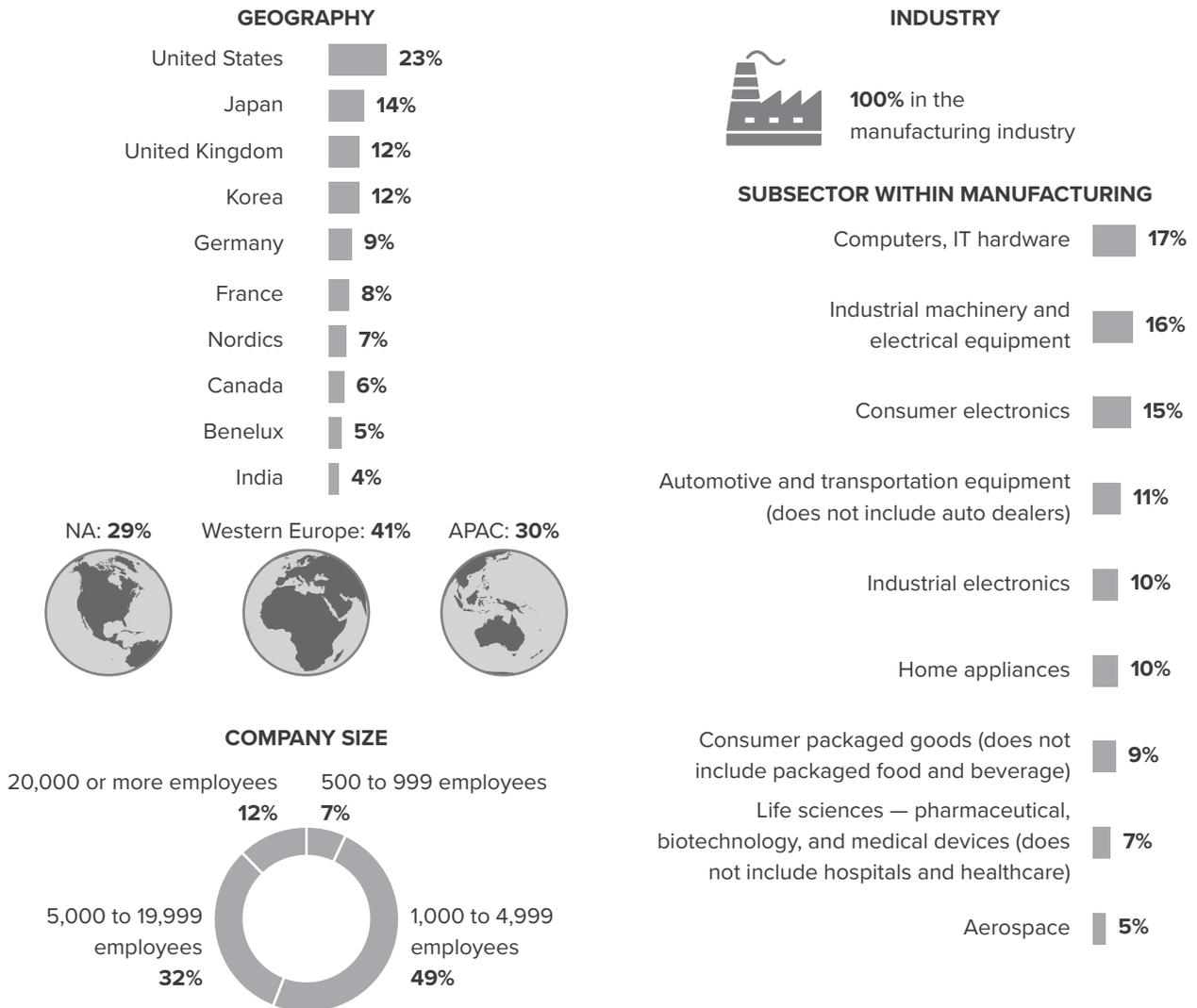


Break up the skill silos. All too often, native development for individual chipsets leads to isolated pockets of skills that are difficult to transfer to new platforms. And the rising demand for connected device developers exacerbates these skill silos. Cross-platform frameworks and tools make it easier for developers to work across different embedded platforms and fill talent needs.

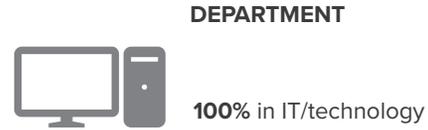
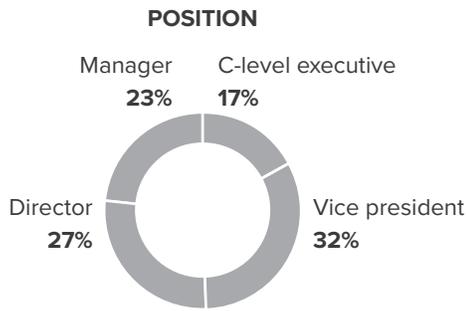
Appendix A: Methodology

In this study, Forrester conducted an online survey of 262 embedded device and connected product development decision-makers at global enterprises to evaluate how companies are developing smart products. Survey participants included decision-makers in IT working at companies that are developing or planning to develop devices or products that require embedded software applications, connected products (designing and manufacturing internet of things-enabled [IoT-enabled] connected products and services), or devices or products that include digital user interfaces (e.g., touchscreens, digital displays). Questions provided to the participants asked about the development cycle, tools available to developers, and challenges. Respondents were offered an incentive as a thank you for time spent on the survey. The study began and was completed in March 2021.

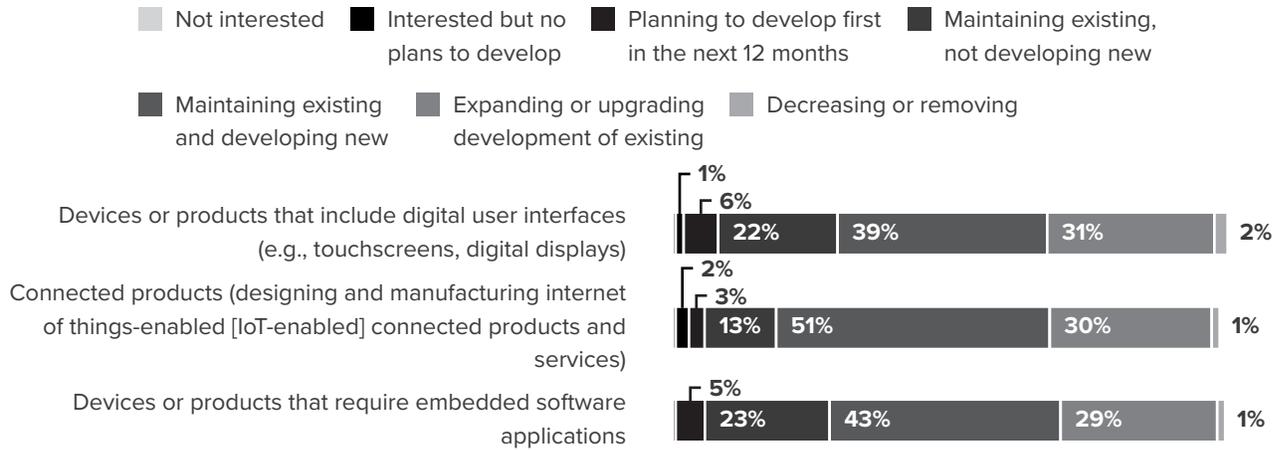
Appendix B: Demographics



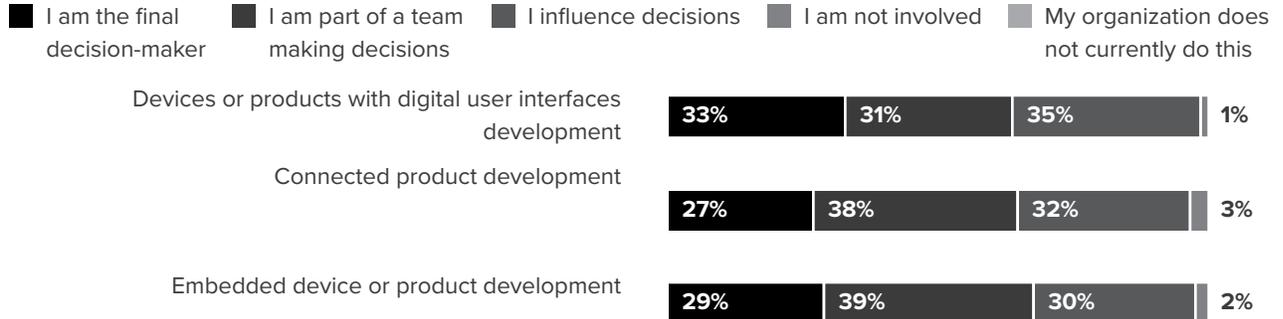
Base: 262 embedded device and connected product development decision-makers at global enterprises
 Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021



ORGANIZATION'S PLANS TO DEVELOP THE FOLLOWING



LEVEL OF RESPONSIBILITY



Base: 262 embedded device and connected product development decision-makers at global enterprises

Note: Percentages may not total 100 because of rounding.

Source: A commissioned study conducted by Forrester Consulting on behalf of Qt, March 2021

Appendix C: Supplemental Material

RELATED FORRESTER RESEARCH

“Digital Transformation Requires Development Transformation,” Forrester Research, Inc., December 29, 2020

Appendix D: Endnotes

¹ Source: Marc Andreessen, “Why Software Is Eating the World,” The Wall Street Journal, August 20, 2011 (<https://www.wsj.com/articles/SB10001424053111903480904576512250915629460>).

² Source: Artie Beaty, “US Households Will Have an Average of 20 Connected Devices by 2025,” Cord Cutters, June 21, 2020 (<https://www.cordcuttersnews.com/us-households-will-have-an-average-of-20-connected-devices-by-2025/>).

³ Source: “Connected Medical Device Market Outlook, Size, Share, Revenue Growth, Development, Demand, Regions & Forecast To 2025,” MarketWatch, March 10, 2021 (<https://www.marketwatch.com/press-release/connected-medical-device-market-outlook-size-share-revenue-growth-development-demand-regions-forecast-to-2025-2021-03-10>).

⁴ Source: “Digital Transformation Requires Development Transformation,” Forrester Research, Inc., December 29, 2020.

⁵ Ibid.

⁶ Ibid.