KPMG

Future of hardware

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Contents

Foreword

These are pivotal times for hardware manufacturers. The COVID-19 pandemic accelerated trends in customer behavior — such as a growing preference for as-a-service purchasing — and introduced widespread changes in workplace models. Hardware continues to be used in new ways: in edge computing embedded in smart machines like robots and autonomous vehicles. Increasingly, suppliers compete on customer experience, making their products easier to buy, use, and upgrade. This has implications for how hardware companies go to market, source their products, and invest their capital.

Hardware players can thrive in this future by adapting business and operating models and becoming connected enterprises. As enterprises, with front, middle and back offices seamlessly connected, internal silos can be removed, data is freely shared, and companies can truly focus on customer needs.

The connected hardware enterprise can consistently gather customer and performance data to help guide development and go-to-market activities.

But there are plenty of obstacles to overcome. As the market moves toward as-a-service business models, we believe many hardware makers will need to invest in new distribution models, including a direct sales force. This will likely require new capabilities and organizational change. At the same time, demands by investors and customers for better environmental, social and governance (ESG) performance are likely to dictate how and where products are sourced and built to achieve sustainable, circular business models. Supply chain disruptions, pressure on energy prices, and inflation are weighing on the global economy and the prospect of recession has hardware makers bracing for slower growth.

In this report, we explore critical signals of change influencing the global hardware environment and describe five strategic imperatives to help seize the opportunities of the coming years. We also describe how a connected enterprise can help hardware makers win by aligning every critical process, function, and relationship of your business with the goal of meeting customer expectations, creating business value and driving sustainable growth, all while harnessing cloud technology and a platform mindset.

We hope these insights give hardware industry leaders and stakeholders some valuable pointers for approaching the future with confidence.

01

Signals of change

We identify five major forces that in our view are changing the way hardware vendors will design, build, and sell their products in the coming years. These include higher customer expectations for a better experience in buying and using hardware, growing pressure on supply chains and therefore greater focus on creating more responsive and resilient supply chains, meeting growing demands for progress on ESG metrics, and managing regulatory pressures. A connected enterprise can address these forces, helping to create a borderless, digitally enabled organization that is focused on the customer.

1 Shifting customer expectations

Customers have high expectations of hardware vendors — for products and for the experience of buying and using them. They want intuitive interfaces, flexible pricing, and high levels of service and support. They expect simple, swift delivery and installation of configured products, which places new demands on vendor supply chains (even as vendors face supply-chain challenges of their own). Customers also show increasing interest in as-a-service models, which can give them greater flexibility and help reduce capital investments in IT.

According to a recent survey by global research and advisory company Forrester, eight out of 10 hardware manufacturers are making their customer strategy a 'top' or 'high' priority.

Importance of customer strategy in hardware

	N. America	EMEA	APAC
Among our top priority	38%	29%	36%
High priority	43%	53%	49%
On par with other priorities	18%	18%	15%

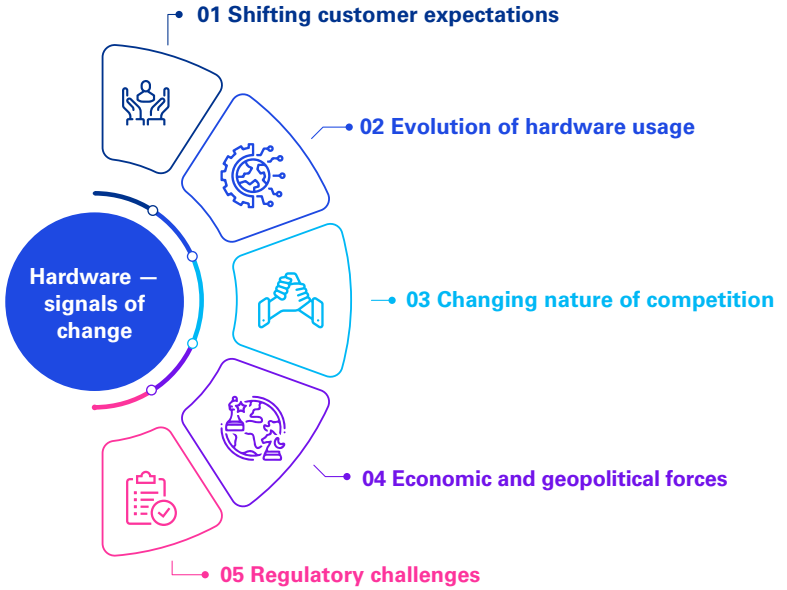
Base: 488 professionals involved with customer-centric strategy decisions at technology hardware manufacturers

Source: A commissioned study conducted by Forrester Consulting on behalf of KPMG, June 2021

2 Evolution of hardware usage

The range of applications for computer hardware, and the places where it is used, continues to expand. Edge computing brings compute power and storage closer to end users. Work-from-home arrangements have increased demand for computers and other equipment that employees could use from home, and forced employers to install new systems to support a remote workforce. The rapid rollout of 5G is providing faster and more data-rich connectivity and enabling cloud data centers to be located closer to customers to deliver edge computing. The Internet of Things (IoT) is pushing hardware deeper into factories, farms, government/military facilities and leisure establishments.

Signals of change



For vendors, one of the most important development in hardware usage is the continuing growth of the as-a-service model. Customers increasingly want to acquire services, rather than products. The benefits to customers can include lower capital investments, regular upgrades, smaller IT staff, and the ability to scale up or down swiftly.

To achieve this, hardware companies should master the concept of software-defined hardware, and be able to push constant software upgrades that enable continuous, new, improved, integrated services. Future hardware design and engineering should consider both the physical product and the software components it will run on.

3 Changing nature of competition

When customers buy products as-a-service, they can more easily switch suppliers, helping to reduce vendor opportunities to 'lock in' users. With loyalty increasingly based on service, support, and ease of use, as-a-service vendors are seeking more direct relationships, as opposed to selling through distributors. Storage hardware producer Pure Storage, who used to sell exclusively via reseller channels, has now added direct sales teams. Selling direct helps vendors build stronger relationships with customers and enables rapid access to equipment performance data to predict maintenance needs and enhance new product design.

A growing number of competitors are collaborating to deliver hybrid, as-a-service models and share risk. Such alliances highlight the rise of co-opetition, creating 'open data' ecosystems where 'common' data or code can be freely used, re-used, redistributed, and combined with other open data. This interoperability can significantly enhance the capability to combine different datasets and help develop more and better products and services.

Such seamless interactions and commerce are a central capability of a connected enterprise, enabled by highly responsive operations and supply chain.

4 Economic and geopolitical forces

In the past few years, the global economy has been buffeted by COVID-19, rising trade tensions, and war. Supply chains have been disrupted by pandemic shutdowns and labor shortages, contributing to price inflation in materials, components, and finished goods. In the face of these risks, CEOs continue to prioritize digital investments — with 72 percent agreeing they have an aggressive digital investment strategy, intended to secure first-mover or fast-follower status. This focus on digital transformation may be driven by increasingly flexible working arrangements and heightened awareness of cyber security threats, exacerbated by geopolitical uncertainty.[1]

[1] https://home.kpmg/xx/en/home/insights/2022/08/kpmg-2022-ceo-outlook.html

The global semiconductor shortage began in 2021. Chips power everything from IT infrastructure to consumer goods, automobiles, medical devices and even toys, and with demand rising and supply stagnant, many products are likely to be unavailable, delayed and/or overpriced. Companies are looking to the US and EU to rebalance supply away from Asia, while adding capacity to meet rising demand.[2] The EU aims to boost European chip production capacity via its European Chips Act, enabling billions of dollars of public and private investments, with a goal of boosting the continent's share of global chip manufacturing.[3] In the US, meanwhile, the senate passed The CHIPS and Science Act of 2022, which includes a 25 percent advanced investment tax credit for certain investments in semiconductor manufacturing.[4]

5 Regulatory challenges

As hardware companies start to behave more like software as-a-service companies and gather vast amounts of customer information, we expect there will be an increased regulatory focus on how they manage software development processes for AI and handle data to ensure compliance with data privacy and security laws and regulations. There are many national privacy laws limiting the disclosure of personal information to third parties. Companies doing business in certain countries may be prohibited from transferring data to a third-party cloud provider for processing or storage outside that country.

Additionally, increasing use of AI is also under regulatory scrutiny in the EU (through the AI Act [AIA]), and elsewhere, with an obligation to demonstrate appropriate data governance to avoid bias, and the incorporation of ethical AI design into product development.[5]

The hardware industry is also exposed to social risks surrounding working conditions and safety standards. There are dependencies upon the mining of precious metals and rare earth elements to produce electronic components, while production often requires large volumes of water, with the potential for polluting wastewater.

[2] https://www.semiconductors.org/wp-content/uploads/2020/07/2020-SIA-State-of-the-Industry-Report-FINAL-1.pdf

[3] "European Chips Act" European Commission, 2 April 2022. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-chips-act_en (edited)

[4] https://home.kpmg/us/en/home/insights/2022/07/tnf-senate-passes-chips-bill-includes-investment-tax-credit-for-semiconductor-manufacturing.html

[5] "Proposal for a Regulation of The European Parliament and of The Council: Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts." European Commission, 21 April, 2021. https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence (edited)

02

Five strategic imperatives

Hardware companies need to become connected, customer-centric organizations to help them adapt to changing customer expectations, as-a-service business models, stressed supply chains, and increased regulatory pressures. With every function of the organization aligned around delivering exceptional customer experience, they can seek to gain reliable, current customer insights and rapidly test and introduce new products and services enabled by decentralized and agile supply chains closer to the customer. Here are five strategic imperatives to help achieve these goals.

1 Compute everywhere

IoT, 5G and AI help drive computing to the edge

The intersection of IoT, 5G and AI will likely continue to create unprecedented demand for edge computing, involving big tech, telcos, cloud providers, software platforms, and industrial players that serve specific sectors. As AI usage becomes mainstream, 'always on' operating models are expected to become the norm.

The growth in hardware is prevalent — in cars, in appliances, in smart appliances and equipment, and in cloud data centers. During the pandemic, shipments of traditional PCs, laptops and other equipment boomed as millions worked from home, fueling 2 years of double-digit growth for PCs. However, in the second quarter of 2022, global PC sales declined by 15 percent year-on-year due to falling demand and continued supply chain volatility.[6]

Nevertheless, with collaborative tools like Zoom and Microsoft Teams evolving, 5G/edge expanding, and the metaverse becoming mainstream, hardware devices should become even more ubiquitous to daily life as a portal to the virtual world. HP's planned US$3.3 billion acquisition of video and audio equipment specialist Poly accelerates its remote working credentials, with HP's aim to "enhance the employee experience, increase workplace productivity and improve hybrid work environments for its enterprise customers."[7]

Ericsson — itself a manufacturer of equipment that powers 5G networks — has a new smart factory with intelligent automation driven by fast, secure cellular connectivity[8] — a trend being seen around the world. Other similar facilities depend heavily on IoT and other hardware, which should signal positive future demand.

Data centers are another area benefiting from the rise of 5G/edge, with a need for smaller centers closer to local end users and devices. Demand is also increasing in Tier 2 cities, as well as in upgrading existing centers. All of this should mean good news for hardware manufacturers that produce the various elements that will make up a data center.

[6] https://www.idc.com/getdoc.jsp?containerId=prAP49455522

[7] https://www.computerworld.com/article/3654838/hp-to-acquire-poly-for-3-3b.html

[8] https://www.ericsson.com/en/about-us/company-facts/ericsson-worldwide/united-states/5g-smart-factory

2 Accelerating the shift to as-a-service

Customers are increasingly interested in hardware as-a-service, which enables them to remove assets from their balance sheets, convert IT investments into operating expenses, and free up capital for other uses. As-a-service procurement can also make it easier to upgrade or switch vendors, with a variety of available models tailored to different needs, and hardware companies are moving into this space at speed.

As-a-service models are proliferating

As-a-service offering	Description
Software-as-a-Service (SaaS)	• Users can access software and licensing online via subscription • Companies get a base software platform and don't have to develop software from scratch
Platform-as-a-Service (PaaS)	• Provider hosts cloud computing platform that can be accessed online, enabling users to develop, utilize and maintain applications, software, and other engineering projects • Users can build products on a cloud-hosted platform, rather than buying/storing hardware
Infrastructure-as-a-Service (IaaS)	• Provider hosts IT infrastructure — such as storage, server and networking resources — delivered to users on-demand via virtual machines accessed online • Enables users to scale IT resources up and down in line with demand, and limits need for on-premise hardware
Storage-as-a-Service (STaaS)	• Provider hosts digital storage space where users can offload data onto a third-party, cloud-hosted infrastructure • Enables data transfers and frees up additional on-premise storage space
Device-as-a-Service (DVaaS)	• Users access computing devices (laptops, desktops, smartphones) through a subscription-based service • Users can outsource device management and more easily upgrade to new technologies
Network-as-a-Service (NaaS)	• Providers deliver networking infrastructure and connectivity to users through the cloud • Companies can develop and use their networks without physical hardware on-site, as well as tailor networks to meet their own security needs

To compete in as-a-service markets, we believe hardware makers need to evolve from a product into a subscription mindset, adopting new revenue models and developing new capabilities:

Accounting: Revenue recognition changes from booking hardware sales upon delivery to distributors or end users, to managing thousands of streams of periodic subscription payments. An upside for hardware makers is lower investments in inventory and a more predictable revenue stream.

Bundling: As-a-service can also create new opportunities for bundling hardware, peripherals, software, and support to help maximize revenue per user. For example, some companies bundle compute and storage hardware with software and related services. Customers are billed for each unit of consumption, such as terabytes of storage or number of virtual machines.

Distribution: The switch to as-a-service models has implications for distribution and marketing. As hardware companies embrace as-a-service, they can choose from numerous revenue models (including usage-based pricing) and market entry points via B2B, B2C, and B2B2C. Here is an example of how companies are expanding their go-to-market footprint:

Large enterprises: We're seeing the likes of HPE and others expanding their offerings, such as establishing a stake in storage, servers, data protection and networking along with hardware products like monitors, printers, and PCs. HPE, meanwhile, is forging ahead with R&D in edge computing — where physical hardware meets digital data.

3 Design for user experience

'Faster, better, cheaper' is a common mantra for hardware designers, but with incredible computational speeds and massive storage a given, one of customers' most important criteria is ease of use. Consequently, hardware companies are having to rethink how to offer value to customers via unique services and experiences — rather than merely selling physical equipment.

Software development: To help meet customer requirements for functionality and ease of use, hardware companies need to adopt best practices in software development, such as agile and DevOps, where the customer perspective — and cyber security — are taken into account at every stage of the life cycle, with experience-driven software design creating simple and customer-friendly user experiences. This can enable fast innovation of resilient new products, as well as speedy, relevant updates to existing ones.

Hardware data analytics: By embracing hardware analytics, organizations can keep abreast of customer demand and tailor different products to multiple customer segments. Meanwhile, operational data helps organizations optimize performance and resource utilization by better understanding how varying workloads are handled or where systems underperform. Many hardware manufacturers are using IoT to connect directly to customers' devices and detect problems or order replacements. And by training AI to mine operational data, it's possible to improve issues like power consumption without human involvement.

Customer experience: Hardware companies are digitizing their business operations to become more connected and customer-centric. Emerging technologies like IoT, AI, and 5G are pushing the boundaries on real-time operational visibility, insights through data, and developing agile and scalable operations. And, by breaking down silos across the company, companies can gain a unified view of the customer journey and experience as they interact (seamlessly) with the front, middle and back office of a connected enterprise.

4 Intelligent supply chains

The events of the past 2 years have demonstrated the weaknesses of the global, just-in-time supply chains that have been developed across industries in the past three decades. Nowhere has this been more apparent than in semiconductors. A global semiconductor shortage that began in the second half of 2020 and continues today has affected production of everything from mobile phones to long-haul trucks. The COVID-19 pandemic exposed weaknesses in many global supply chains, with production held back, reducing availability of everything from lumber to automobiles to semiconductors, and putting stress on margins.[9]

Hardware manufacturers everywhere (including Asia, where most technology is manufactured) are striving to diversify supply chains and make them more resilient to disruption from pandemics, climate change and other geopolitical forces. Supply chains have a significant influence on customer experience, which is why hardware companies are making them more customer-centric and demand-driven.

As they become more connected, supply chains can benefit from technologies like IoT, blockchain, robotics, AI, and predictive analytics — with companies reskilling their workforces around these digital skills. The emergence of cognitive decision centers helps make supply chains collaborative, transparent, and evidence-based by harnessing big data.

Connectivity brings a new level of responsiveness. We expect that configure-to-order capabilities across the supply chain will allow hardware companies to adapt to rapidly changing trends and deliver quickly and efficiently. Supply chains should provide valuable insights into all aspects of a customer's order to allow the manufacturer to pivot to meet new requirements. To keep abreast of changing customer needs, it's important to collect and analyze data across the supply chain from suppliers to consumers, establishing real-time communication channels with supply chain partners to facilitate information flow. Here are some important questions to consider:

- Do you leverage data and analytics across the full value chain to help drive enterprise improvement?
- Are your global and local inventories aligned with a flexible, distributed order management system?

Increasing role of 3D printing in operations and supply chains

3D is at the forefront of the fourth industrial revolution, where digital technologies influence how companies design, manufacture and distribute products.

[9] https://hbr.org/2020/09/global-supply-chains-in-a-post-pandemic-world

Relativity has the world's largest 3D printers, capable of producing a single piece of metal up to 120 feet long and 24 feet wide. The company's first Terran 1 rocket is 85 percent 3D printed by volume, not only manufacturing its own 3D printers but also designing the end product. By dramatically reducing the time and complexity of the manufacturing process, Relativity claims it will eventually be capable of turning raw material into a rocket in less than 60 days.[10]

3D printing is set to transform value chains, with printer manufacturers attempting to manage the entire supply chain, from design, manufacture, and distribution.

Decentralized supply chains

Decentralized 'micro' supply chains enable agile, localized production, assembly, and delivery, helping to bring a faster, more personalized customer experience. A tightly integrated ecosystem of partners, suppliers (and, in some cases, competitors) supports new, as-a-service propositions for existing and new customers. These supply chains are finite, agile 'mini operating models' with flexible contracts, and manufacturing closer to the point of purchase. Adopting such a decentralized approach can enable hardware companies to quickly alter production content and volumes, change delivery routes, and introduce new products.

While micro supply chains have been around for some time, their importance and role in the overall organization value chain has dramatically risen over the last few years. By creating as much value as close to the customer as possible, these supply chains can bring independence and flexibility to adapt to unique local customer segments with individual preferences.

Intelligent supply chains, powered by IoT and connectivity with other players in the chain, should help hardware companies adapt to changing economic, political and environmental conditions, and address rising ESG and regulatory demands.

5 Meeting higher regulatory and ethical standards

ESG has become a critical, board-level issue as companies seek to combat climate change, create resilient supply chains, encourage diversity, inclusion and equality, and support local communities. Investors expect organizations to report on their non-financial impacts and more frequently base decisions on companies' ESG performance. Customers also prefer to do business with hardware providers whose values match their own.

According to the KPMG 2021 CEO Outlook Pulse Survey, 49 percent of CEOs plan to put in place more stringent ESG practices, while 96 percent are placing greater focus on the social component of their ESG programs.[11] The previous 2020 survey found that 65 percent of CEOs say managing climate-related risks will be a key factor in keeping their jobs over the next 5 years.[12]

Sustainability is no longer a 'nice to have', but a business imperative and a source of competitive advantage. We're seeing more and more examples of ESG initiatives from the anything-as-a-service (XaaS) sector, including recycling, volunteering, employee well-being initiatives, and reduced carbon footprint due to hybrid working and less business travel.

While hardware companies are seeking to move to geographies with favorable regulations, they are also trying to balance the environmental risk, which is shifting their business values and models.

[10] https://www.relativityspace.com/press-release/2022/10/24/relativity-space-maps-path-to-terran-r-production-at-scale-with-unveil-of-stargate-4th-generation-metal-3d-printers
[11] https://home.kpmg/xx/en/home/insights/2021/03/ceo-outlook-pulse.html
[12] https://home.kpmg/xx/en/home/insights/2020/09/kpmg-2020-ceo-outlook-covid-19-special-edition.html

Hardware manufacturers need to reduce their carbon footprint as these companies recognize that technology is among the heaviest consumers of energy. Chipmakers, system vendors, and technology providers are under pressure to make technology run cooler, use sustainable energy sources, and participate in a circular economy that reduces electronic waste. Most hardware production proposal requests now include sustainability targets.[13]

Hardware and semiconductor supply chains require extensive mining to procure metals and other raw materials (such as tin, tantalum, tungsten, and cobalt) for electronic components. Production also uses large volumes of highly purified water, while wastewater contains high amounts of heavy metals and toxic chemicals. These sectors have also been criticized for poor working conditions and safety standards, particularly in Asia. Future business models' design will not only have to consider geographical locations and regulations, but how to make a positive ESG impact through greater diversity, fair labor practices, and working with communities.

Ethical AI regulations

Given the increasing use of software and emerging technologies such as AI to drive customer experience, we expect hardware manufacturers will have to develop strong software design procedures to meet emerging AI-related regulations.

[13] A commissioned study conducted by Forrester Research, Inc. on behalf of KPMG, June 2021

[14] https://idatalaw.com/2021/04/23/new-eu-regulation-on-ai/

[15] "Proposal for a Regulation of The European Parliament and of The Council: Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts." European Commission, 21 April, 2021. https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence (edited)

[16] "Proposal for a Regulation of The European Parliament and of The Council: Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts." European Commission, 21 April, 2021. https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence (edited)

[17] "Proposal for a Regulation of The European Parliament and of The Council: Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts." European Commission, 21 April, 2021. https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence (edited)

[18] "Proposal for a Regulation of The European Parliament and of The Council: Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts." European Commission, 21 April, 2021. https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence (edited)

Ethical AI regulations

In April 2021, the EU proposed new regulations governing the use of AI. Despite its exit from the EU, the UK is also expected to adopt these measures.[14]

Companies are required to adopt procedures and practices such as:

- Providers of AI systems must establish appropriate data governance and management practices and use datasets that are relevant, representative, free of biases and complete.[15]
- Consequence scanning should be adopted to incorporate ethical AI design into product development.
- High-risk AI systems should be designed to allow users to oversee them in order to prevent or minimize potential risks. Design features must enable human users to avoid over-reliance on system outputs (automation bias) and allow a designated human overseer to override system outputs.[16]
- A system's technical documentation should contain metrics used to measure potentially discriminatory impacts and information about the foreseeable unintended outcomes and sources of risks to biases and discrimination (intended or unintended).[17]
- Companies should prohibit AI systems from providing social scoring for general purposes by public authorities. The regulations also preclude the use of 'real-time' remote biometric identification systems, such as facial recognition, in publicly accessible spaces for law enforcement purposes.[18]

These changes are expected to make it harder to develop AI-based applications and have far-reaching implications for hardware companies as they build their as-a-service capabilities. They could also impede the use of data analytics for as-a-service business models.

Data privacy regulations

As hardware companies rapidly move to as-a-service business models, collecting and harvesting customer, supplier, and partner data will play a key role in driving insights, which is needed for continuous and innovative product development. But by collecting these vast amounts of data, hardware companies should start thinking about data privacy laws and regulations.

There are many national privacy laws limiting the disclosure of personal information to third parties. Companies doing business in certain countries may be prohibited from transferring data to a third-party cloud provider for processing or storage outside that country.

Examples of data protection laws include:

1. Abu Dhabi Global Market (ADGM) introduced Data Protection Regulations 2021, aimed at increasing the protection of personal data processed in the United Arab Emirates (UAE).[19]
2. China's Cybersecurity law (article 37) requires IT infrastructure operators to store all personal information collected from users (sales, marketing, accounting, etc.) within the country's mainland territory.[20]
3. Europe's Digital Services Act aims to create a common set of rules on intermediaries' obligations and accountability across the single market. This should open new opportunities to provide cross-border digital services while ensuring a high level of protection to all users, no matter where in the EU they are based.[21]
4. Data privacy laws in the US are gaining ground with the CCPA (California Consumer Protection Act) and similar bills in Virginia and Florida.[22]

[19] https://home.kpmg/ae/en/home/insights/2021/03/adgm-new-data-protection-regulations-2021.html
[20] https://home.kpmg/cn/en/home/insights/2017/02/overview-of-chinas-cybersecurity-law.html
[21] https://home.kpmg/ie/en/home/insights/2022/07/data-privacy-matters/data-privacy-matters-eu-uk.html
[22] https://advisory.kpmg.us/articles/2019/reach-of-the-california-consumer-privacy-act.html

03

Hardware and the KPMG Connected Enterprise

A connected enterprise can help align front, middle and back offices to more closely connect organizations with customers, employees and business partners, respond quickly to market signals, and pivot to seize opportunities as they arise. Many critical processes, functions and relationships are thus focused on meeting customer expectations.

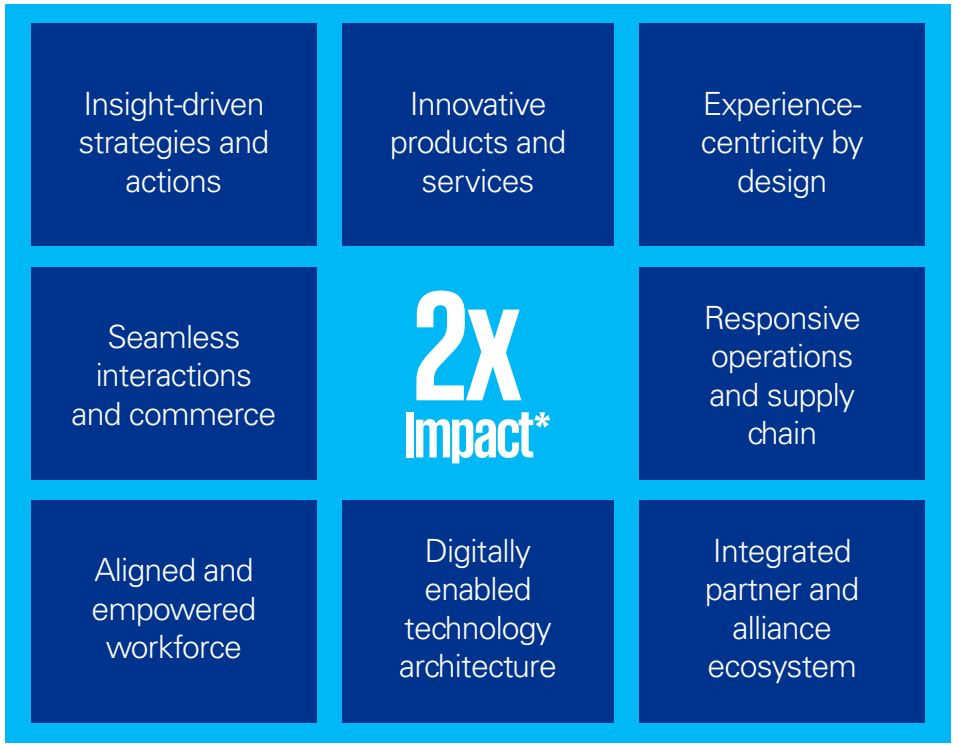
In a recent global survey of hardware executives conducted by Forrester Consulting on behalf of KPMG, almost half (49 percent) of respondents are investing in at least six customer-centric capabilities, with North America leading the way at 62 percent.[23] The study found that high-maturity hardware providers are 95x more likely to demonstrate better execution of a customer-centric enterprise strategy — one that spans six or more capabilities — than low-maturity organizations:

- Digitally enabled technology architecture: Hardware companies have embraced an agile, product-aligned delivery model aligned to customer outcomes.
- Aligned and empowered workforce: Hardware companies have a primary focus on redesigning the workplace and providing digitally enabled learning opportunities for employees.
- Seamless interactions and commerce: Hardware companies are focused on improving their digitally enabled sales, and digitally enabled marketing capabilities to orchestrate timely, effective, and differentiated customer interactions.
- Insight- driven strategies and actions: Hardware companies want to improve their ability to use CRM and customer data and insights to understand customer groups, dynamics, and behavior.
- Innovative products and services: Hardware companies want to adopt innovation labs to strengthen product/service design and dynamic pricing, in order to prioritize flexibility in their organization.
- Experience-centricity by design: Hardware companies continue to prioritize finding ways to put customer experience at the heart of what they do.
- Responsive operations and supply chain: Hardware companies have a strong desire to make use of data and automation to build intelligent supply chains ensuring that they are digitally enabled, operationally interconnected, and resilient.
- Integrated partner and alliance ecosystem: Hardware companies have an urgent need to design a scalable digital framework to support an integrated partner ecosystem and govern their service delivery.

A winning hardware strategy requires maturity in eight connected capabilities.

As hardware manufacturers seek to deliver their products as-a-service, they are developing their connected capabilities and adopting a platform mindset.

The eight capabilities that together make up a KPMG Connected Enterprise



*Base: 1,299 professionals involved with customer strategy decisions

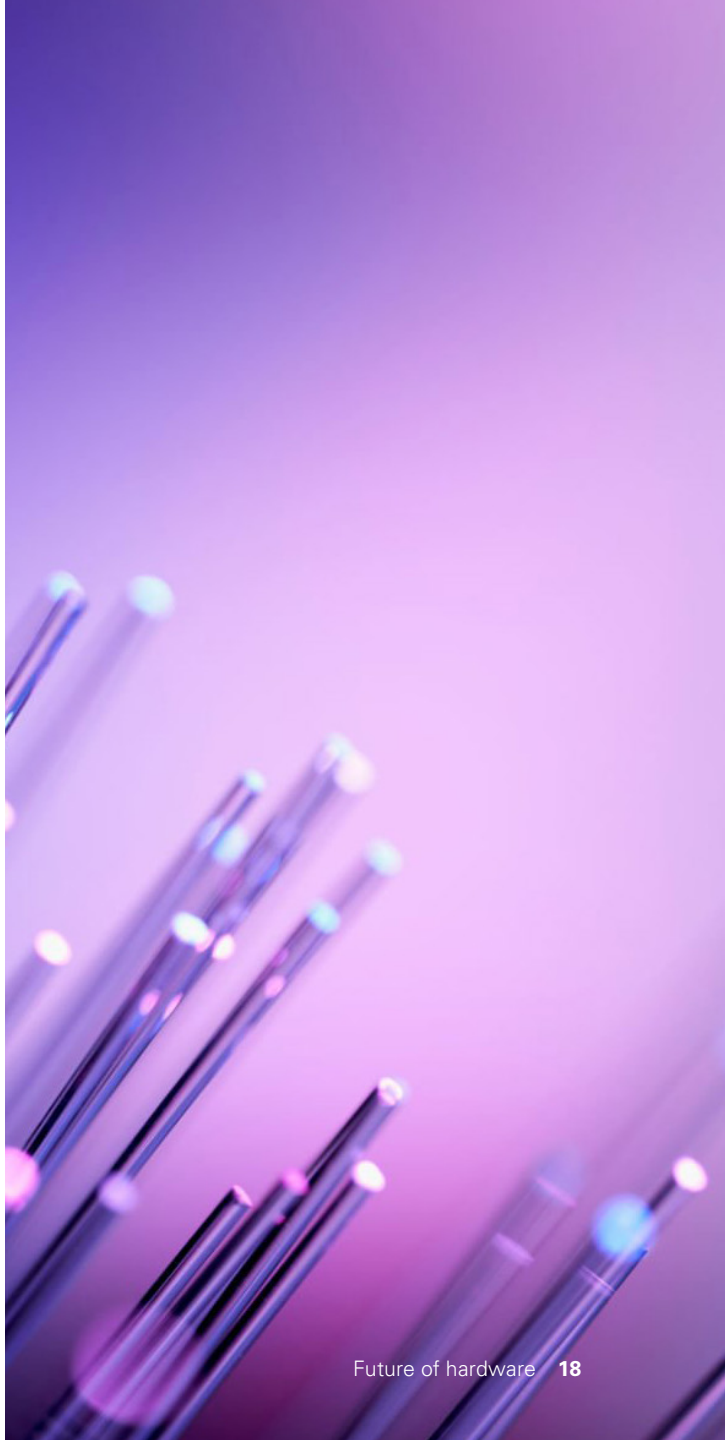
Source: A commissioned study conducted by Forrester Consulting on behalf of KPMG, 2018. The research was conducted on a sector specific basis. Each capability is enabled by five level two capabilities.

[23] A commissioned study conducted by Forrester Consulting on behalf of KPMG, June 2021

Connected capabilities can enable a winning strategy

An effective strategy requires maturity in eight capabilities that together make up a connected enterprise.

Insight-driven strategies and actions 01	Harness data, advanced analytics and actionable insights with a real-time understanding of the customer and the business to help shape integrated business decisions.
Innovative products and services 02	Develop compelling customer value propositions on price, products and services to engage attractive customers and drive profitable growth.
Experience-centricity by design 03	Design seamless, intentional experiences for customers, employees and partners, supporting the customer value propositions and delivering business objectives.
Seamless interactions and commerce 04	Interact and transact with customers and prospects across marketing, sales and service with the goal of achieving measurable results.
Responsive operations and supply chain 05	Operate the business with efficiency and agility with the aim of fulfilling the customer promise in a consistent and profitable way.
Aligned and empowered workforce 06	Build a customer-centric organization and culture that inspires people to deliver on the customer promise and enhance business performance.
Digitally enabled technology architecture 07	Create intelligent and agile services, technologies and platforms, enabling the customer agenda with solutions that are secure, scalable and cost-effective.
Integrated partner and alliance ecosystem 08	Engage, integrate and manage third parties to help increase speed-to-market, reduce costs, mitigate risk and close capability gaps to deliver the customer promise.



Investment in key digital capabilities helps drive better performance

Compared with their less-mature peers, high-maturity hardware manufacturers are more likely to successfully:

- Interact and transact with customers and prospects across marketing, sales and service to achieve measurable results.
- Build a customer-centric organization and culture that inspires people to deliver on the customer promise and drive up business performance.
- Engage, integrate and manage third parties to increase speed-to-market, reduce costs, mitigate risk and close capability gaps to deliver the customer promise.
- Develop compelling customer value propositions on price, products and services to engage the most attractive customers and drive profitable growth.
- Harness data, advanced analytics and actionable insights with a real-time understanding of the customer and the business to shape integrated business decisions.
- Design seamless, intentional experiences for customers, employees and partners, supporting the customer value propositions and delivering business objectives.
- Operate the business with efficiency and agility to fulfill the customer promise in a consistent and profitable way.
- Create intelligent and agile services, technologies and platforms, enabling the customer agenda with solutions that are secure, scalable and cost-effective.

Base: 247 professionals involved with customer-centric strategy decisions at technology hardware manufacturers

Source: A commissioned study conducted by Forrester Consulting on behalf of KPMG, June 2021

Achieving the five strategic imperatives

As hardware manufacturers seek to deliver their products as-a-service, they are developing their connected capabilities and adopting a platform mindset in order to develop agile, scalable operations. This involves digitizing their business operations to become more connected and customer-centric, and adopting emerging technologies like IoT, AI and 5G to help deliver real-time operational visibility and data insights.

The five strategic imperatives we believe are critical to success in the future hardware market, when aligned to the KPMG Connected Enterprise capabilities, can provide insights into which capabilities companies need to invest in the most. The following table illustrates those capabilities.

How becoming a connected enterprise can help hardware companies achieve their strategic imperatives

Connected Enterprise capabilities	Compute everywhere	Design for user experience	Accelerating the shift to as-a-service	Intelligent supply chains	Meeting higher regulatory and ethical standards
Insight-driven strategies and actions	**Pervasive use of IoT,** distributed applications, and enhanced networking to gain direct insights from the field	Use insights to **drive design principles and fit-for-purpose experiences** in products and services	Capture **customer, commercial, and operational data insights** to consistently inform and validate as-a-service business model	**Robust operational insights** driven by data mining, big data, predictive modeling, and machine learning	Enterprise-wide insights to drive focus on regulatory issues to **help improve business performance**
Innovative products and services	IoT drives **new breakthrough products/ services,** enabling a technology ecosystem to accelerate automation and expand into new sectors	A robust **innovation function to quickly prototype** and test new products, while building a product ecosystem that can help provide a competitive advantage	Market research and competitor knowledge fuels **data-driven product innovation** and road map, driven by consistent customer insights	Insights from the supply chain ecosystem help **build competitive advantage** and bring forward innovative and differentiated products to customers	ESG initiatives and goals are an **embedded capability** to help drive product and service innovation
Experience-centricity by design	**Next-gen experience** is designed using innovative, forward-looking technologies like IoT, 5G and AI	A consistent and iterative **human-centric design** that promotes an intuitive and frictionless customer experience	**Brand experience** is designed around customer and channel expectations across omni-channel interactions	**Customer journeys** are consistently managed across all channels within the ecosystem	Customers, partners and suppliers experience a **consistent brand message** on regulatory and ethical standards
Seamless interactions and commerce	**Integrated traditional and digital solutions** at the edge, supporting customers across many channels	Develop **digitally enabled, engaging and personalized interactions** across the value chain and customer journey	Offer a **unified commerce experience** across the product ecosystem, with the ability to bundle value-added services	A tightly **integrated ecosystem of partners and suppliers** is heavily driven by technology to help provide intelligence and proactively remove friction points	All channels and geographies where commerce is conducted to help achieve the **same environmental sustainability standards**

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Responsive operations and supply chain	Technology-driven, **intelligent workflows and automation help** provide real-time insights into operations and supply chain	Measure **value in real time** and provide consistent input to product design process using operational and supply chain insights	Provide insights into **customer engagement and develop predictive network signals** to proactively respond to environment changes	A **resilient supply chain** that uses predictive analytics to build more robust and responsive operations, while helping to minimize risk	Supply chains and manufacturing operations are designed to **minimize environmental impact** and to positively influence ESG efforts
Aligned and empowered workforce	Technology promotes a user-centric experience that enables a workforce to be **'citizen developers'** and accelerate innovation	A workforce that has the **shape, size, skills and workplace** to build innovative, software-led design into products	Invest in building a workforce that has a **digital-first mindset and an agile culture** that responds rapidly to changing customer needs	A re-skilled workforce with digital skills to **quickly embrace emerging technology** across the supply chain	Environmental and **ethical standards are clearly understood by employees** and are part of their normal ways of working
Digitally enabled technology architecture	Ability to compute at the edge to make **real-time decisions,** powered by a mature API and micro-services-driven cloud architecture	A digital architecture, which **enables agility,** is integrated across the ecosystem and securely supports product development	Scalable digital platforms that enable **rapid product innovation** across front, middle and back-office process areas	A **'building block' approach** powered by cloud- and API-driven architecture to integrate an ecosystem of suppliers and partners	A technology architecture that **enables ESG goal and effort tracking** and provides visibility into goal attainment
Integrated partner and alliance ecosystem	Automated and **real-time flow of information** across the partner ecosystem, which orchestrates and integrates core processes	Partner ecosystem that is **integrated with core product development functions,** able to provide real-time insights into performance	Create an **integrated and common digital platform** to integrate partners across the value chain, enabling co-creation	A digital framework that **automates on/off boarding of partners** and third-party suppliers while helping to reduce risks and costs	An integrated partner ecosystem **aligned with regulatory and ESG ambitions,** with clear and measurable metrics

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How KPMG can help make connectivity happen

KPMG Connected Enterprise is an insight-led, customer-centric approach to digital transformation. In the experience of KPMG professionals, there are a number of key considerations that can help hardware companies make faster progress on the connected journey.

1. Keep close to what your customers want.

The ability to think — outside in — is key in building a customer-centric business. Strive to ensure you know and act on what your customers want, need and value; keep continually looking up and outside of the organization and industry to help ensure alignment with the best customer experiences in day-to-day life.

2. Do things in an agile way.

Break changes down into specific steps, sequence them and implement. Keep standing back to assess whether the change has been successful in a 'test and learn' approach. It's about a series of small changes that together can add up to a significant and impactful transformation.

3. Build in resilience.

Take on today's challenges with determination, and be prepared to expect the unexpected, fail fast, and learn along the way. By developing a connected enterprise architecture, your ability to change course at speed can be significantly enhanced.

4. Keep it human.

While embedding new technologies such as AI and automation is likely to be critical in developing seamless interactions for customers, remember that you also need to keep the experience 'real'. We believe organizations remain defined by the quality and passion of its people and its sense of purpose.

5. Make use of new technologies.

Continually look at what new technologies are becoming available that could help you serve customers better or connect your business. Experiment with the opportunities enabled/ available through cloud, machine learning, and advances in data science.

KPMG helps hardware providers evaluate and improve all eight connected capabilities. These capabilities align with the operating model and can allow companies to prioritize, shape and execute their digital transformation. The experience of KPMG professionals in digital transformation has informed a set of transformation accelerators, including a range of configurable hardware solutions from leading technology providers.

By applying these principles and methodologies, and working closely with clients, we help address **key challenges facing hardware providers.**

1. How can you better connect customers with compelling value propositions, opportunities and interactions?
2. How can you best empower your employees to deliver on the customer promise?
3. What can you change to connect your front, middle and back offices to execute the customer growth agenda?
4. What kind of strategies and actions can help you connect your ecosystem of business partners to jointly deliver on commitments to customers?
5. How can you improve the way you connect to market dynamics and digital signals?

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