Reengineering Your Business for a Smart and Connected World

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The shift from standalone hardware to smart, connected products is pervasive—and it’s here to stay. Forward-thinking hardware companies are taking leadership positions in a new era of product development. Will you be one of them?

The world of engineered products (think: planes, automobiles, medical equipment, and appliances) is changing. Traditional hardware is rapidly converging with technology. Electrification, software, and AI are disrupting the value chain and changing the competitive playing field. Top innovators and new entrants are leading the charge and being rewarded by the capital markets. Even young startups with zero revenue are seeing valuations on par with century-old Fortune 100 companies.

Software and connectivity are playing a much bigger role in differentiating the customer value proposition. Value is moving from the product itself to the broader business ecosystem of software-defined services. This movement, in turn, is completely changing the traditional model of launching new products in fixed cycles. In the new paradigm, we will see more companies launching integrated and scalable hardware, software, and services platforms into the market and continuously releasing upgrades over the product life cycle.
The classic example of this in the automotive sector is Tesla. The Model S was launched in 2012 and the vehicle itself still looks the same today, but the user experience has continued to improve over time. In response to changing technologies and customer demands, Tesla routinely releases new features that make the car safer, more autonomous, and more fun to own—and the upgrades are delivered primarily via software, seemingly in real time. What’s more, Tesla leverages technologies in the vehicle to access the broader ecosystem. For example, using data and connectivity, the vehicle can diagnose and resolve automotive issues, often over the air, replacing traditional dealers and service repair shops. In this way, Tesla has created a business that is scalable, sticky, and capable of accessing new pools of recurring profits.

While making this shift is a strategic imperative, there is also a sizable prize ready for the taking. By transitioning to a scalable, high-touch, high-response business model that generates recurring revenue, companies can double their margin per unit sold (taking into account the lifetime value of these revenue streams) and drive loyalty to 80% or higher. The scalable nature of these businesses also has a direct impact on cost and efficiency. Because software and the broader technology stack eliminate a great deal of complexity, product development cost efficiency can improve by up to 30% and product development timelines can drop by as much as 50%.

This shift from standalone hardware to smart, connected products is pervasive—and it’s here to stay. To compete in this new era, hardware-centric companies must reimagine product development: from hardware to software, from product to ecosystem, and from fixed-cycle launch to
continuous release. To support these moves, they will need to invest in new capabilities and ways of working: a technology-centric organization, agile systems engineering practices, digital platforms and tools, and renewed governance.

Reimagining Product Development

To reimagine product development, companies should ask themselves two fundamental questions.

**How can embedded technologies create access to new revenue streams and business models?** To seize new opportunities in the market, original equipment manufacturers (OEMs) must first examine the end-to-end ownership experience for retail customers and identify where electrification, AI, or software and connectivity provides a right to win or enhances the customer experience. Tesla’s approach to maintenance and repair is a great example of this. The vehicle’s ability to diagnose itself and even preorder parts for repairs creates a highly differentiated experience for the customer.

For commercial customers, companies must examine their products’ full life cycle P&L and identify opportunities to enhance throughput, cost, or productivity. The shift we are seeing to autonomous, robotic “fleets” across a range of applications illustrates how AI and connectivity are enabling a move away from sales of equipment to sales of services that continuously improve over time.

**What technology platforms—whether hardware, software, or ecosystem—will best deliver these new opportunities?** Until now, embedding electric, AI, and software and connectivity technologies into products has not been a focus of hardware-centric companies. But they will need to develop this expertise because it has become a key
competitive differentiator. Here are just some of the strategic challenges that companies will need to address:

- Creating a roadmap and investment plan for battery technologies to meet customer demands for range, run time, and cost
- Designing the sensors and machine-learning algorithms that will drive robotic applications
- Designing the software, data, and IoT platform architectures to ensure applications can be released at scale and integrated seamlessly with third parties

It is critical to meet each of these challenges, and strong execution will determine a company’s success on the new competitive playing field.

**Investing in New Capabilities and Agile Ways of Working**

To capitalize on new business model opportunities and design the right technology platforms, OEMs will need to invest in new capabilities and ways of working. We have identified four key imperatives: build a technology-centric organization, employ agile systems engineering, invest in digital platforms and tools, and establish an effective governance model.

**Build a technology-centric organization.** In many ways, if hardware-centric companies want to compete effectively with technology companies, they will need to resemble them. First, from an organizational perspective, they must transition from functional siloes into independent, cross-functional business line teams that oversee the life cycle P&L and focus on the end-to-end customer experience. This
ensures that decisions about the product can be made with a view to the revenues that may be generated beyond the point of sale—a foreign concept to many hardware-centric companies.

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Second, companies must establish technology platform teams that will design architecture and develop technologies in parallel, independent of new product launches. This approach to product development is key to ensuring common, scalable platforms across the portfolio, de-risking the timing and cost of new product launches, and ensuring that the new competitive differentiators are continuously upgraded and released.

**Employ agile systems engineering practices.** To support the continuous release of innovative products and keep pace with consumer demand, companies must employ agile ways of working. Agile puts customer needs at the center of the product development process. Agile DevOps principles use existing architectures and modular building blocks developed by the technology platform teams as the starting point, and they identify the priority areas for innovation investment specific to the new product launch.

Small, cross-functional teams work simultaneously to develop and systems-engineer new customer innovations—quickly. These teams design, test, and validate products in rapid, iterative sprints to get customer input early. To ensure that any technical compatibility issues or tradeoffs can be managed, full product integration occurs regularly. A
common misconception is that agile concepts cannot be applied to hardware-centric products that require stringent quality testing and long lead times for capital investment. Although these constraints do exist, agile can still be applied in an effective manner. Typical stage-gate criteria can be managed at a system level as long as the APIs are predefined and full product integration occurs regularly.

**Invest in digital platforms and tools.** To attain the desired levels of speed, collaboration, and iteration, companies will need digital tools. Digital brings the ability to automate manual work, disseminate knowledge and best practices, integrate information, and simulate impact more quickly. Four tools are particularly useful:

- **CAD/CAE:** Computer-aided design software helps engineers develop virtual 3-D models to simulate any aspect of a product’s life cycle. Once engineers have created these models, they can be analyzed with computer-aided engineering tools to simulate performance and improve product designs.

- **Digital twins:** Using advanced analytics and artificial intelligence, a digital twin simulates a product’s performance, including all the complexity that drives value. It identifies where volatility and uncertainty exist, as well as where optimization is possible. With access to these insights, companies can continuously improve product performance.

- **Shared continuous integration platforms:** The software industry has relied on continuous integration toolsets for a long time, and hardware engineers are used to product lifecycle management and digital mockup reviews. But rapid releases, together with increased integration of hardware, software, and operations, naturally require much faster feedback loops. Shared platforms enable end-to-end integration testing.
• **Model-based systems engineering (MBSE):** Companies should also invest in model-based systems engineering, a method for designing and managing complex systems over their entire life cycle. When coupled with agile methods, MBSE incorporates the benefits of systems engineering in digital modeling to reduce complexity in the design phase and ensure that all requirements are satisfied at the system level.

While such platforms deliver obvious benefits over the long term, they must be aligned with organizational performance, product strategy, and connectivity so that measurable benefits can be demonstrated along the way.

**Establish an effective governance model.** To support the new way of working, it is critical to establish the right incentives, funding mechanisms, and governance forums to reinforce the desired organizational behaviors.

Technology platform teams become accountable for technology and the costs of the key competitive differentiators, while ensuring that the platforms are scalable and that they effectively meet the needs of the business lines.

Business line teams, acting as independent squads, take on primary P&L ownership for not only the product but also the ongoing monetization of software and ecosystem services. The business line teams should be empowered to make all of the decisions related to delivery of a successful product launch. They must work within the boundaries set by the platform team’s architectures, resources, and budgets but can ultimately decide what and how to prioritize from there.

How funding and resources are allocated across each of these groups becomes an important factor in clarifying priorities among business lines.
and technology platforms. Annual capital and resource allocation can be an effective mechanism to determine which technology platforms should be prioritized based on the most crucial needs of the business lines.

Perhaps more important is how the product is managed over the life cycle. New products should not be viewed as standalone items but as components of a scalable hardware, software, and ecosystem platform that evolves in response to customer needs. Life cycle management in this context means that quality issues are resolved by the teams and individuals who worked on original development, that the technology platform teams release new features per their technology roadmaps, and that the business line teams ultimately decide which features are released to which customers and how the features will be monetized.

Getting Started

Once organizations have reimagined their product development process and put in place new capabilities and ways of working, they can rapidly begin to deliver hardware at the speed of software. Getting started typically involves two foundational steps.

Set up an incubated “lighthouse” team that will ultimately become the new model for the organization. The lighthouse team has the mandate to develop a roadmap for the product, features, and releases, starting with the launch of an “MVP” (minimum viable product). This will require the development of robust technology platforms to support new hardware, software, and ecosystem opportunities. The lighthouse team pioneers agile ways of working, incubated from the rest of the organization.

Establish platform teams for the key technologies to support the lighthouse team and ultimately drive technology leadership across the
portfolio. Identify leadership talent (most likely from outside the organization) to build the required capabilities. Given the urgency of getting started and the scarcity of available talent, consider adopting a partnership or outsourcing model.

New tech entrants and leading incumbents are moving quickly to redefine their customer offerings. We’re seeing 100-year-old hardware companies with a rich tradition of engineering and manufacturing make the transition—very successfully—to business models that resemble those of highly successful tech companies. For hardware companies willing to reimagine the business, introduce new capabilities, and transition to new ways of working, it’s time to take a leadership position in the electrified, smart, connected world.
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